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Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options

Sanchai Jaturasitha (ed.)

**4th International Symposium – cum – Workshop in Southeast Asia
13-17 October 2003, Chiang Mai, Thailand
Proceedings**

Journal of Agriculture and Rural Development in the Tropics and Subtropics

Supplement 80

Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options

4th International Symposium - cum - Workshop in Southeast Asia
13 - 17 October 2003, Chiang Mai, Thailand

Sanchai Jaturasitha (ed.)

Forward

This proceeding is a collection of papers presented at the 4th International Symposium-cum-Workshop for Southeast Asia German Alumni Network (SEAG) on Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options held in Chiang Mai, Thailand from October 13-17, 2003.

I would like to express my sincere appreciation and gratitude to our colleagues from the University of Marburg, the University of Göttingen, the University of Kassel and Chiang Mai University, for their valuable assistance in serving on the steering and organizing committees as well as in working as supporting staff. Without their work, the success of the Symposium-cum-Workshop and the publication of this book could not be materialized. I would also like to thank the Journal of Agriculture and Rural Development in the Tropics and Subtropics for publishing our proceeding.

I am also greatly indebted to the German Academic Exchange Service (DAAD) and the German Ministry for Economic Co-operation and Development (BMZ) for financially supporting the symposium as well as the publication. Many special thanks also to Miss V. Leangwunta for computer work

Sanchai Jaturasitha
Editor
SEAG-Thailand Representative

Preface

The goal of this proceeding, funded by German Academic Exchange Service (DAAD) and the German Ministry for Economic Co-operation and Development (BMZ), was to provide a forum for long-term collaboration among German Alumni in Southeast Asia (SEAG).

The proceeding was published in "Journal of Agriculture and Rural Development in the Tropics and Subtropics" University of Kassel, Germany. All of the topics and issues were revised versions of those presented in the 4th International Symposium-cum-Workshop on "Food Security and Sustainable Resource Management in a Market Economy - Challenges and Options" held October 13 - 17, 2004 at Amari Rincome Hotel, Chiang Mai, Thailand.

These research works were conducted in Germany and Southeast Asian countries (Cambodia, Indonesia, the Philippines, Thailand and Vietnam). The first keynote address "Land and Resource Policy in Post-Conflict Countries" was delivered by W. Zimmermann who has a lot of experience working in Cambodia under German Technical Co-operation (GTZ). The second keynote address "Knowledge Mobilization and Academic Entrepreneurship" was given by Prof. Dr. J. Röpke from Marburg University, Germany. Prof. Dr. J. Röpke has provided valuable input to this presentation.

Following the articles are scientific works which are divided into 3 sessions according to the research topics. The three major topics were: (A) Food Security, (B) Natural Resources, further divided into subtopics (1) Forestry and Agro-forestry Systems (2) Plant Production and Irrigated Agriculture (3) Livestock Production Systems; and (C) Organization and Management of the Rural Economy.

Publisher

July, 2004

Table of Contents

Forestry, Agro-forestry Systems

Plant Production, Irrigated Agriculture

Livestock Production Systems

Organization and Management of the Rural Economy

Supplement

Welcome and Opening Remarks

Report
by
Dr. Sanchai Jaturasitha
SEAG Local Representative
4th International SEAG Symposium – cum – Workshop on
Food Security and Sustainable Resource Management
in a Market Economy – Challenges and Options

Amari Rincome Hotel, Chiang Mai

October 13, 2003
_____

Mr. Suwat Tantipat, Governor of Chiang Mai, Thailand
Mr. Hagen Dirksen, Honorary Consul, the Federal Republic of Germany
Organizing Committee
Distinguished guests
Ladies and Gentlemen
On behalf of SEAG local representative, Thailand, I would like to express my sincere thanks for your kind presiding over this opening ceremony for the 4th International Symposium-cum-Workshop on "Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options" today.

The German Academic Exchange Service (DAAD) and the German Ministry for Economic Co-operation and Development (BMZ) are tasked with promoting international academic cooperation through the exchange of university members.

Recognizing the need to establish strong collaborative linkages among the different societies in order to have strong development strategies. The International German - Southeast Asia Alumni Network (SEAG) was found in 2000, financially supported by DAAD. This network consists of three German universities (Göttingen, Kassel and Marburg) together with alumni and universities from Indonesia, Thailand, The Philippines, Vietnam, Myanmar, Cambodia and Malaysia.

Last year, the members of our network that attended the 2002 symposium in Hanoi agreed to convene the 4th International Symposium-cum-Workshop on Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options in Chiang Mai, Thailand.

Chiang Mai University hosts this workshop and all the events have been jointly prepared by the Chiang Mai organizing committee together with the German consortium.

The workshop has participants from Cambodia, Germany, Indonesia, the Philippines, Vietnam and Thailand. They mostly are from the fields of agriculture, forestry, fishery, food science, veterinary science, economics, agribusiness and higher education. This symposium also gives an opportunity for graduate students from Chiang Mai University to participate in order to gain the international experience in academic fields as well as social activities.

Lastly, I extend my best wishes to all participants and hope your stay in Thailand will be a most enjoyable one.

Thank you!

Address
by
Prof. Dr. Michael Kirk
SEAG Consortium Coordinator
4th International SEAG Symposium – cum – Workshop on
Food Security and Sustainable Resource Management
in a Market Economy – Challenges and Options

Amari Rincome Hotel, Chiang Mai

October 13, 2003

Your Excellency, Mr. Governor
Dear Honorary Consul, Mr. Dirksen
dear Alumni-Colleagues from the neighbouring countries
dear friends, supporters of and contributors to SEAG
dear Sanchai,

on behalf of our Consortium which has been built up by the Universities of Göttingen, Kassel and Marburg, and which is represented here in Chiang Mai by Prof. Gode Gravenhorst, Dr. Sia Amini and myself, I would like to welcome you wholeheartedly to our fourth SEAG seminar. Welcome to Chiang Mai, welcome to Chiang Mai University, welcome to Thailand which is hosting SEAG for the first time.

Some of you who participated in our seminars already for the fourth time will remember where it all began: it was in 2000 at Institute Pertanian in Bogor, Indonesia. Three years of time may be too short for a retrospective reflection, for looking back with pride on our achievements and - hopefully - other positive sentiments.

But we have to face as well reality and have to realize that for a programme like ours the first phase is already behind us and an external evaluation team initiated by DAAD and BMZ has nearly finished its work to assess the programme. Some of you may have been contacted already by the evaluators as they have interviewed us already in Germany. We will have to discuss their results at the Alumni Conference in Bonn in November this year at which representatives from SEAG countries will participate. These are the reasons why Anke Stahl from DAAD could not make it to be with us this year. She asked me to give you her warmest greetings and her best wishes for the success of this conference. Let us interpret it as a sign of confidence and maturity of SEAG that DAAD representatives are not any more attending all of our conferences.

SEAG has become mature at least from point of view of DAAD as we start our second term this year as a "consolidation phase" which means above

all: less funding available and, in turn, even more creativeness and activities expected from us. This follows the well-known self-help principle, or in economic terms, the infant-industry argument meaning that external funding will be reduced stepwise in order to strengthen self-responsibility, independence, competitiveness and even self-consciousness.

You may protest immediately: if I start to consolidate I need - first of all-a broadened base including diverse, even contradictory experiences, on which I will start to consolidate! Can we rely on such a base already? Although I personally think, we can, we have to discuss this in the next days.

Expectations from our sponsors are high and we have to decide to what degree we can and we want to fulfil them:

- more tangible, more sustainable results in networking (whatever it means in concrete terms to us),
- more external funding from third sides going hand in hand with less BMZ funding (however to raise them) and
- a higher material contribution of all those who really want to keep the network working (if ever this is affordable to all).

We already experienced that the new changed frame conditions created a lively backstage discussion in the preparation phase of the symposium here in Thailand:

- Is a fee of US$ 50 a tolerable rate for partner country (by the way: be happy that we still calculate in Dollar, not in Euro!) are existing exceptions like those for Vietnam and Cambodia justified? Can we bear an annual increase up to 100 $?
- How to handle the fact that times are definitely over where we had been inviting all those who applied? What would, then be a fair mechanism to develop for a necessary screening or selection process? We started with the reviewing process this year based on intensive communication with your elected network coordinators. Was it a fair and participatory process from all participant's point of view? I already heart some rumour that not all criteria we applied for the selection were fully appreciated. What are, thus, alternatives taking into consideration the much limited time to prepare the process, the time-lags created by reviewing but as well the costs of participation!

This year, we will need time to discuss intensively the changed situation, the new challenges but as well the chances ahead of us. In this context, we should not forget about the immense progress and the achievements we made in the last three years:

- We have built up three network centres in Indonesia, the Philippines and Vietnam. A forth, the Chiang Mai one, is in fact already operational looking at the efforts made to prepare this conference. Iis, Florentina, An Bui Thi and Sanchai, they all have worked hard and

very effectively in keeping our Alumni together, in maintaining the information system, preparing the meetings, etc.. In this context, I would like to remind you to an important fact: this all has been done as on a voluntary basis without any direct financial support, as – by the way – has been the work of the Consortium in Germany as well. We all do this in addition to your other jobs. In case something went wrong in the last weeks in course of preparation, please, do not be too critical with us: we are no commercial event service or consulting agency, however, we aren't less enthusiastic as they may be!

- New initiatives have started after we met last time in Hanoi: I would like to remind you to the two mini-symposia held in Indonesia, financed by DAAD, but organized by the Alumni-net.

- We took the requests from our sponsors quite seriously and started to look for external funding. This year two young colleagues from Cambodia join SEAG for the first time. Their participation has been made possible by programmes of German Technical Co-operation, in particular, the German-Cambodian Forestry Project, and the Land Management and Administration Programme, represented by Willi Zimmermann. Welcome to the Cambodian colleagues, thanks to Willi's team and to Juergen Hess from Forestry. And please: to all of our experienced Alumni who know well how to network, let's feel our new members comfortable amongst us, make it easy for them to join the SEAG-family.

- Other German colleagues like Prof. ter Meulen and Prof. Manig are true friends of SEAG as they contributed with own funds to make this conference a success.

- And we made another big step ahead: It is a pleasure to me to welcome three representatives of another Asian network, of BAN, the Berlin Alumni Network, who will participate at our conference. This is a first step towards a meta-network of networks, we hope others will follow in different parts of Asia. Thanks for coming.

You see, a lot of work is ahead of us: mainly conceptual issues are at stake for the near future: funding, participation, meaning of consolidation, etc. but as well very practical ones: where to meet next time, how to improve communication etc.? What will be the next steps: what is our willingness to pay to contribute to the club goods our network can create? How to remain open to new interested members without losing our generated identity? How to better integrate Alumni from Myanmar and Laos who still have problems to join us? These are but some aspects.

Before we continue with our work I would like to thank, already at this early stage, the Chiang Mai organizers, motivated and driven forward by Sanchai Jaturasitha, for their excellent preparation up to now, the Asian network

coordinators, Christine Werthmann, and all members of the German staff who accompanied the preparation to this final point, our opening ceremony.

I wish us five stimulating days with interesting discussions, in meeting old friends and colleagues, making new ones and with bright ideas for our common future.

Thank you!

Welcome Address
by
Prof. Dr. Dr. h.c. Udo ter Meulen
Honorary Alumni of Chiang Mai University
4th International SEAG Symposium – cum – Workshop on
Food Security and Sustainable Resource Management
in a Market Economy – Challenges and Options

Amari Rincome Hotel, Chiang Mai

October 13, 2003

Your Excellencies,
Presidents of the different Universities,
Deans, Professors, Students, Ladies and Gentlemen
and especially dear Alumni!

As Alumnus of the Chiang Mai University I welcome you all to our Symposium-cum-Workshop for Alumni from the region of Southeast Asia, sponsored through the German Academic Exchange Service (DAAD), Bonn, Germany.

Some of you will know that I received the honourable Ph.D. degree of this renowned University, from the hands of Her Royal Highness, Princess Maha Chakri Sirindhorn in January this year. I regard this as an outstanding honour.

I received the honourable Ph.D. degree for my work in supporting the Thai lecturers of the Department of Animal Science in the field of teaching and research mainly in the area of Animal Nutrition.

Our co-operation dates back a long time ago. We started *The Thai-German-Animal Nutrition-Project* on the 1st of April 1981 with financial support from the German Agency for Technical Co-operation (GTZ) and under my supervision as a short-term consultant.

The aim of the project was to set up a Feed Analyses Laboratory to be used for teaching Animal Science students at the B.Sc. - as well as M.Sc.- levels. At that time the Department of Animal Science at Chiang Mai had not yet started on their M.Sc. Programme. Therefore co-operation with the Kasetsart University was initiated where M.Sc. students from Kasetsart were invited to carry out their practical and analytical work in Chiang Mai. More than 30 students from Kasetsart University benefited from this arrangement. Their MSc exams took place in Bangkok and as one of their supervisors I was invited to participate in practically every case. To give this arrangement a legal status, I was appointed then as a Visiting Graduate Staff Member of the Faculty of Agricultural Science, Kasetsart University.

The *Thai German Animal Nutrition Project* ran for eight years. Apart from the activities in Chiang Mai, three scholarships for PhD studies in Germany were also given to Thai Ajarns during this time. One can say that these activities were a resounding success.

How did the co-operation proceed? After *The Thai German Animal Nutrition Project* came to an end in 1990, a three-years research programme was initiated, supported by the German Research Foundation.

Then a six-year *German-Academic-Exchange-Service-Partnership-programme* followed, which will finish at the end of this year. To date, this Programme has supported in total 44 researchers and students with travel funds to enable them to visit Göttingen and Chiang Mai, respectively. For the main part, Thais have been supported. The results and outputs from this partnership programme are documented in more than 60 research publications based on research mainly conducted in Chiang Mai. These results demonstrate the dedication of the Thai colleagues for this programme.

However we don't want to stop at this point. If anything, we are feeling as if we are just getting started. We want the partnership programme to become bigger and better and benefit more people and institutes. To this end, we have asked DAAD for a new activity and DAAD has fortunately agreed. From next year onwards we will embark on a trilateral partnership programme between Göttingen in Germany, Chiang Mai in Thailand and Phnom Penh in Cambodia with special focus on developing the co-operation between Chiang Mai, Thailand and Phnom Penh, Cambodia.

Not only have the activities in Chiang Mai led to success at the professional level. These activities have also brought me a lot of appreciation and recognition from my own University. Privately I also have very positive recollections of this time, during the period of the partnership. I got married in Chiang Mai, not to a Thai however but to a Dane, who at that time was stationed here for FAO. We have a marriage certificate which we cannot read - but it is still valid to this day. With this love, the love for Thailand also grew, and we are happy to think back on this time and to visit Thailand, whenever possible.

I see today among the participants and guests many well known faces:

Colleagues, who I have known since the initial days in Thailand,

Colleagues, who studied in Göttingen, partly as my Ph.D. students,

Colleagues, who within the frame of our partnership visited Göttingen and our Institutes.

I do not feel any different from all the people gathered here today. Although I am based in Germany, I feel that this happening here is more like a welcome home occasion!!

I wish us all successful deliberations.

Thank you!

Remark
by
Mr. Hagen Dirksen
German Honorary Consul, Chiang Mai
4th International SEAG Symposium – cum – Workshop on
Food Security and Sustainable Resource Management
in a Market Economy – Challenges and Options

Amari Rincome Hotel, Chiang Mai

October 13, 2003

Mr. Governor of Chiang Mai, Distinguished Participants, Ladies & Gentlemen:

It gives me great pleasure to participate in the Opening Ceremony of the 4th International South-East Asia German Alumni Network (SEAG) – Symposium-cum-Workshop on "Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options".

There are several reasons why I'm delighted about this event. Please let me explain:

(1) Globalization is advancing faster than many of us have anticipated. As a result, our political, social and economic responsibilities are moving beyond national institutions and borders. In agriculture, for instance, research, disease control (e.g. BSA), food standards, trade arrangements and environmental aspects pose challenges that cannot be tackled by national organizations and/or individual countries alone. We are increasingly compelled to share knowledge, form alliances and find new solutions that are acceptable to the stakeholders concerned. Subject-specific expertise is essential; however, it needs to be backed by effective formal and informal channels of communication and collaboration, i.e. by competent NETWORKS! Our universities and related institutions are important catalysts to build and maintain such networks.

(2) Being an agronomist and agricultural economist myself, I strongly believe that the topics you have chosen for this symposium-cum-workshop are most appropriate. Food security & poverty reduction, in conjunction with sustainable resource management, are and remain important issues for the entire region. From a national point of view, adequate food production for domestic consumption and for export is imperative for sustained economic progress and political & social stability.

(3) Last but not least, in the capacity of the German Honorary Consul I have to be very pleased that the organizers of this event have selected Chiang Mai as venue. We strongly feel that our city is an ideal and central place in the

region for hosting international seminars and workshops. Chiang Mai is not only endowed with the necessary modern facilities, it also provides an atmosphere and attractive surrounding that is most conducive for seminar participants and other visitors.

Finally, I would like to thank the sponsors, the Federal Ministry for Economic Cooperation (BMZ) and the German Academic Exchange Service (DAAD), as well as the representatives of the German university consortium (Göttingen, Kassel and Marburg), and their counterparts here in Thailand and in neighboring countries, for the continuing support of the SEAG. I'm confident that this event will be successful and most enjoyable for everyone.

Thank you!

Opening Speech
by
Mr. Suwat Tantipat
Governor of Chiang Mai
4th International SEAG Symposium – cum – Workshop on
Food Security and Sustainable Resource Management
in a Market Economy – Challenges and Options

Amari Rincome Hotel, Chiang Mai

October 13, 2003

Mr. Hagen Dirksen, Honorary Consul, the Federal Republic of Germany

Organizing Committee
Distinguished guests
Ladies and Gentlemen

It is my great pleasure to be invited to preside over the opening ceremony of the 4th international Symposium-cum-Workshop on "Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options" today.

I would like to express my sincere appreciation to the German-Southeast Asia Alumni Network, injoining effort with the Chiang Mai University and three German universities, namely Göttingen, Kassel and Marburg to organize this international Symposium and to the German Academic Exchange Service (DAAD) and the German Ministry for Economic Co-operation and Development (BMZ) for the kind financial support. Without these joint efforts, the symposium today could not have been possible.

Distinguished participants, I cordially welcome all of you to join this interesting symposium in Thailand. You may be well aware that "Food Safety" is one of the most important issues in the 21st century that food export countries are facing.

Definitions of sustainability will vary depending on the circumstances, but it seems that we should view sustainability as a goal rather than a specified set of practices. The concept of sustainability generally involves one or more of the following:

- A focus on economic food sufficiency, community development, and careful maintenance of the ecosystem.
- Improvement of the productivity of natural resources to ensure that food supplies are adequate for any growth of the population or the economy.

- The production of safe, wholesome and nutritious food which promotes human well-being.
- A long-term view, to avoid negative consequences of agriculture.
- Economic returns to farmers to ensure the continuation of the family farm and rural communities.
- Compliance with community norms and social expectations.

In a marketing system, market information is an important facilitating function. It facilitates marketing decisions, regulates the competitive market processes and facilitates marketing mechanisms. Market information is vital to minimize information gaps and uncertainties that exist in the agricultural sector of a developing economy such as that of Thailand. It is much needed by farmers in planning production and marketing, and equally needed by other market participants in arriving at optimal trading decisions.

Ladies and gentlemen, in the other points, small and medium enterprise (SME) should come along with as you know we work hard to produce our product safely and should find the market as well. It is quite a challenge and option for new decade.

Ladies and gentlemen, I would like to conclude that food security and sustainable resource management must be the responsibility and concern of the whole food chain and market way, this means, not only within the food production countries but also international food protection agencies should share more roles and assist in problem solving.

May I now declare the 4th international Symposium-cum-Workshop on "Food Security and Sustainable Resource Management in a Market Economy: Challenges and Options" open. I wish the seminar a great success.

Thank you!

Keynotes

LAND AND RESOURCE POLICY IN POST-CONFLICT COUNTRIES

Willi Zimmermann

The Key role of Land in the Rural and Urban Economy

Providing secure tenure to land is improving the welfare of the poor. At the same time it creates incentives for investment, a key element underlying sustainable economic growth. There are a wide range of mechanisms for providing secure tenure beside private ownership.

Facilitating the exchange and distribution of land through rule-based, transparent land and rental markets and non-market government-guided mechanisms are central for the urban and rural economy and the non-farm sector.

Governments (central and local) have a clear role to play in promoting and contributing to socially desirable land allocation and sustainable land use patterns.

- Land is a key asset for rural and urban economy and for the poor.
- Land constitutes about 50% of the asset endowment of states as well as of the poor in developing countries.
- Land is the primary means for generating a livelihood.
- Land is a main vehicle for investing and economic growth.

Driving forces for rapid change

- Dynamics of conversion
  Forest/agriculture, Agri/urban
  Common property/private/state
- Changing the meaning
  Urban elite uses land for tax saving and speculation
- Changing agrarian structure (WTO impact on land, market economy)
  Concession licenses, concentration, contract farming, waning interest
- Urbanization
  Speculation, informal settlements, wide range of tenure models
- The new role of local government
  Local control and revenues
- PRSP millennium goal (Poverty Reduction Strategy Program)
  Conditioning of funding

LMAP-GTZ, Cambodia

Implications for Land Policy Design

- Provide secure and comprehensive tenure systems (rule of law).
- Support fair access to land (pro-poor orientation, PRSP).
- Giving management authority to local communities and define the new role of local government (decentralization).
- Improve functioning of Land Administration Institutions (accountability, trust, updated records, access, cost recovery).
- Develop/improve wide range of effective land policy instruments.
- Establish functioning/transparent Land Markets.
- Improve land rental markets, contract choice and credit markets.
- Improve legal security for women (transfer, use, inheritance).
- Design sustainable land use pattern.

Post Conflict Situations

Post Conflict
- *Rule of Power*
- *Role of military*
- *Refugees*
- *Forced Resettlements*
- *Erosion of socio-cultural values*
- *Land-mine contamination*
- *Large scale expropriation*
- *Huge number of land conflicts*

Transition
- *Period of legal vacuum*
- *Waste of state assets and natural resources*
- *Little involvement of Civil Society*
- *No tradition in managing private property*
- *Corruption*
- *Lack of transparency and accountability*

Implications for Land Policy Design in Post Conflict situations

- Generate Synergies with Reform Agenda for Good Governance
- Road Map from Rule of Power to Rule of Law (a decade for committed action)
- Making Accountability a Field of Priority (auditing, transparency, law enforcement)
- Strategy for SWA in Policy Design (from Policy to National and Local Implementation and Impact Assessment)

- Building Strategic Partnerships with development partners and civil society
- Policy and instruments for Regularization of informal settlements, occupied state land, de-mined areas, etc.
- Out of Court Dispute Resolution (formal and informal)
- Reforming the Professional Education
- Strengthening PPP as Policy Element
- Gender Mainstreaming (Land and Institutions)
- The new Role of ICT as Governance Tool

LMAP[1] as a Model for Land Policy in Post Conflict Countries in Transition
(MLMUPC[2]/ WB[3]/ GTZ/ FIN)
[1]LMAP: Land Management and Administration Programme
[2]MLMUPC: Ministry of Land Management, Urban Planning and Construction
[3]WB: World Bank

- Land Policy
  CLP (Council of Land Policy), Consultations, International engagement
- Regulatory Framework
  Land Law, eight sub-degrees
- Institutional Reform
  De-concentration, Decentralization
- Professional Education
  New Faculty and Curriculum (2)
- Large Scale Land Registration (all Land)
  Commune by commune, all land including state and indigenous
- Mechanism for Dispute Resolution (out of Court)
  Formal: CC (Cadastral Commissions)
  Informal: Legal Aid and Awareness
- Land Reform
  Social and Economic Concessions
- PLUP (Urban and Rural)
  Franchising Model, commune based
- State Land Inventory and Management
  Role of CLP, Visualization

Mechanism for (out of Court) Dispute Resolution, Cadastral Commission (CC)-Model
- to reduce the number of land disputes faster
- to improve quality and impartiality of dispute resolution mechanisms
- to take cases away from courts which tend to have very limited capacity and credibility

- to increase fairness in land regularization
- decentralization: to provide better access to dispute resolution (essential to obtain tenure security) and allow for 'in-situ'-dialogue
- contribute to social stability and local capacity building

Capacity Building in Dispute Resolution
- Developing Training Manual for Investigation, Conciliation and Procedures (including videos, role play)
- Training of Trainers (24 trainers)
- Training of Practitioners at Provincial level (64)
- Training of Practitioners at District Level (450)
- Awareness building for Civil Society
- Developing Transparent Monitoring system
- Reporting to the Council of Land Policy and to Auditor

Poverty and Social Impact Assessment of Pro-poor Land Distribution

Objective of the study:
            Determine the poverty and social impacts of land distribution and the conditions for the successful realization and sustainability of potential benefits, i.e. institutional and policy issues, availability of support services and infrastructure and potential availability of land for distribution

Content of the study:
1. Potential poverty and social impacts
2. Institutional and policy issues: Design and implementation of Social Concessions
3. Availability of support services and infrastructure
4. Potential availability of land for distribution

From Land Policy to comprehensive Resource Policy
Harmonize legal key elements, recognize common property and
decentralize management functions to local level:

Forest and Trees
- *Land/forest classification*
- *social forestry*
- *Multiple use rights*

Inland Fishery
- *High/low water impact on land use and rights*

Water Rights
- *Upstream/downstream*
- *Dry/wet-season access*
- *Competing with urban and industry*

Environment
- *Expropriation of common property in protected area*
- *Buffer Zone*
- *Degradation*

Key Questions for the Future of State Land
1. Is state land mainly an asset: annual public revenue through fees, licenses, rents?
   Fiscal perspective
   - Existing instruments, macro-economic impact (investment rates tax and other revenue) and micro-impact (burden of firms, farms, household)

2. Actively use of state lands as a policy instrument
   Development perspective
   - Potentials, limitations and risks for the state
   - Privatizing: loss of hidden rents for bureaucracy
   - Direct revenue loss, compensation through higher growth

Development dimension of state land
- Pro poor growth: key role of agriculture and rural economy*, improve productivity and services (credit, modern input, skills).*
- WTO accession: increasing demand for agricultural concessions and contract farming, *poor legal security for foreign investors, state land not yet delineated.*
- Distribution of land through social concessions.
- Housing policy: peri-urban state land for housing the poor, *range of tenure options, regularization, land sharing, land banking.*
- Environmental goals: *zoning, land banking, risk assessment (flood, drought).*
- Implementing PRSP, *securing common property rights, multiple land use models.*

Economics of Delineation of Property Rights

**Economics of Delineation
of Property Rights**
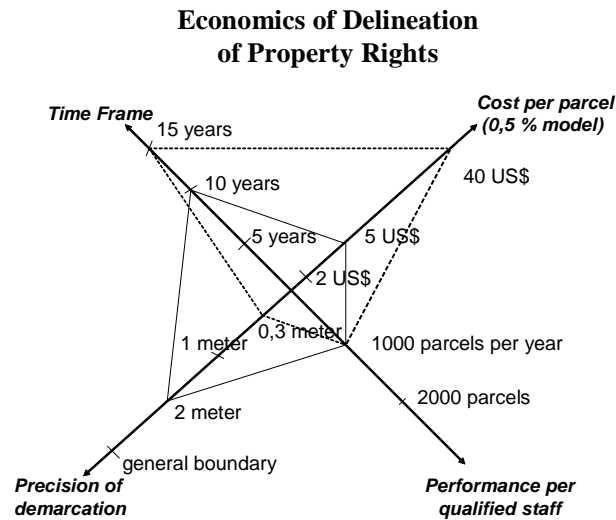
Issues for Action Research

- Resource tenure, Lake TONLE SAP (spatial and temporal change and management of resource complexity)
- Future models for delineating indigenous land rights
- New Organizational models for linking Agribusiness / Smallholder
- Tenure and land management options in peri-urban areas
- Land and forest classification and re-classification (conversion models and institutional reform)
- PSIA, Poverty and Social Impact Assessment

Generating Knowledge through Networking and Partnership

- Global initiative Land Policy for Growth and Poverty Reduction, WB initiative with development partners since 2001
- Interactive discussion forum on Land Policy, World Bank Group Land Policy
- Regional Workshop Land Policy Asia, 2002 in Cambodia
- Land Net initiative GTZ
- First interactive Land Policy Forum Asia, making use of distance learning centers in Thailand, Vietnam, East Timor, Sri Lanka in December 2003 (WBI/GTZ)
- Establish distance learning center Cambodia in 2004

KNOWLEDGE MOBILYZATION AND ACADAMIC ENTREPRENEURHIP

Jochen Röpke

1. **The illusion of knowledge**
2. **The knowing-doing-gap**
3. **The Humboldt problem and the Schumpeter solution**
4. **Academic entrepreneurs and the entrepreneurial university Bibliography**

**Entrepreneurship is like swimming against the stream.
If you stop, you fall back.[1]**

1. The illusion of knowledge

In itself, knowledge does and creates nothing. Knowledge in itself is dead matter. To give a hypothetical illustration: Let us pick the best brains (nobel price winners) in each science and let them do a time travel into a stone

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[1] A similar saying is attributed to the Chinese sage Laozi. Joseph Schumpeter, writing 2500 years later, used this metaphor: "While he [the entrepreneur] swims with the stream in the circular flow which is familiar to him, he swims against the stream if he wishes to change its channel. What was formerly a help becomes a hindrance" (Schumpeter, 1934, p. 79-80).

age economy. Compared with the local folk, they are all genies, endowed with unbelievable amounts of knowledge. What happens to this knowledge? Can it contribute something to uplift the meager subsistence of stone age people? Can they provide higher productivity and better health care?. Without turning into entrepreneurs *or* without bridging the gap between knowledge and practice – **a knowing-doing-gap**.

These eminent brains remain - economically speaking - an unproductive resource. They do not contribute to development. They even may get killed or chased away, because the locals may perceive them as using up their meager resources without contributing something worthwhile to their subsistence.

What the illustration teaches us: Knowledge does not travel automatically into the mind and hearts of other people. Knowledge and competence gaps can be so huge, that the knowledge is non-transferable. There is a pool of knowledge. But due to low absorptive capacity, knowledge (theory) cannot transform into practice. A lot of knowledge is actually not protected by intellectual property rights. It is freely available. Everybody could make use of it. Why does this not take place more often? Our answer: entrepreneurship and non-existence of the conditions which make for entrepreneurial action (rights, competencies, willingness; figure 3).

This actually is an old insight. Joseph Schumpeter, the Austrian-born economist, has said it over and over again, for the first time in 1911. The distinction between invention and innovation, drawn by Schumpeter, is the classic acknowledgement of this point. Without entrepreneurs, "inventions are dead". The idea, that economic development is based on "knowledge", on the "advancement of our knowledge" is "wrong". This is a "thousand times proved by the miserable fate of the inventors". Schumpeter wrote this in 1911 (p. 480).

We, as members of "knowledge societies", seem to see this differently. Our discussion here nevertheless follows the Schumpeterian lead. [2]We indeed come to a conclusion very similar to him. It is ironic to see how much fuss is made by inventions and their patenting.[3]

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[2] As the reader of this piece will discover, the approach presented here is unashamedly Schumpeterian. I indeed believe, that the most we can contribute to our topic has already been contributed by the scientific creator of development economics (in a wide sense). For me, it is a pity to see, what authors after him have done with the genie of Schumpeter. I see no reason to move outside the framework provided by Schumpeter. It is indeed the single and most outspoken scientist having formulated the problems discussed here. What Schumpeter has not done, and he knew this very well, is delving more deeply into those factors, "causing" what he calls "entrepreneurs" to act as they act. Following the authentic Schumpeter is a path less traveled, less secure, but most needed. Few of the decision-makers in the economic and political system have ever been there before. Yet our troubled world may wait for it, and the path is at hand.

Knowledge turns into a productive resource, when it becomes fused with entrepreneurship. In other words: knowledge must somehow become embedded into entrepreneurial action How this is possible is shown below. **A knowing-doing gap** arises, when the process of integrating knowledge into entrepreneurial action becomes handicapped.

I am aware that this is hard stuff to swallow for science people, for teachers and educators, for agents operating in the systems of science and education. It may go against their belief systems, the institutional ethos of the organizations in which they work, and of course, against the popular belief of a (post-modern) knowledge society as the highest level (western) society has reached in its course of evolution.

Development is seen to be caused by innovation, and innovation is driven by entrepreneurs Capabilities, rights to innovate and motivation are the primary causes of innovation. Knowledge impacts on these, but is not a prime mover of development. This theoretical framework requires some clarification.

In our paper, a special focus will be the contribution of institutions of higher learning as universities to economic development. Universities are traditionally seen as producers of knowledge, capabilities and skills. What is their development contribution? If knowledge and competencies do not on their own contribute to development, how universities can become agents of development, and how can they contribute to an eradication of poverty and to an enlightment of ordinary people and decision-makers? There is not automatism at work. Look at the middle ages in Europe. Wonderful universities. Stagnant economy. Look at universities in Africa, in some Near-eastern countries. The same. Then look at Cambridge UK. Cambridge University seems to be a dynamo for regional development. What makes the difference?

Our logical framework is thus:
University ⇨ Innovation/innovators ⇨ Development

▲

- **Capabilities, rights, motivation**

- **Knowledge**

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[3] For an illustration see the report of the Enquete Commission of the German parliament concerning the importance of patents for technology transfer, as incentive for knowledge production, for innovation, and so on (Deutscher Bundestag, 2002, pp. 286-293). A professorial colleague in Chemistry once told me: "We have a lot of patents outstanding. Why you talk always about the lack of innovation in the university." How it comes, we may ask, that a country like China, with a patent law nearly nonexistent, achieves a growth rate 5-times higher than the "capitalistic" knowledge societies of continental Europe. And how it comes, that more than 95% of the patents issued are never used (according to the president of the European patent office)?

Innovation means putting new knowledge into practice by new recombination of resources. This requires to bridge a gap between knowing and doing. Overcoming the knowing-doing-gap is a main function of any kind of entrepreneurship. The mainstream function of universities is not considered to be "entrepreneurial". The task of universities is teaching, education, research. Their contributions to development are considered by-products and unintended effects of their main functions.

Figure 1 illustrates that with each long-term economic cycle or Kondratieff/Schumpeter wave, knowledge intensity increases and the role of science and academic entrepreneurship becomes more crucial. The fifth wave and those still coming, are crucially dependent on knowledge produced in the science system and those able to make innovative use of it. If a society misses out on any of these trends (knowledge, science, entrepreneurship), it will be "punished" with a lower growth rate, living standard and a paucity of new employment opportunities. As the lower part of figure 2 shows, there is a definite trend to theory-based innovation and entrepreneurship during the course of economic development (at least, this is our hypothesis). The knowledge intensity increases from Kondratieff (long wave) to Kondratieff.
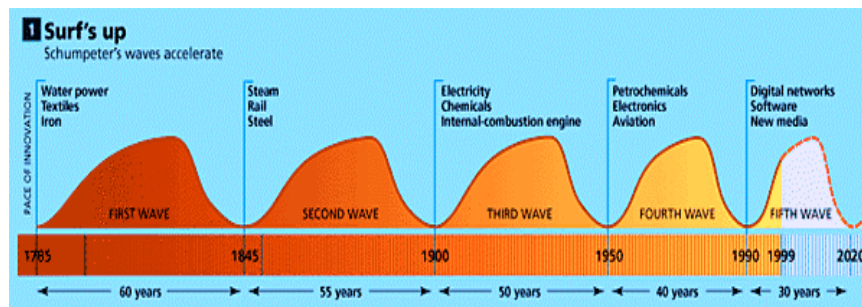
Figure 1. Kondratieff waves and knowledge production

Quelle: The Economist, Catch the wave, 18. Februar, 1999
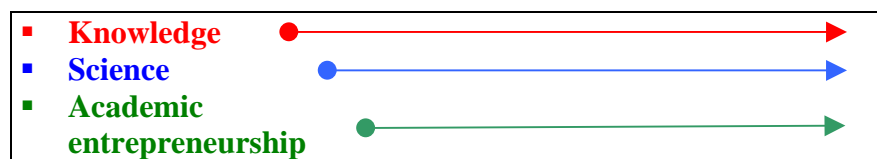
Science is an evolutionary opportunity for increasing the probability of innovation.

From the standpoint of economic development, the most important question is: how do we get entrepreneurs excited about investing in the implementation of new knowledge created in the science system of society. As entrepreneurs become energized, knowledge creation and application, technical change, capital accumulation, would likely proceed more or less smoothly and on the way create employment opportunities and wealth. Growth makes the rich richer and the poor richer. These are well established facts.[4] Where opinions divide is how to account for growth/development.

Why this should be problematic at all? Do modern societies not achieve more or less spontaneously if not automatically satisfactory institutional solutions for the use of (scientific) knowledge? Unfortunately, this is not the case. Modern society operates on the operational closure of its functional systems (for details see later). Each subsystem (economy, science, politics, etc.) operates on its own logic. Science and economy function with a high degree of autonomy. If each subsystem is closed towards informational inputs from other subsystems, as modern systems theory tells us, how knowledge from science can enter the economy?

In later sections, we analyze the mechanisms available for disseminating knowledge and technology.

Let me state now the core point of the argument:

Even if academics are doing their research for the most philanthropic and idealistic reasons; the only way the scientist is ever going to get any of his results into the economy, is by the intervention of entrepreneurship.[5]

If you believe, this to be just a problem of developed economies, which operate at the frontier of knowledge and which therefore need for its innovational activities a permanent supply of scientific ideas, you are probably mistaken. The challenges India, or the Philippines (see citation below) faces are fundamentally the same as for the US.

On the status of the 103 R&D studies implemented [in the Philippines]... only 6.79% are utilized and commercialized. ... This status contributed to a very low adoption rate of research outputs. ... the research activities were not disseminated to the clientele (Dumlao, 2003).

For a similar constellation, look at a multinational firm operating in a developing country. How does the knowledge of this firm enter the host country?

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[4] See the impressive accumulation of data and reports by the World Bank under: http://econ.worldbank.org/programs/poverty/library/.
[5] See Nelsen (n.d, p. 284) for a similar argument concerning the dissemination of medical research into the health system (the patient).

What factors determine whether the knowledge is spreading outside its organizational boundaries or remains exclusively owned by the firm?

For an answer, let us distinguish between two constellations:

- Those who know provide their knowledge to those who do not know.[6] This situation is at the core of so-called *knowledge management*. This popular approach faces several difficulties, independently of what systems of management are employed.[7] They seem to result from a single overriding fact: those who know are *not* identical with those who do not know.

- Those who know are the *same* persons as those who undertake to work with what they know. This constellation still leaves us with many difficulties to be master, but they are from a different kind than those of knowledge management. As soon as the person who knows is identical with the person who undertakes, we encounter no difficulties with asymmetric information/knowledge, i.e situations that some people have information others have not. On the contrary, in an important sense, the assumed identity of knowers and doers overcomes the asymmetries of information and knowledge in a (theoretically) similar way as cooperatives and other user-owned firms overcome the difficulties of firms doing business with stakeholders[8] who are different from the owners of the firm, or with entrepreneurs, who, confronted with hesitant banks and financiers, are financing their projects themselves or via friends.

This distinction allows us to introduce the main thesis of our paper.

Universities and other institutions of higher learning are producers of knowledge. But this knowledge offers just a *potential* for innovation, nothing more. Only *entrepreneurial* action based on knowledge can transform potentiality into (economic value creating) reality. With an increasing scientific intensity of knowledge production, the gap between what is known (in science) and what is done (in the economic system), seems to increase (see figure 2). What the members of these institutions can do themselves in order to bridge the "gap"? Our answer: They must mutate into entrepreneurs. This may require a transformation of the function of universities. If this transformation does not come along, my prediction is: universities will become more and more irrelevant in knowledge societies. The "law of accelerating returns" (Kurzweil, 2001) will bury them.

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[6] We leave for the moment undefined the meaning of knowledge. For an elaboration see the appendix.
[7] For a critical discussion of numerous approaches see Kalmring (2003). The difficulties we discuss on the following pages often remain invisible to an observer due to his specific conceptional and theoretical concepts employed.
[8] Stakeholders = employees, suppliers, customers, banks, government, media, regulators, etc.

Simply knowing - recognizing or understanding what to do in order to manage an organization, to do research, to prepare a talk/lecture - is not enough for an individual to become a successful manager, researcher, teacher/speaker. It is also not enough to get the knowledge produced in one system of society applied in another one. One of the first to mention this explicitly was the Greek philosopher Aristoteles: "With action, the goal is not to explore and to recognize, but to do. We do not observe, that only with knowledge from books, somebody can act as a doctor" (Nikomachische Ethik, X.10,1179b; X.10,1181b).

In every system on every level we observe a fracture between what is known and what is done. The astonishing but in the end, as our discussion will show, not really surprising thing about this is the non-relevance of this gap to the actors within the system. In general, the awareness of an gap is non-existing. Those who "own" the information and knowledge do not observe such gaps, they do not care, they have no incentive to change their behavior, often they lack the right to do so. Result: Knowledge remains unapplied, problems remain unsolved, etc.
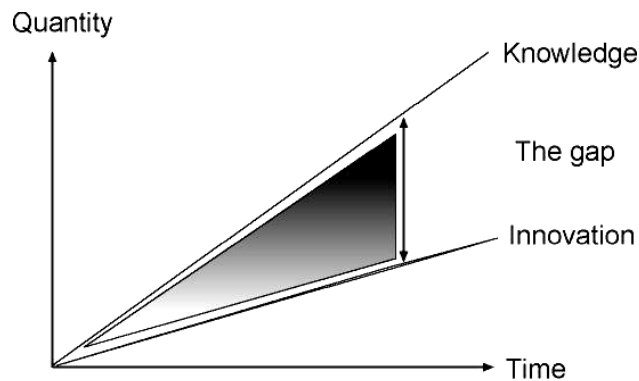
Figure 2. The innovation gap

Again, we may ask, why this is a problem at all. Living standards for many peoples are increasing, productivity is increasing, life expectancy is increasing, etc. Where is the problem? The trouble becomes obvious, if we return a moment to figure 1. If economic development is more and more based on *scientifically* produced knowledge, i.e. knowledge "owned" by the science system, then obviously, the comparative ability to make productive use of this knowledge decides to a much larger degree than earlier (Schumpeter waves 1-4) about the performance of firms and nations. Those who bridge the gap more effectively march ahead, those who do not, are left behind.

In the standard model of economic growth, we are not faced with this difficulty, since it operates with a different theoretical software. We call it the *input logic* as compared to the development logic, which allows us to observe the gap. According to the input logic, knowledge, wherever produced, will foster growth. Knowledge is either a free or public good or can easily transfer from those who own it to those who need it. In the development logic, this model breaks down and is seen falsified by empirical facts.

In German language, two phrases summarize our problem:
- "Vielwisser aber Nichtskönner" (people who know a lot but are poor achievers/doers)
- "Hochqualifiziert aber inkompent" (Highly qualified but incompetent people).

2. The knowing-doing-gap

Two American management academics, Jeffrey Pfeffer and Robert Sutton (2000), became intrigued by the large number of managers and executives that they worked with who **knew** what needed to be done but **failed to implement** it.

They referred to this phenomenon as the "knowing-doing-gap."

"The so-called knowledge advantage is a fallacy - even though companies pour billions of dollars into training programs, consultants, and executive education. The reason is not that knowledge isn't important. It's that most companies know, or can know, the same things. Moreover, even as companies talk about the importance of learning, intellectual capital, and knowledge management, they frequently fail to take the vital next step of transforming knowledge into action. The Knowing-Doing Gap confronts the paradox of companies that by showing how some companies are successful at turning knowledge into action." (from the book jacket)

> **know too much**
> **and do too little**

This observation remembers me on a common definition of entrepreneurship:

Entrepreneurship
It's not how
many ideas you have,
it's how
you make them happen.

To make new ideas happen or apply new knowledge in creative ways depends on three necessary conditions (see below and figure 3). Let us apply the concept to the science system or a university. A traditional university creates ideas (information and knowledge). An entrepreneurial university not only creates ideas. It makes university-created ideas happen. It transforms knowledge into action.

Figure 3 illustrates the gap, based on the three-factor-model of entrepreneurial action.
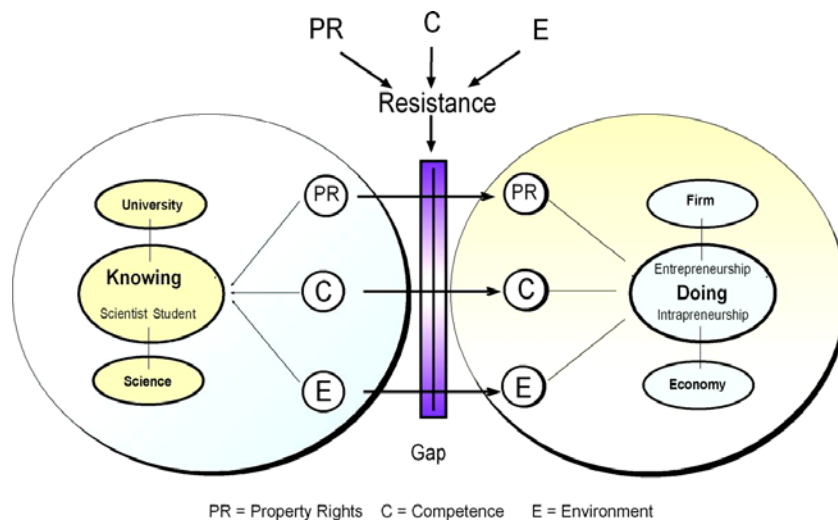
Figure 3. Factors causing the knowing-doing gap

Science produces knowledge, entrepreneurs create value and new employment with the knowledge. Because the "gap", knowledge is not used by entrepreneurs, it remains "idle", "dead" or "slow" (träge). The structural coupling between science and the economic systems remains deficient (To stress again, this is not a difficulty of knowledge-frontier societies; it permeates all systems independent of their level of development).

As mentioned, there are two ways out: knowledge/transfer management and entrepreneurship: Those who are in the know do not mutate into doers because they lack the

- **rights** to do so;
- **competencies** (capabilities)
- **motivation** (will, energy) to engage in innovation (making new things happen).

If any of these three conditions should not be given, entrepreneurial activity will be on hold or turn to zero and the knowing-doing-gap becomes reproduced.

Pfeffer & Sutton and other management writers do not give us a systematic account of the causes and the way out of the "gap" (which obviously does prevent them to make a lot of money with their idea; at least they have bridged for themselves the gap between knowing and doing).

How knowledge is connected with the basic entrepreneurial equation
entrepreneurial action = f (rights, competencies, motivation)?

Within the society of a developing nation, we are confronted with the same difficulties. How we get the knowledge and qualifications taught and acquired in institutions of higher learning into the productive economy. How many academics are idling around, are driving taxis, are selling vegetables or cooking meals for sale? They are either unable to bring their (academic) knowledge and qualifications into the market, or nobody is willing to engage them for work which uses their academic qualifications. In both cases, we are confronted with the same diagnosis: lack of entrepreneurial activity.

This situation is more common then we may think. It is the *normal* and *natural* situation. A university remains an oasis within the region in which it operates. Weak knowledge and competence linkages between a university and the regional economy abound.

And this really goes to the very heart of modern society, which is increasingly based on scientific insight and knowledge (figure 1).

Research without action is daydreaming, action without research is nightmare.

3. The Humboldt problem and the Schumpeter solution
To know something and to make productive use of it, are different things. This holds for both explicit and implicit knowledge. To make use of knowledge, we need people willing and able to use it and are endowed with the right to use: Motivation, competence, property rights.

In his groundbreaking *Theory of Economic Development*, Schumpeter (1911; 1934) explained the innovation process in an economy by the actions of creative entrepreneurs and the impact they have on the course and dynamics of development. Entrepreneurs are defined through their function of realizing "new combinations [innovations] in the economic sphere."

How do we transform theoretical insight into practical action, meaning new products, technologies, practices, that increase economic value and productivity – the basis of any increase in living standards and reduction of poverty?

Since Wilhelm von Humboldt (1769-1859), the function of an university has been understood as research plus teaching (training), its purpose is the education, research and the dissemination of knowledge. How does what we learn at a

university about how the world functions, and what we learn in order acquire higher qualifications, enter the economic system?

The knowing-doing-gap we are talking about is illustrated in figure 4. It reflects the ideal type of a Humboldt university: research + teaching. This ideal constellation has turned out to be dysfunctional in a knowledge economy. The gap cannot be bridged.

The following figure 4 shows three autonomously operating "subsystems" of a differentiated society (The logic follows the Luhmann theory of systems.) It reflects therefore more the situation in a developed country as Germany or Japan. Many LDCs are fast moving into this direction as the contributions to this volume demonstrate.
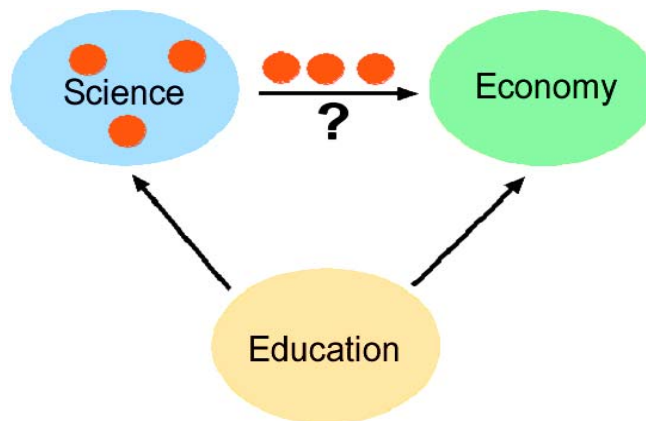
Figure 4. The knowing-doing-gap

The three (red) dots represent knowledge incorporated in new ideas. The ideas try to travel into the economy. But they are rejected. Why? Because they are divorced from the people who produce the knowledge and who may even own it, because they lack in capabilities for implementation and/or because they have insufficient motivation for doing so (figure 3).

The figure actually shows two systemic mismatches: between science and the economy and between education and the economy. The second one is widely being discussed. The education system (schools, universities) does not create what the economy needs. This mismatch is usually framed within an input

logic.[9] The inputs needed by the economy do not match with the outputs produced by the education system. Since basic innovations of the Kondratieff type (new technological revolutions) require new technical, managerial etc. qualifications, there is a danger, from the input view, that a mismatch develops. The economy faces bottlenecks, structural unemployment results, etc.

Each of the Schumpeter/Kondratieff waves (figure 1) requires a different qualification profile of manpower (human resources, labor input).[10]

... precisely because each constellation is unique, they will have very different effects in each technological revolution [wave]. The recurrent effect is a pervasive pattern of structural change, but the industries and occupations most affected will be different in each case. Obviously also, the new industries will be quite different. All this means that increased structural unemployment is likely to be a major recurrent feature ... A mismatch of the skill profile is likely to be widespread (Freeman & Louca, 2002, p.338)

The mismatch the two authors describe is indeed a serious problem. But it is not a the center of our contribution. We consider not an input-output-mismatch, but a systemic mismatch between science and economy, which at its heart is an entrepreneurial gap: Those who know do not implement what they know. Actually, a mismatch of the skill profile will only emerge (in the Schumpeter waves of the knowledge society), if there is *no* disparity between knowledge and action of the entrepreneurial type between science and economy. If there is a gap, no new wave will materialize, henceforth, a mismatch of the first type becomes a less serious problem. The emergence of any type of intersystemic input-output-mismatch, is, in other words, a function of entrepreneurial viability. Entrepreneurship is, as Hirschman (1978, p. 25) has suggested, the ultimate or highest level scarcity. What is different from previous innovation waves in an entrepreneurial knowledge economy, is the deeper *scientific* foundation of entrepreneurship (figure 1).

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[9] *Input logic* operates with the hypothesis, that it is factor accumulation which drives growth. And that portion of output growth which cannot be accounted for by accumulation is called total factor productivity TFP) or the "residual": unexplained growth. TFP thus captures the "free" growth in output, that is not paid for (accounted by) the costs (the amount and growth) of inputs. Researchers such as Abramovitz, Kendrick and Solow found out, that this residual accounted for approximately 50 percent of the growth in measured output in the early 20th century. Thereafter, a large body of research was going on to explain the residual, often thought as a measure of technological progress, but really "a measure of our ignorance".

[10] Whether the Schumpeter waves accelerate indeed as assumed in the chart, is another matter not discussed by us. If this were indeed the case, the mismatch problems would indeed turn out to be more serious, requiring for its solution an increasing flexibility of labor markets and a high level of innovation and change in the education system.

Schumpeter leaves no doubt, how to overcome the "gap" and how to answer the questions put forward above. Schumpeter's answer is creative entrepreneurship.

Actually, all this is trivial matter. Nevertheless, it has remained a neglected subject, and within mainstream economics, it cannot even be discussed.[11] And with the transformation to a knowledge-based society/economy, these trivialities suddenly move towards the center of attention.

You may think, that the conjectures discussed are really the problems of economically advanced societies. Actually, this is not so. If we compare economies which have prospered (mostly in East Asia) with those stagnating (Africa, Latin America, Near East), these very problems immediately become obvious.

The "knowledge pool" of the world is available to every nation. Why some did make productive use of it, while others continue to live their economic lives with the knowledge of their forebears. Kant and Schumpeter provided early answers.

Within the society of a developing nation, we are confronted with the same difficulties. How we get the knowledge and qualifications taught and acquired in institutions of higher learning into the productive economy. How many academics are idling around, are driving taxis, are selling vegetables or cooking meals for sale? They are either unable to bring their (academic) knowledge and qualifications into the market, or nobody is willing to engage them for work which uses their academic qualifications. In both cases, we are confronted with the same diagnosis: lack of entrepreneurial activity.

The Schumpeterian solution to the knowing-doing-gap is simple indeed: do what you know or do it yourself. One cannot have an asymmetric-information-problem with oneself.[12] One cannot have a knowing-doing-gap due to difficulties of transferring knowledge. I know what I know.[13] How a science

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[11] Because it is either assumed that every actor in the market is operating with the same level of knowledge, or alternatively, that a pool of knowledge exists, that is available to everybody (knowledge as a public good). Recent discussions on information economics have entered more deeply into these fields, but still have difficulty to come up with an entrepreneurial approach (see Kozlova, 2003). In addition they fail to differentiate between information and knowledge. In an address given in 1999, former World Bank chief economist, Joseph Stiglitz (see Stiglitz, 2001) has made important points by differentiating between codified and tacit knowledge.

[12] This shows, that the Schumpeterian factors of recombination and its causes are theoretically on a deeper level than the information and knowledge asymmetries, with which Hayek and information economics are occupied with. A person can have mastered his asymmetries, but still run into the difficulty of entrepreneurial acting. Only in the case of routine and arbitrage entrepreneurship, these difficulties do not arise. With innovation, the theoretical book is barely opened, when Stiglitz and Hayek have closed their theoretical book in the believe to have mastered what is worthwhile to master.

[13] On a deeper level, difficulties arise also here. Do we really know what we know and do not know. How conscious are we aware of what we know and do not know, and so on.

system would look like which follows the Schumpeterian road, is sketched in the next section.

Many firms, not to speak of research institutions, are able to come up with new knowledge to create new technologies and products. But they face difficulties as soon as the company's knowledge and skills need to be transformed into competitive advantages in the market. In 1957 Siemens created the first fully transistorized computer in the world. IBM did not introduce similar computers until 1959. But IBM achieved market leadership, not Siemens. Thomas J. Watson, IBM's former chairman, commented: "We consistently outsold [competitors] because we knew how to put the story before the customer, how to install the machines successfully, and how to hang on to customers once we had them." In other words: IBM was a better innovator in the Schumpeterian sense. There is another famous case which involved Siemens. This company built the first fax machine. The knowledge underlying the fax technology was protected by patents. Siemens did not bring the machine to the market. It licensed the knowledge away to Japanese firms, which put it to immediate use and built up the fax industry, and by doing so actually destroyed the market Siemens wanted to protect by not innovating herself: the telegraph. There is an old saying about Siemens: "If only Siemens did know what Siemens knows." We would rephrase this saying as: "If only Siemens did, what Siemens knows." [14]

The function of the entrepreneur

It is no part of his function to "find" or to "create" new possibilities. They are always present, abundantly accumulated by all sorts of people. Often they are also generally known and being discussed by scientific or literary writers. In other cases, there is nothing to discover about them, because they are quite obvious. ... But nobody was in a position to *do* it. Now, it is this ‚doing the thing', without which possibilities are **dead**, of which the (entrepreneur's) function consists (Schumpeter, 1934, p. 88; emphasis added).

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[14] To be fair to Siemens, we should mention, that the German industrial giant is developing a radical program to help overcome or avoid the problems mentioned. Siemens implemented a wide-ranging management strategy to improve decision-making and boost innovation. For recent developments at Siemens see Marsh (2003). The case of Microsoft is similarly interesting. Paul Abrahams (2003, S. 8) describes the difficulties, to apply the knowledge, created by Microsoft researchers, within the company. Microsoft tries to provide strong incentives for internal intrapreneurs in order to develop new products based on the insights from internal research.

Another illustration: In 1979, three European companies – Olympia, Olivetti and Thriumph-Adler – had a three-year lead over their Japanese competitors in electronic typewriter technology. They owned the knowledge and the engineering skills, but they failed to conquer the world market. Some years later, a similar situation arose with video recorders. The Video 2000, developed by Philipps/Grundig was technologically significantly superior to Matsushita's VHS system. Nonetheless, the European firms lost out.

In each case of firm failure, we observe this gap. Managers/ entrepreneurs know something, they are aware of difficulties and problems, but they do nothing or not enough.[15]

In each case, the Europeans did not handle the Schumpeter problem effectively. They could not translate their knowledge advantage into market success, i.e. realizing "new combinations in the economic sphere."

4. Academic entrepreneurship and the entrepreneurial university

The above arguments lead directly to treating the problem of knowledge (produced or available in the system of science) as a "Schumpeterian" or entrepreneurial one. Entrepreneurs have the unique role of being engines that drive economic and social development. They are change agents, who may destroy the existing order. They are doers, they overcome the knowledge-doing gap, they are putting other agents together, to create something distinctly different. What is the basis of their competitive advantage?

If their knowledge and skills could easily by transferred, taken up and used by other companies, their would be no need to worry about the problems of structural coupling between science and the economy. We would be in a "neoclassical" world more or less. Knowledge and skills created in the science system would be available as a public good, more or less, for the fabrication of Schumpeter goods in the economy. The other side of this same coin is the Humboldt university. We discussed at length, why neither view harmonizes with the requirements of an entrepreneurial knowledge economy.

Fortunately, the very difficulties, barriers to diffusion and knowledge gaps assumed as non-existing in the traditional paradigma, create the incentives and opportunities for those owning non-transferable knowledge and skills and thus open up the economic space for academic entrepreneurs.

It are precisely difficulties in transferring an organization's (university's, science system's) knowledge base, as it is embedded in its staff (tacit knowledge) or in competence gaps, that constitutes a basis for the competitive advantage of academic entrepreneurs. Non-transfer ("market

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[15] Ignoring change: "Motorola and other companies… such as Rubbermaid, Wang Labs and General Motors were fully aware of how the market was shifting but chose not to do anything about it" (Finkelstein, 2003, p.9).

failure" for knowledge) is the basis for competitive advantage. Asymmetric information is the way for innovation success.

This result seems paradoxical only within the framework of equilibrium economics, to which information economics belongs. Within this paradigm, information and knowledge, which destroy equilibrium (optimal allocation), is theoretically ruled out. The same holds for those agents, who account for the creation of new knowledge, uncertainty and recombination.

If we enter deeper levels of theoretical territory, the paradox disappears with the theoretical flatland. Non-transparency and so-called information failures turn into action parameters for innovative entrepreneurs. This requires, evidently, on the theoretical and conceptual level, a paradigm shift, and on the institutional level the evolution of a concept of a university beyond the Humboldtian functional constraints and property rights and ethical restrictions.

To answer why knowledge production per se often does not pay economically, requires to delve into problems discussed in our paper. It is a matter of the structural coupling between science, economy and the education system. Low returns to research (and development) are due to a lack of entrepreneurial skills (competencies), their regulation, the environment and the challenges, with which entrepreneurs are confronted with (competition, taxes and so on; see figure 3).

In other words: knowledge *is* available; problems emerge when basic knowledge needs to be transformed into innovation: the knowledge-doing-gap. The same can be said for education and training. If the output of the education system does not become part of the innovation system, resources for education etc. are, economically speaking, wasted. This result is actually drawn by Wolf (2002).[16]

In still other words: putting more resources (inputs) into the system, does not on its own result in growth and rising living standards.[17] The (additional) resources need to be recombined creatively. This requires a theoretical and policy mutation from an input logic to a development or entrepreneurial logic.

In this sense, we can talk of an **entrepreneurial university**. An entrepreneurial university has the capacity to put the competencies and knowledge of its staff (teachers, researchers) and students into action. The knowledge does not only circulate via publishing and talking (to each other and

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[16] For theoretical and empirical underpinning of this view see besides the writing of the author (especially Röpke, 2002a, chapter 3; Röpke, 2002b for China) the work of Aß mann (2003) which also contains a chapter on the university system in a regional context. In addition to the empirical material cited by the above authors, see the contribution of Hanushek (2003). He shows empirically for input-based schooling policies what Aßmann and Röpke, following Schumpeter's lead, derive for the science and higher education system.

[17] We are interested in the long run. In the short run, things are different.

to students), but becomes implemented by entrepreneurial action <u>outside</u> the academic community.

The entrepreneurial university: five meanings

An entrepreneurial university can be conceptualized from various theoretical and practical angles. [18]All are relevant and do not exclude each other. (1) Making the university more entrepreneurial in its traditional role as a producer of science, knowledge, skills and qualifications. Universities, unfortunately, are one of the most conservative and tradition-bound organizations in the world. Even making the university entrepreneurial in its traditional function requires innovations of a fundamental nature as transforming lecture or faculty oriented teaching into student or learner oriented teaching. (2) The first approach is sometimes mixed up with the goal of better management of resources *within* universities in the sense of cost controlling, operations management, etc.: The McKinseynisation of the university. But a well-*managed* university is not the same as an entrepreneurial university in the above sense. Both goals may be in conflict with each other. Concerning actually practiced university reform, the second approach is what is really done – not at least because the masters of the university system (politicians and bureaucrats) somehow believe that this is the approach a private firm makes competitive and because they believe to save money with such a reform. (3) The university becomes entrepreneurial by better marketing, sharing and transforming knowledge and competencies (via patents, knowledge transfer, joint research with commercial organizations, and so on). (4) The university turns entrepreneurial by linking up with other subsystems of society, especially the economy via entrepreneurial undertakings of members of the university. It is in this sense, that we use the concept of entrepreneurial university in our discussion. The entrepreneurial university in any of the types mentioned should not be equated with a commercial university. It is possible to run an entrepreneurial university on a commercial or non-commercial mission or on a mixture of both.

The distinction between (2) and (4) follows Schumpeters original reasoning for introducing "entrepreneurship" into economic theory: the distinction between the creation of new value-generating activities (new opportunities) as opposed to statically maximizing (profits) by appropriating higher rents from an existing opportunity. (5) Sometimes, entrepreneurial is

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[18] I have elaborated on this theme previously (see Röpke, 2000; Röpke, 2002a, section 4.6). I still consider these earlier contributions as valid. What I propose in the present contribution is my special focus an the diversity of knowing and doing in a development context

equated with privatizing the university. To transform a university into a privately owned organization can go hand in hand with the entry of entrepreneurship in one of the four senses mentioned above. Privatization means to make the university a "capitalistic" entity more or less run for the interest of its shareholders. Entrepreneurship can definitely not be equated with the function of the capitalist, as Schumpeter (1934; 1943) has stressed repeatedly.
The two states Schumpeter compares - profits that result from allocating and coordinating activities at a given point of time and with given technology and the creation of new value-adding activities – can in my view directly be applied to distinguish the approaches (2, in part 3; in part 5) and (4):

"A system – any system, economic or other – that at *every* given point in time fully utilizes its possibilities to the best advantage may yet in the long run be inferior to a system that does so at *no* given point in time, because the latter's failure to do so may be a condition for the level or speed of long-run performance" (Schumpeter, 1947, p. 83).

In other words: an entrepreneurial university in the sense discussed in our contribution may require a non-optimization/misallocation of resources. How (2) and (4) can be combined or reconciled has so far not yet been discovered.

The debate on these matters is highly confused, since important distinctions are not drawn. For an example see Glotz (2002), who hopes that somehow, by approaches (1) and (2), a MIT in Germany may emerge. If you do (4), i.e undertake what MIT is doing, the other things would follow naturally.

The main function of a scientist and academic teacher is self-evident. That the scientist can also be – or even must become, in an *entrepreneurial* knowledge society – an "entrepreneur", an innovator, is considered as something strange, or worse – immoral and unethical.

What we observe here seems a contemporary replay of developments of the past. Until very recently, innovation was indeed a dirty word. It had strongly negative connotations from the 16th into the 19th centuries. An innovator was a troublemaker, a rebel, a subversive[19]. Schumpeter did not use the word in his *Theory of Economic Development*, first published in German in 1911. Instead of innovation, introduced by him in his *Business Cycles*, published 1939, he wrote of "new recombination".

A very similar negative connotation seems still in place concerning academic entrepreneurship outside the system of science and education. There are massive legal, regulatory and ethical resistance toward the kind of entrepreneurship we believe is needed to close, even marginally, the knowing-doing gap. If "the law of accelerating returns" (Kurzweil, 2001) is more than

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[19] See the Oxford English Dictionary for the historical emergence of the meaning of innovation.

science fiction, the consequences for the management and regulation of universities and other institutions of higher learning are indeed so fundamental, that countries, who do not jump on board will face the punishment Darwin and Schumpeter dish out for those unwilling to evolve: creative destruction.

As in any kind of entrepreneurship, overcoming resistance will be a normal part of the daily activity of academics venturing into the entrepreneurial field. The innovator who is welcomed with open arms by society has still to be born.

The type of academic entrepreneur we discuss plays a dual role: doing research *and* "transporting" the academic fruits of his research into the economy (or other subsystems of society). He does not transfer. He applies knowledge and competence *outside* the system where it was created to another system where it becomes applied.

He acts as a dual-function entrepreneur/intrapreneur.

Our main interest is ***not*** in implementing the knowledge as a teacher/scientist **within** the science/research/university system. Our focus is the implementation of knowledge **outside** the university, the application of science/knowledge in the economy and the social-political environment of the scientific/teaching institutions in which scientists and teachers work.

Figure 5 illustrates this constellation for a society, in which the dynamics of innovation are reproduced through the structural coupling of autonomously operating subsystems as science, politics, economy, etc. In system-theoretic terms, we call such a society an autopoietic innovation society. The evolution of such a society necessitates entrepreneurial universities and academic entrepreneurship.

We know a lot about the transfer of knowledge and the problems of transfer between science and the economy. Not so much known about the difficulties scientists face when taking the knowledge problem into their own hands: acting entrepreneurially. This dimension of the problem is practically absent from public discussion and seldom enters into reform proposals.
There are three challenges (figure 3):

- competence challenge (fit between scientific and entrepreneurial competences)
- regulatory challenge (have scientists the right to engage in entrepreneurial activity – commercially or other - without leaving the university/science system)
- ethical challenge (is entrepreneurial engagement ethically problematical?).
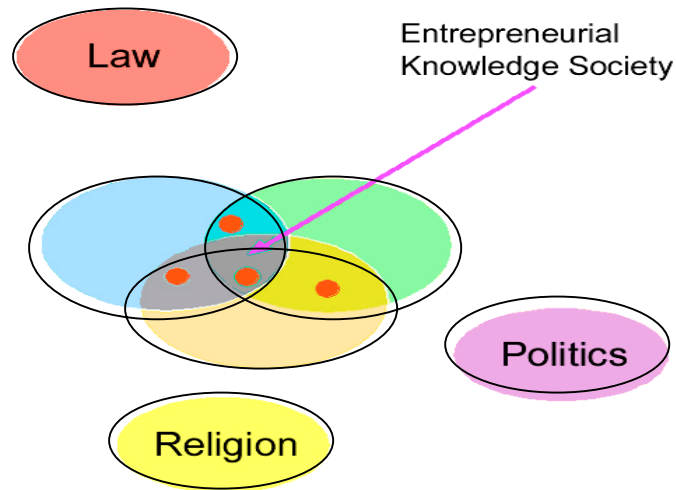
Figure 5. An entrepreneurial knowledge economy

In quite many a country,[20] putting knowledge into practice by the researcher/teacher himself is often seen as not the task of the scientist cum teacher. It does not fit the Humboldt tradition of the university. The *Verwertung* (application, often commercially) of knowledge is often seen as unethical.

In the USA, the main initiative for university-industry research collaboration and centers originated with universities. This contradicts the corporate manipulation thesis. It supports the argument of Etzkowitz (1999) that "entrepreneurism" has permeated US universities. There are indeed worlds apart between the USA and Europe concerning the incentives for academic entrepreneurship (Henrekson & Rosenberg, 2000).

The US is surely ahead of Sweden (and Continental Europe, Japan) in tackling the "gap". But she offers no smooth sailing for academic entrepreneurs. Conflict of interest is seen as a big problem. The person directing the Technology Licensing Office at MIT, has this to say about how start-ups are handled by university regulators:

...we have drawn a Chinese wall between the start-up company and the university. We do not take a seat on the board, we do not let the company sponsor research coming out of the lab, and we do not do any confidential work (Nelsen, n.d., p.284).

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[20] Practically the whole of continental Europe, Japan, to some degree even the U.S., which has traveled the most on the road to an entrepreneurial university.

At least, it seems, some ideas generated in science (the university) make it into the economy (or other subsystems of society). Economy, science and training/education overlap or fit (figure 5). This does not mean that science becomes dictated/manipulated by economic goals. It means, that the knowledge and competence in science can be applied in the economic system. The central question is: by whom? Our answer: by those, which have created the knowledge, have the ability to put their own knowledge into practice.

To repeat: The focus of the paper is implementation, use, or application of the academics' knowledge, expertise, and capabilities in the creation of value and improvement of people's well-being

Outside
The science/education system.
Obviously, this can take place in many ways.
The papers and case studies within this book inform us on

- a variety of ways of implementation (consultancy, promoting business, establishing (becoming partner in) a firm, fostering SMES, etc.),
- difficulties researchers/teachers are facing in undertaking entrepreneurial initiatives;
- ethical problems in bridging the gap;
- capabilities needed to overcome the gap and the ways and means to acquire (entrepreneurial) competencies.

There is one big difference between so-called developed countries and the developing world concerning the knowing-doing gap, and this difference may handicap those of us trained in a country like Germany. Without strong and vital entrepreneurship there is no economic hope for developing countries. Germany and other rich countries could (theoretically) live happily with the living standard and quality of live already achieved. [21]In less developed countries, this is obviously not the case. This being so, makes the interaction of universities with their economic and political environment so much more crucial and makes the promotion of entrepreneurship (private, state, for-profit, community-oriented, etc.) a cardinal if not *the* feature of any development strategy. In other words: as the function of universities and similar institutions in developing nations becomes more vital, the

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[21] If we believe research on the connection between the level of happiness and the level of material wealth (Ryan & Deci, 2001), a lot of what is going on in developed countries seems actually to reduce the level of happiness. To increase their material welfare, people in rich countries engage in actions and follow lifestyles, which reduce their emotional and physical well-being. Money and material wealth, beyond a rather low level, does not appear to be a reliable way to either happiness or well-being.

model that alumni bring with them from Western nations and Japan concerning the ideal university (the Humboldtian vision) may actually be more problematical.

        The scientific world is brimming with giants of knowledge and dwarfs of implementation. If university people do <u>not</u> engage as cultural and economic promoters outside their home turf, substantial opportunities for the improvement of society are missed and valuable opportunities for self-improvement (also in the traditional role as teachers etc.) are disregarded.

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Food Security

MULTIPLE EMPLOYMENT AS A STRATEGY OF LABOUR RESOURCE MANAGEMENT FOR SUSTAINABLE FOOD SECURITY (CASE STUDY IN PEASANT COMMUNITY OF NORTH SUMATRA, INDONESIA)

Jongkers Tampubolon

Introduction

North Sumatra belongs to the regions in Southeast Asia, which suffer from high population density and land scarcity. Most of the farmers in the region cultivate less than one hectare arable land, which is insufficient to form a basis for family subsistence. Members of such farm-households are therefore forced to engage themselves in off-farm activities to generate more income to guarantee their subsistence (see e.g. Kuhnen, 1986 and Leinbach/Smith, 1994).

Albeit multiple employment in farm-household is a world wide phenomenon, which should be understood as an adjustment to changed environmental framework in agriculture (von Frauendorfer, 1966; and FAO, 1998), this aspect is not yet accommodated in the rural development policy of most developing countries. In many cases, "industrial policy has been pursued as an alternative (rather than a complement) to agricultural policy" (Staatz, 1997: 1) or in the opposite direction, "policy maker in developing countries have tended to consider the farm sector as the principle sector for creation of rural employment and income opportunity" (Reardon, 1998: 1).

This paper, founded on empirical research, points out that for farm household with multiple employment, agricultural and non-agricultural sectors are linking on the household level. Based on a case study in peasant community of North Sumatra, Indonesia, the paper goes on to reveal the magnitude of multiple employment, its role as an income source to secure the household subsistence and the reason to choose it as the main strategy of resource management. Further, the policy implication of the empirical finding will be discussed.

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Empirical Background

Information in this paper is based on field research's results in irrigated paddy region of east coastal of North Sumatra. The research was conducted in two villages, one village situated about 2 kilometers from an industrial area (henceforth industrial village) and the other about 25 kilometers from the same industrial area and quite isolated (henceforth non-industrial village). The farm situation in both villages are presented in table 1.

Land scarcity is worse than what is presented in table 1, since 15.5% of household in non-industrial village have no access anymore to land, so that they have to rely their existence on off-farm employment only, and one out of ten farm-households (11.8%) are landless and have to manage farm on totally rented cultivated land. In the industrial village, this proportion is 35% and 34% respectively.

Generally, the farms in both villages are small. This small farm could not be made as a single income source for related farm-household. Therefore, all farm-household in industrial village and almost all in non-industrial village, combine farming with paid off-farm activity (table 2). Such households are called as farm-household with multiple employment, a parallel terminology for multiple jobholding (Fuller, 1983: 8) or pluriactivity (Fuller/Brun, 1990) as well as part-time farming/farmer (Kada, 1980; Lund, 1991 and Bryden/Fuller/Mackinnon, 1982).

Table 1. Farm size distribution

Farm Size (ha)	Industrial Village		Non-Industrial Village	
	Average	Proportion (%)	Average	Proportion (%)
< 0.25	0.2	36.0	0.2	35.5
0.25 – 0.50	0.4	22.0	0.4	29.0
0.51 – 0.75	0.6	20.0	0.6	17.2
0.76 – 1.00	0.9	18.0	0.9	9.7
> 1.00	1.4	4.0	1.4	8.6
Population (n)	**48**		**93**	

Table 2. Agricultural situation in the research villages

Description	Industrial Village	Non-Industrial Village
Average farm size (ha)	0.47	0.49
Proportion of Household without farming (%)	34.72	15.45
Proportion of farm household with multiple Employment (%)	100	94.68
Total Household (n)	**72**	**110**

In line with multiple employment categorization by Spitzer (1987) majority of practiced multiple employment in the research villages is household multiple employment. In industrial village, the role of non-agricultural sector to provide employment is already noticeable, since in 51% of farm-household, a part of household economically active members work permanently off-farm. In such cases, agricultural and non-agricultural sector are linking on household level. Whereas 28.6% farm-household in industrial village and 41.3% in non-industrial village belong to category of multiple employment, where all economically active household members are working on their own farm and all of them engage in multiple employment (farming and off-farm linking on individual level). It means the same person holds farm and off-farm work and the work in both sector is carried out seasonally with regular and cyclical pattern. Therefore, there is no competition between both sectors.

The off-farm works are widely varied, but working as agricultural worker is the most favored employment, especially as a second occupation. This phenomenon is applicable for household heads; as well as, household wives and for both villages[22]. Thereafter, petty trader is the other alternative work in non-industrial village. Whereas in industrial village, industrial sector and its supporting system transportation sector have already provided permanent occupation for 19.4% household heads of farm-households with multiple employment (table 3).

It is worth noting, that wages in industrial sector are lower than that in construction and transportation sector, whereas work with the highest wages is work as agricultural worker (especially for harvesting and planting). However, income from own farm (in term of family labour return) is still far higher than income from wages. From this point of view, off-farm employment could be considered as a marginalization process (compare with ISLAM, 1984: 307). Farmer with multiple employment prefer to manage a bigger farm rather than to work off-farm.

Theoretically, the farm-household face two options to utilize the resources they possess in order to increase the household income, namely (i) to intensify the usage of limited land, which is supported by irrigation network, so that the land can be cultivated three times in one calendar year (cropping index 300%), and (ii) to allocate the household labour to engage in off-farm employment.

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[1] It seems that such phenomenon is wide well known in Indonesia (see e.g. Golaszinski, 1986 for East Kalimantan; Arman, 1987 for West Kalimantan and Leinbach/Smith, 1992 for South Sumatra). Junghans/Benad (1984) considered this phenomenon as an effect of agricultural intensification (read green revolution), whereas Golaszinski (1986) shared the opinion, that work as agricultural worker is the easiest work to find (without extra qualification) and this work can be run almost without capital requirement.

Table 3. Off farm employment of household heads and wives of farm household
           with multiple employment

Industrial Village				
Sector of Employment	**Main Occupation (%)**		**Second Occupation (%)**	
	HH Heads	Wives	HH Heads	Wives
• Plantation	4.5	-	-	-
• Construction	4.5	-	-	-
• Transportation	7.5	-	3.0	-
• Industry	11.9	1.4	-	-
• Petty trader	-	4.2	4.5	2.8
• Home industry	6.0	9.9	4.5	7.0
• Agricultural worker	9.0	11.3	38.8	32.4
• Others	1.5	2.8	-	-
Population (n)	**67**	**71**		
Non-Industrial Village				
Sector of Employment	**Main Occupation (%)**		**Second Occupation (%)**	
	HH Heads	Wives	HH Heads	Wives
• Plantation	4.9	-	12.4	2.4
• Construction	8.6	-	2.5	-
• Petty trader	11.1	8.3	11.1	3.6
• Home industry	2.5	1.2	1.2	3.6
• Agricultural worker	1.2	-	29.6	39.2
• Others	2.5	-	8.6	-
Population (n)	**81**	**84**		

The most suitable cropping pattern from the viewpoint of agro-economic that is followed by the most farmers is Paddy-Paddy-Soybean. Soybean cropping delivers advantages with it in the matter of the facts, that gross margin positive, improvement of soil quality (legume effects) and soybean plants cover the soil surface so that weed growth could be suppressed, which could reduce the preparation costs for the next planting season for paddy. Nevertheless, only 60% of cultivated area is planted with soybean, the remainder is let to be fallowed until the next paddy cropping.

To put the priority on off-farm (labor resource allocation) rather than on soybean production (farming or land resource allocation) is based on economic decision. Soybean production requires capital (which is not provided by government in the same manner like paddy production), besides soybean farming has risks with it (if in the first week of planting is rained, the

germination of seeds will be prohibited, which leads to the failure of the whole production) and there is no price guarantee, which is reflected in a small family labor return. Whereas off-farm employment, especially agricultural worker; as well as, work in informal sector, could be undertaken without capital and risks as well.

Income generated from off-farm employment plays an important role in both villages, since 72.9% farm-household with multiple employment in industrial village and 65.1% in non-industrial village obtain ≥50% their household income from off-farm activities.

Statistical analyses exhibit that capital expenses per hectare farm do not show a significant relation with off-farm income per capita. This fact leads to the interpretation that the addition income from off-farm activities does not use to promote investment on their own farm (productive objectives). This finding contradicts the study results in some other regions (Klennert, 1986) in Pakistan and Arman (1987) in West Kalimantan. For peasant community in east coastal of North Sumatra, off-farm income are using nothing other than to fulfill their consumption need (food security) as often expressed in the interview, "for meals we get the rice from our own farm and the side dish like fish, meat and vegetable we buy with the money we got from off-farm work". Suppose that household income is already above subsistence line, an additional income will be spent to finance house repairs or education of the children. Investments on own farm take only the fourth or the fifth priority.

The importance of off-farm employment could be seen not only on household level but theoretically also on regional level. In average, off-farm income for farm-household with multiple employment generate addition income equal to yearly farm income of 4.1 *rante*[23] cultivated land in non-industrial village and 4.5 *rante* in industrial village respectively. If during the research period, cultivated area in both villages is 2.02 and 1.67 *rante*, the practice of multiple employment thus has tripled the carrying capacity of rural area.

Concluding Remarks and Policy Implication
The empirical facts described above could be summarized as follows:
1. In peasant community of North Sumatra, multiple employment is a general persistent phenomenon. Farm-household, which rely their income solely on own farm, is already rare.
2. The magnitude of off-farm sector for employment as well as income generation are significant and far above the average of Southeast Asia as it was synthesized by FAO in "State of Food and Agriculture 1998" (see Reardon, 1998).

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[23] *Rante* is a local term for farm size, where 1 *rante* = 400 m^2 (0.04 ha).

3. The importance of off-farm income is not only to guarantee the sustainable food security on household level, but also to increase the carrying capacity of the rural region to face the pressure of population growth.

In addition, experiences from the finance crisis in Indonesia highlight the role of multiple employment as a stable strategy of labor resource management. During the crises period, August 1997 through 1998, the unemployment and the incidence of poverty did not rise as high as that was predicted. This can be put down to the fact that household could undertake a flexible adjustment to economic shock, through reallocation of household's labor from the sectors that suffered badly during the crisis, such as construction to the sectors, which were benefited from the crisis (Manning, 2000; Berry/Rodriguez/Sandee, 2001; Bresciani *et al.*, 2002).

This situation strengthens the argument for proposing reorientation in agricultural and rural development policy in Indonesia. This reorientation includes:

1. With high contribution to per capita income, multiple employment should be understood as a permanent situation, in which the farm-households make an effort to generate income from two different sources (on-farm and off-farm) to secure the existence of the household. It means, multiple employment is not a transitional phenomenon, as an excess of structural changes process, in term, that the current farm-households with multiple employment will be divided into farmer with big farm and workers, who totally engage in non-farm activity. Experiences in industrial countries refuse the transitional interpretation of multiple employment phenomenon. Bertrand's (1967) prediction, which stated, that "part-time farming is an aspect of the transition from agricultural to an industrial economy" is empirically no longer valid, since the magnitude of part-time farming in Japan (Kada, 1980), USA (Barlett, 1986), Kanada (Kerkemeyer, 1988) and in European Union countries (Fuller/Brun, 1990) are still remarkable.

2. Increasing of peasant income, either for poverty alleviation or for sustainable food security cannot be obtained other than through utilization of the abundance resources (means of production) they possess i.e. labor resources. The most suitable policy measure in line with these objectives is policy that can support simultaneous growth agricultural, industrial and service sectors and which can promote integration among them, in order to create "linkage-friendly" agricultural and non-agricultural activities (compare with Reardon, 1998).

Since the area, which provided off-farm employment is widely varied, development policy, which is based on sectoral transformation (especially single purposed industrialization) is irrelevant for employment as well as income generation of peasant community. Infrastructure development to promote rural

small industry and interregional labor mobilization will create centers of economic activities which further will induce demand on labor in various area, without neglecting agricultural development itself. Such constellation will provide the peasant household an opportunity "to seek the best of two worlds" (Barlett, 1986) or "to balance the potential benefit from on-farm work and off-farm work, since the farmer feels more secure by keeping one foot in agriculture and one foot off-farm" (Arman, 1987). This balance can be reached if and only if agricultural and non-agricultural grow simultaneously in the certain region (regionally structural development)

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A SYSTEM DYNAMICS MODEL FOR POLICY ANALYSIS IN FOOD SECURITY SYSTEM IN INDONESIA

Setyo Pertiwi

Abstract

The ever increasing world population and limited capacity of nature in producing food lead to the growing concerns on food security everywhere. Hence, the concerns on food security have progressed over the last 50 years from purely physical availability at the global level to the provisions of food to households/individuals and the role of poverty in ensuring year round access to food. The interaction between agriculture/food policies and socio-economic factors at the micro and macro-level are now considered crucial to ensuring food availability.

In view of the above, a study has been undertaken to develop an appropriate model that can function as an analytical instrument in undertaking policy analysis that would direct the food security system in Indonesia. A structural approach using system dynamics modeling methodology has been selected in the formulation of the model that representing inter component interaction characteristics that are typically observed in Indonesia, either in urban or rural area. The model provides a general representation of the major linkages among the most relevant system elements to be considered in undertaking the desired analysis, namely the food security systems of the country. The system elements included in the model are, among others, population, labor, land use, price policy and input technology. Using the model, the likely impact of intervention policies on the food security system can be reflected. Therefore, it makes possible to identify a range of solutions appropriate to the local context.

Introduction

In 2000, the world had 6.1 billion human inhabitants. This number could rise to more than 9 billion in the next 50 years. For the last 50 years, world population multiplied more rapidly than ever before. Indonesia is the fourth most populous country in the world after China, India and the United States. The Indonesian population is about 210 million people in 2002, from which about 60 percent of the country's people live on the crowded island of Java. Even though

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Indonesia's growth rate had decreased over the decades since independence, the population continued to grow and population density increased significantly, particularly on the main islands. The average annual growth in the last decade had fallen to 1.35 percent from 1.97 percent during the 1980-1990 period. It is then projected that the population will be up to 222 million in 2005 and 254.2 million in 2020 (Wirakartakusumah, 2002).

Meeting the increasing demand for food is probably the most basic challenge and the most salient population and environmental crisis. The ever-increasing world population and the limited capacity of nature in producing food lead to the growing concerns on food security everywhere. There is a typical fear that population size would one day exceed the food supply the world can do. Hence, the concerns on food security have progressed over the last 50 years from purely physical availability at the global level to the provisions of food to households/individuals and the role of poverty in ensuring year round access to food (Hall, 2002). Food insecurity can be a result of the unavailability of food, insufficient purchasing power, inappropriate distribution, or inadequate use of food at the household level. Poverty, natural disasters, political violence, and other geopolitical factors create a disproportionate distribution of the world's food. Therefore, the interaction between agriculture/food policies and socio-economic factors at the micro and macro-level are now considered crucial to ensuring food availability.

In view of the above, this paper is aimed to discuss a study that has been undertaken to develop a model that can reflect food security system in Indonesia, and also to demonstrate the possibility of using the model as analytical instrument in undertaking policy analysis that would direct the food security system.

Methodology

The study was carried out by using system dynamic modeling method, i.e. a perspective and set of conceptual tools that enable understanding the structure and dynamics of complex systems (Forrester, 1968). It was involving five (5) steps, namely 1) identification of the real system through field observation and literature study, 2) articulation of the problem to be addressed, 3) formulation of dynamic hypothesis or theory about the cause of the problem, 4) formulation of computer simulation model to test the dynamic hypothesis and testing the model, and 5) designing and evaluating policies for improvement (Sterman, 2000).

Understandings about the system gained from the first step were articulated in the form of causal loop diagram. It was then transformed to the system dynamic flow diagram, which contains components of the system, inter component interactions and its behaviors. Computer simulation model was developed by using commercially available software, and it was validated by

using historical statistical data. Several scenarios were simulated to understand the possible problems and its solution of the system.

Result and Analysis

The model of the food system has been developed by focusing on the process and factors that govern the dynamics of food supply and consumption in the country. In general it consists of three sub-systems, i.e. sub-system production, sub-system distribution, and sub-system consumption. These three sub-systems are strongly influenced by the dynamics of population change. Therefore, a set of structural mechanism that determines the dynamics of the level of population is incorporated in the model. Figure 1 shows the causal loop diagram reflecting food system in Indonesia, in which A, B and C are indicating production sub-system, distribution sub-system, and consumption sub-system, respectively.

Population change results from the interaction of three variables: births, deaths, and migration. The difference between births and deaths in population produce the natural increase (or decrease) of a population. Natural increase usually accounts for the greatest amount of growth in a population, especially within a short period of time. Net migration is the difference between the number of persons entering a geographic area (immigrants) and those leaving (emigrants). For simplification purpose, in the food system model net migration is assumed to be zero.

The gained food production is a result of interaction between land, labor, material input, technology and potential yield of the crops. In certain situation, land use for agricultural production may compete with land use for housing and other living activities. When housing land expands toward agricultural land in order to keep pace with needs of growing population in the region, this may lead to the decrease in food production. Level of input for food production given by food producers to a certain extend is influenced by the gain in previous production season (Ratnawati, 1999). In the developed model, food production is represented only by rice production, the most important staple food in the country. In this case, the probabilistic nature of agro-climate, which affects the crop growth, has not been incorporated in the model. There is also an assumption on no technological change that can affect the crop productivity during simulation time horizon.

Availability of access roads and market price of commodities govern food distribution system in the region. It is including the common behavior of food producers on determining the portion of food they produce that will be consumed by themselves or delivered to the market. This will determine the level of food availability (food stock) in rural area as well as in urban area.

People's nutrition status is determined by the level of food consumption and health. The food consumption level is determined not only by

the food availability level. Beside culture and food habit, accessibility of the food to the people is also the main factor determining food consumption. This factor is naturally influenced by food price and people income. In turn, nutrition status will affect the reproductive capability of the people.
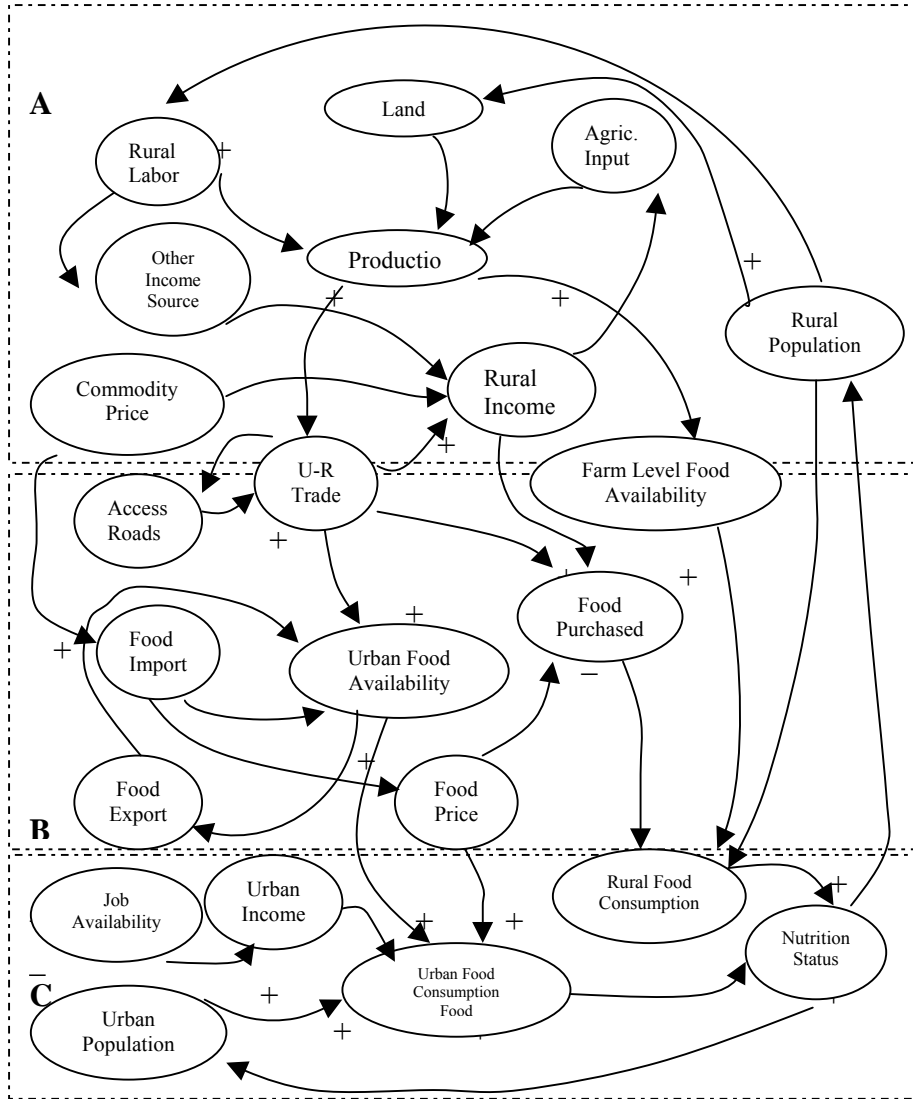
Figure 1. Causal loop diagram of food system

With the major considerations in the model building described above, a model of the food systems of Indonesia was constructed to represent the situation and condition typically found in the country. Flow diagram of food system dynamic is presented in Figure 2. The suitability and validity of the model to represent the general features and behavior of the food system in the country was demonstrated through simulation experiments, by its ability to emulate the historically observed behavioral patterns. Figure 3 shows the simulation result in comparison with historical statistical data of Central Java province. Thereby, the model can be considered as a valid model.
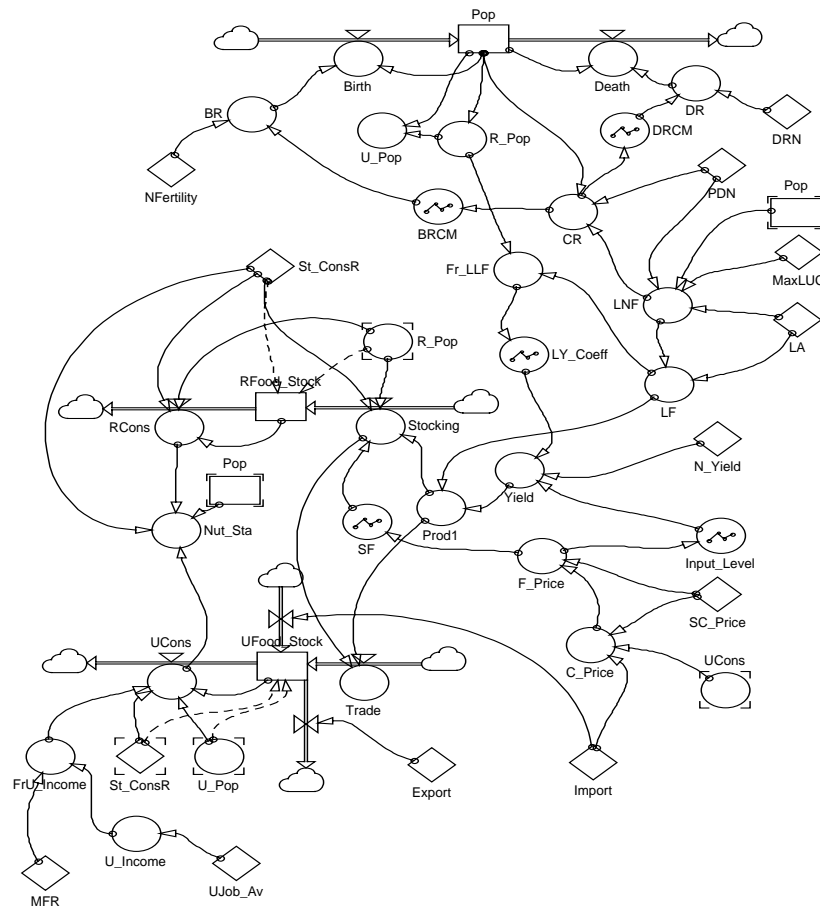
Figure 2. Flow diagram of food system dynamic

The desired features of the model in terms of its ability to explore possible future responses to various scenario or policies intended to direct the food system towards sustainable food security system have also been demonstrated. This was done by a set of simulation experiments, whereby the model is subjected to simulate the policy of control on land use and trading policy (including export and import).

The particular policy on control of land use, considered in investigating the system responses, are those policy that would 1) strictly maintain the current agricultural land use, 2) tolerate 10% land use change, and 3) tolerate 25% land use change (Figure 4).
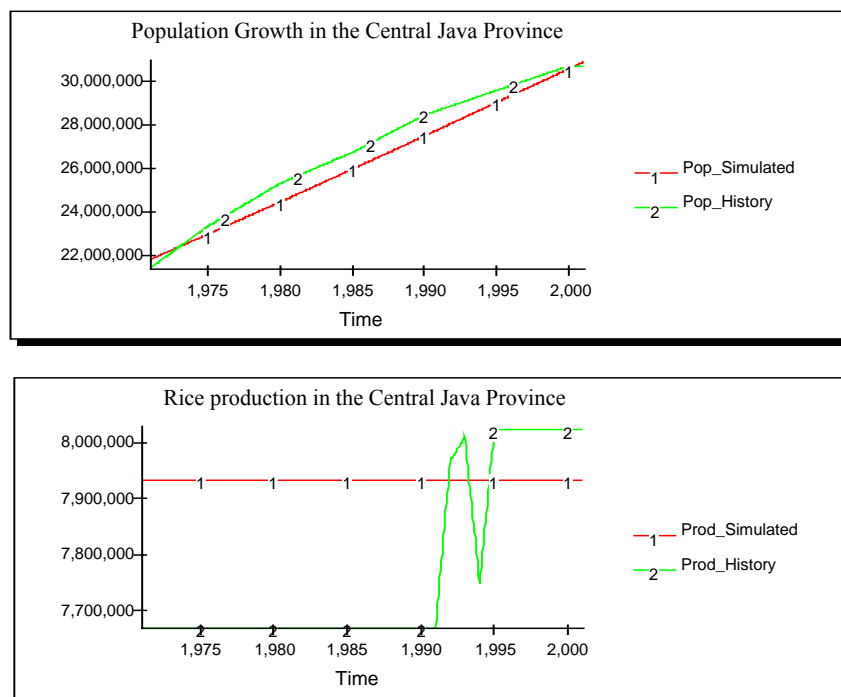
Figure 3. Validation of the model by comparison of model Simulation result with historical statistical data
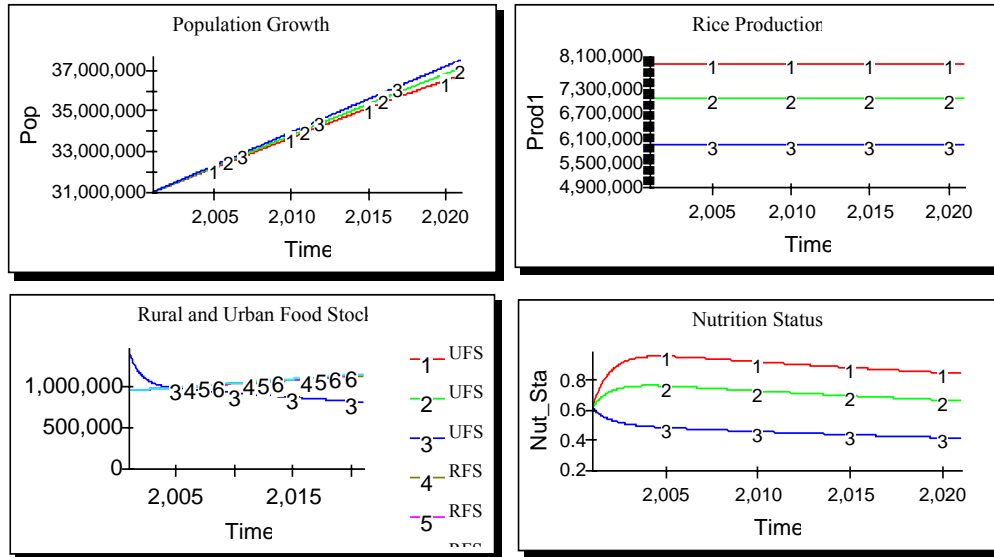
Figure 4. Responses to policies on control of land use

       The generate policy scenario responses reveal that the food security system are vulnerable to strategies that will require land use change. As seen from Figure 4, at one hand tolerating land use change from agricultural land to another type of use will cause the decrease of food production. On the other hand it cause the greater increase in population. Therefore, food availability becomes lower, and the nutrition status of the people becomes lower as well. From this result, it is understandable that maintaining the current status of agricultural land use is an important point.

       Central Java province is one of the rice producing area in Indonesia. It has a surplus in food production that can be distributed to another provinces or abroad through trading. Figure 5 shows the response of food system to the change of net food trading to the food availability and nutrition status. Ten percent (10%) increase of net (outgoing) food trading will result to lower food stock in rural area (4) as well as its nutrition status (2). Decreasing net (outgoing) food trading for about 10% will serve better to the people in the province in terms of food availability and nutrition status.
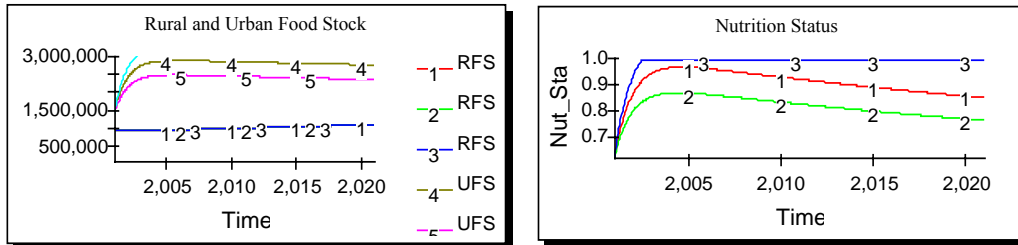
Figure 5. Response to change on net food trading

Conclusion and Recommendation

A study has been taken to develop a model that can reflect food security system in Indonesia. By considering some modeling constraints and assumptions, the model is considered to be valid. The model has demonstrated the possibility of using it as analytical instrument in undertaking policy analysis that would direct the food security system. For further improvement of the model, the probabilistic nature of agro-climate, which affects the crop growth, and the possibility of technological change on food production need to be incorporated in the model.

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THE ROLE OF POST HARVEST HANDLING SYSTEM IN THE INDONESIAN FOOD SECURITY PROGRAM

Edy Hartulistiyoso

Introduction

The food security has become an important program in Indonesia since the economic crisis has wide impacts to some sectors including food supply. The economic crises should become a valuable lesson for Indonesia to improve his capability to manage its abandon natural resources. The real sector, which based on natural resources such as agriculture, has showed its endurance during the crisis comparing to other sectors. The improvement of production with high quality is therefore necessary.

As a tropical country Indonesia has abondon natural resources which are very much potential to secure the food supply. Its typical tropical climate with relatively high air humidity causes however damage and losses which may reduce the total production. The agricultural products should therefore be preserved properly for better quality of the products and extending market opportunity. Hence, the role of post harvest handling system becomes important. In general the system faces various challenges and problems which lead to the low product quality; such as, limited area and investment, handworks with very simple means, lack on sanitary and safety condition and lack of management. The current status of post harvest handling system and its role for supporting food security program in Indonesia will be discussed.

Food Security Program

The food security program in Indonesia is focused on the food and nutrition availability in quantity and quality with fair price. The system covered two main sub-programs of the availability, accessibility, stability of supply on rice self sufficiency at national level and food diversification. The implementation of the programs are designed to be in line with the development of agribusiness.

Some aspects of the agribusiness development should therefore be considered, including global market, advanced technology, local products specific, local natural & human resources as well as fair market. The agribusiness development programs cover:

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a. Production system, post harvest and distribution.
b. Job Opportunities
c. Agribusiness base rural development
 The discussion in this paper will be focused on the post harvest system and its role in the food security program in Indonesia.

Post Harvest Handling System
 The current status of production and post harvest handling system are simplified and showed in figure 1. The system indicates that the reproduction as well as post harvest are mainly processed by traditional and individual farmers. This condition causes low quality of the products and therefore only limited market access. For the development of agribusiness, the system should be modified which respect to the high quality of the products and customer satisfaction. Figure 2 shows the development of production and post harvest system in agribusiness. It shows that for producing high and assured quality products the precision and corporate farming in production and post harvest and processing terminal should be established.

Harvest

Individual
Post Harvest Handling

Traditional Farming

Traditional Market

Grower

Unguaranteed
Quality Products

Fluctuation,
Insufficient reward

Consumer
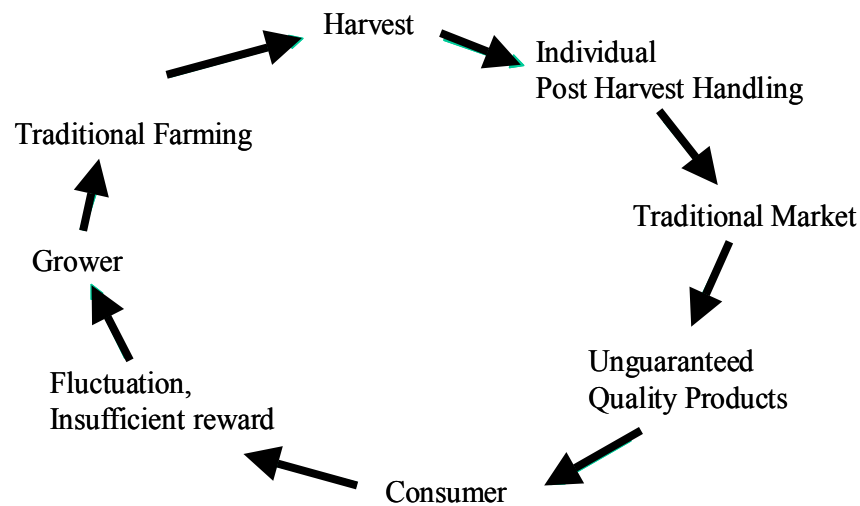
Figure 1. The current status production and post harvest system (Purwadaria, 1996)
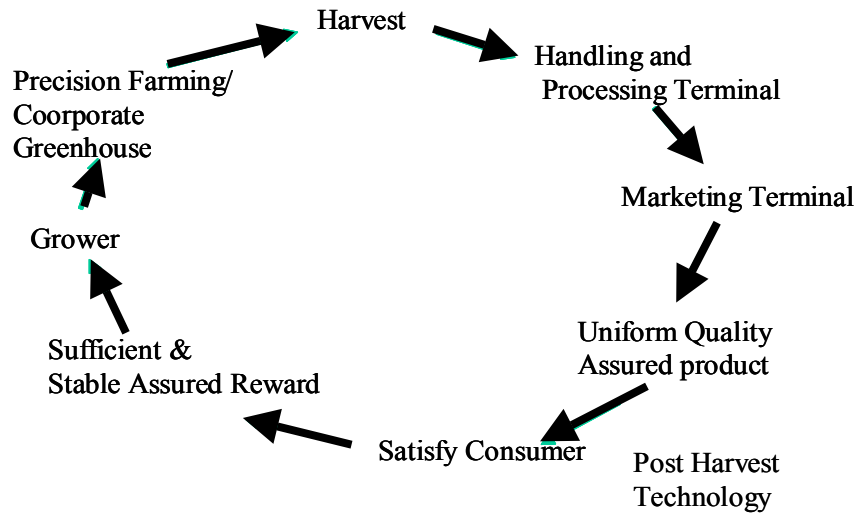
Figure 2. The development of production and post harvest system in agribusiness (Purwadaria, 1996)

The Role of Post Harvest System

The application of post harvest technology in respective product faces various challenges and problems but the problems refer to the same result of low product quality and quantity (high losses). In general, some reasons of post harvest technology in agriculture can be listed as:

- Most of producers are small farmers with limited area and investment.
- Handworks with very simple means
- Lack on sanitary and safety condition
- Lack of management

The low product quality leads to an unnecessary impact of low nutrition value, low price and limited market access. This will reduce the success of food security program objected to human resources and global market orientation.

Improper post harvest handling has also impact on the high losses. The case study of rice production indicates the the post harvest losses reach 20.5%, covering 9.52% losses during harvesting, 4.78% during threshing, 2.19% during milling and 2.13% during drying, which equivalent to about 1,500 Million Euro.

A study on the projection of production and consumption balance of rice are shown in Table 1. The data indicate the deficit of the balance of about 2.5 million tons of rice, which shows the necessity of imports or extra production effort. The improvement of post harvest handling system, which leads to the reduction of losses, has a potential to cover the deficit. The reduction of losses up to 8% (from 20 to 12%) has an equivalent of 2.4 million tons will cover the projected deficit. This illustration shows the important role of the post harvest system to the food security program.

Table 1. Projection of balance of consumption and production of rice in 2001 – 2004 (Tons)

Year	Consumption	Production	Deficit (Import)
2001	32.771.264	30.283.326	2.487.920
2002	33.073.152	30.586.159	2.486.993
2003	33.372.463	30.892.021	2.480.442
2004	33.669.384	31.200.941	2.468.443

Sources: Department of Agriculture of Indonesia, 2002.

Conclusion

The food security program in Indonesia is aimed to availability of food and nutrition in quantity and quality with fair price. The implementation of the program should be in line with the development of agribusiness. This implicates on the necessity of high quality production and quantity products (low losses). The role of post harvest handling system in reducing losses, for the success of the food security program is important. The current status of post harvest handling system should therefore be developed and improved.

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STRENGTHENING FOOD SECURITY PROGRAM BY UTILIZATION OF MEDIUM ALTITUDES LAND ON POTATO CULTIVATION

C. Wibowo[1], E. Pawelzik[2], E. Delgado[2] and Nurpilihan[3]

Abstract

The world population is tend to increase which raises serious concern in whether the world's production system will be able to feed so many people while the stock and quality of natural resources are declining. Potato has high priority in vegetable production, due to its potential as an alternative carbohydrate source in food diversification to strengthen food security program. An increase of potato production could be obtained by intensification or extensification. Expanding new area for plantation represents a problem, due to limitation of highland. Therefore, medium altitudes land could be an alternative. Potato crops in medium altitudes are especially subjected to heat and water stress. Therefore, watering plays an important role to supply water need and reducing the temperature.Potassium is necessary due to its positive effect on the growing process and increasing its resistance to environmental stress. The objectives of this research were to study the utilization of medium altitudes land to strengthen food security program and to investigate the effects of water supply and potassium fertilisation on yield and potato tuber quality.

Field experiment was conducted in Jatinangor, Bandung, Indonesia and chemical analysis was done in Goettingen, Germany. The experiment used a completely randomize design arranged by factorial with three replication. First factor was three treatments on water supply (watering every: 2, 4 and 6 days) and second factor was three treatments on potassium fertililization level (50, 100 and 150/ha). The cultivar of potato cultivated was Granola, due to its popularity in Indonesia (85-90% of total cultivated area). Besides yield, potato quality determined were: dry matter content, blackspot susceptibility and after cooking blackening

The result of this research showed that the highest yield obtained by watering every two days and 150 kg/ha potassium fertilization, while the highest dry matter content obtained by watering every four days and 150 kg/ha potassium fertilization. The reduction on yield and dry matter content was 48% and 14% respectively, compared with cultivation in highlands. Based on the chemical composition, Granola tubers grown in medium altitude are suitable for salads, vegetables or canning but not for chipping industry.

Key words: food security, potato cultivation

[1] = Soedirman University
[2] = Göettingen University
[3] = Padjadjaran University

Introduction

The world population is estimated grow up to 7 billion people in 2020, it raises a serious problem on food production to feed so many people while the stock and quality of natural resources are declining. Therefore food security is an important issue to be considered. To ensure the food security program could be addressed on increasing agricultural productivity in the frame of sustainable development, the utilization of medium altitudes land could be an alternative solution to support this program. Potato, which has well known as the highland crops, could be cultivated in medium altitudes land with some addition treatments. Nowadays, potatoes have the high priority in vegetable production due to its potential as an alternative carbohydrate source in food diversification and export market (Karjadi, 1998). Potatoes are traditionally used in Indonesia as vegetable potato, whilst only small amount are being processed.

Granola is the most common potato cultivar in Indonesia and it is estimated to be grown on 85% to 90% of the total cultivated potato area. Its preference is partly explained by its early maturing, high yielding and its high proportion of large tubers (Kusmana and Chujoi, 1998). Throughout the islands of Indonesia, potato tubers is grown in the highlands between 800 and 1800 m above sea level (asl). An increase of potato yield and production in Indonesia could be obtained by intensification or extensification. Expanding new area for plantation represents a problem, due to limitation of highland. Therefore, medium altitude land (500-700 m asl) could be an alternative. Potato crops in medium altitudes are especially subjected to heat and water stress due to unfavourable conditions of high temperature and water shortage during the growing season, which adversely affect growth, tuber yield and quality. Temperature averages between 23-27^{0}C. According to Rehm and Espig (1991), the optimal temperature for the growth of tubers is 16-18^{0}C. In such hot, dry climates the demand of water will increase. Therefore, watering plays an important role to supply water need. In addition, it is also needed for reducing the temperature.

Potato is sensitive to water deficiency and has a shallow root zone. Potato roots are not vigorous and seldom penetrate in hard soil layers below plow depth. Even without restricting layers, potato plants absorb most of the water from a surface not deeper than 30 cm of soil (Trout *et al.,* 1994). Thus, interval irrigation plays an important role to supply water requirement of the potato during plantation.

Besides watering, plant nutrients influence yield and quality of tubers. Therefore, supply of nutrients must be adequate. Next to nitrogen, potassium is the mineral nutrient required in the largest amount by plants. Potassium is necessary at medium altitude due to its positive effect on the growing process and increasing its resistance to environmental stress. When plants are under water stress, potassium may increase drought tolerance of plants by

accumulating proline, which helps to retain water by lowering the osmotic potential and maximizes root permeability to water (Walingford, 1980). Therefore, potassium fertilization is neccesary in order for tubers to grow well in stress conditions.

Quality is an important factor influencing consumer preferences and saleability of potatoes. Potato quality depends on physical, chemical and biochemical characteristic of tubers. In general, tubers must be uniform in shape and size, unmarked skin, firm flesh and must have shallow eyes. Tubers should also have good cooking and processing properties. Starch, protein, reducing sugar and mineral content are some of the chemical properties determining tubers quality. The diverse of physical, chemical and biochemical characteristic of the different cultivars determine to a large extent its final use. (Lisinska and Leszczynksi, 1989).

Some cultivars are adapted mainly for cooking due to their firmness and pleasant flavour. Cultivars with high level of dry matter find an ample use in the starch industry, whereas large tubers are needed for french-fries and chips production. These tubers should have a low content of reducing sugars to minimize the *maillard* reaction during frying (Kaaber *et al.,* 1995). Processed tubers should have an attractive and acceptable color, desirable texture, good flavor and a relatively long shelf life (Talburt and Smith, 1987).

The objectives of this research were to study the utilization of medium altitudes land to strengthen food security program and to investigate the effects of water supply and potassium fertilisation on yield and potato tuber quality.

Material and Methods

The material is potato cultivar Granola, it is a well adapted cultivar to the intensive cropping system of the highland. It has an average of growing period of 90 days.

The field experiment was conducted in Jatinangor, Bandung, Indonesia, from May to August 2000, at a medium altitude of 754 m asl. It is situated in $6^0 55'$ degrees south and $107^0 20'$ degrees east. Weather data for the growing season is shown in Table 1. Data was obtained from the Meteorological Station in Jatinangor.

The treatments were three water regimes (watering every 2 (A1), 4 (A2) and 6 (A3) days) and three levels of potassium application (KCl dosage: 50 (P1), 100 (P2), and 150 (P3) kg/ha). Application of water regimes was 60 l per row by furrow irrigation. Cultivar was planted by hand with a space of 50 cm and 50 cm within a row in ultisol soil consist of 45% clay, 35% loam and 20% sand. Each plot consisted 9 rows of 5 m length and 1 m width, and was initially irrigated uniformly during cultivation. KCl used as potassium source as the farmers do.

Table 1. Weather conditions in Jatinangor between May and August 2000

Weather condition	Data
Maximum temperature (^{0}C)	28
Minimum temperature (^{0}C)	17
Average temperature (^{0}C)	23
Precipitation (mm)	1.22
RH (%)	76
Soil temperature (^{0}C)	26

At harvesting, tubers were analyzed and the rest of samples were freezed dried in a vacuum freeze drier unit (Edwards High Vacuum Int., England), for four days. Freezed-dried material was milled. Besides yield, quality parameter determined were: dry matter content (EAPR methods), blackspot susceptibility (McNabnay *et al*., 1999; by spectrophotometer) and after cooking blackening (Putz and Weber, 1993; by colourmeter). The experiment used a completely randomize design arranged by factorial with three replication. Data was analysed using 'Sigma Stat' statistical software version 2.0 (SPSS Inc. Chicago, USA, 1997).

Results and Discussion

The results of this research, namely yield, dry matter content, black spot susceptibility, and after cooking blackening were summarized in the Table 2.

Yields

Potato yields more food per ha than any other crops. The average yield of the three potassium treatments of Granola was higher (p=0.002) by A1 (12.68 ton/ha) than A2 (7.53 ton/ha) and A3 (7.04 ton/ha). The results showed that yield decrease by low water supply, since potatoes are sensitive to water deficiency due to their shallow root system. The results of these investigation agree with finding of Delgado *et al.* (2001). These authors found a yield decrease of tubers by potato plants grown under drought stress. Talburt and Smith (1987) found that a evenly water distribution in the soil during plant growth has a positive effect on yield, whilst water excess and long intervals between watering can decrease it.

Watering at medium altitudes also acts as cooling agent. The optimum temperatures for the growth of tuber are 16-18^{0}C (Rehm and Espig, 1991), whilst the average temperature in medium altitude is 23-27^{0}C. Apparently, Granola is better adapted to highlands, Kusmana and Chujoy (1999) obtained 26 ton/ha of Granola tubers planted at 1,400 m asl in West Java. The same cultivar yielded 48% less when planted at medium altitude by A1 and P3.

Dry matter content
        Dry matter is one of the important characteristic of tuber quality. The yield of processed potato depends on the DM of raw stock. Potato tubers is a storage organ and starch is the main material stored. Starch is synthesized in the plant from glucose formed in the leaves as product of photosynthesis. Starch constitutes 65-80% of the DM of the tuber. Starch contents and its physical, and chemical characteristic are not only strong associated with various parameters involved in the quality of processed products but they also dictate operational conditions for processing (Talburt and Smith, 1987).
        The dry matter content of the tubers ranged between 14-17%. Within water regimes, A3 resulted in tubers with higher Dry matter (p=0.003) than A1 and A2. Potassium had an effect (p=0.016) to Dry matter. The highest Dry matter content was achieved by P1.

Table 2. Result of investigation of potato cultivar Granola grown under different water regimes and levels of potassium fertilization.

Parameter	A1P1	A1P2	A1P3	A2P1	A2P2	A2P3	A3P1	A3P2	A3P3
Yield (ton/ha)	11.55	12.82	13.68	7.30	7.06	8.21	6.55	6.93	7.63
Dry Matter (%)	16.27	14.17	15.34	16.49	15.40	17.46	14.57	15.12	14.57
Blackspot Susceptibility (AU_{475})	0.64	0.74	0.67	0.63	0.67	0.59	0.66	0.75	0.71
After Cooking Blackening (L value)	64.70	73.20	67.50	72.50	71.90	73.50	74.40	75.10	74.80

Notes: A1 = watering every 2 days; A2 = watering every 4 days; A3 = watering every 6 days; P1 = potassium fertilization 50 kg/ha; P2 = potassium fertilization 100 kg/ha; P3 = potassium fertilization 150 kg/ha

        According to Mosley and Chase (1993), Granola which had DM contents less than 18%, can be classified as low. These cultivars could be used as vegetable potato, salads or canning. Tubers for chipping must have Dry matter higher than 18% (Mosley and Chase, 1993). When the cultivar Granola was planted in highland in Indonesia it had a Dry matter of 18% (Sahat *et al.,* 1998), which was 14% higher than when this cultivar was planted at medium altitudes. Dry matter was affected by the interaction of watering and fertilizer (p=0.008). Water supply during plant growth affected tuber Dry matter. The results showed that the highest Dry matter by Granola was obtained by watering every four days and 150 kg/ha potassium fertilization.

Black spot susceptibility

Black spot (Total Oxidative Potential) is an internal discoloration of potato tuber caused by a sequence of biochemical oxidation which is initiated by a mechanical injury. It may occur during harvesting, transport, storage, and processing. Black spot formation may divided into two stages. The first constitutes cell disintegration, resulting the liberation of polyphenol-oxidase (PPO) from its subcellular compartments, and the second is formation of black spot as a result of the biochemical oxidation reaction between PPO and phenolic substrates (Stevens and Davelaar, 1997).

The value of measurements represented the potential of tubers to discoloration. Within potassium level, P3 had the lowest value compared with P1 and P2, Results of this investigation agreed with findings of McNabnay, *et al.* (1999), that potassium deficiency increased black spot susceptibility. Application of watering every four days and 150 kg/ha potassium fertilization could minimize black spot susceptibility of Granola.

Besides chemical and biochemical aspects, the physical aspect of tubers also influenced the black spot susceptibility. The physical aspect included among others cell wall strength, cell flexibility, tuber turgor and cell sap viscosity.

After cooking blackening

After cooking blackening occurs after boiling, whereas tubers base or apices discolored to bluish gray or black. ACB has no effect on flavour or nutritional value, but it imposes an unattractive aspect to the tuber. It appears first to the greatest degree just under the skin and the stem end of the tuber and decreases in intensity toward to the apical end. After cooking blackening is due to the formation of a dark-colored complex of ferric iron and an ortho-dihydric phenol, probably chlorogenic acid (Talburt and Smith, 1987). The brightness value of all investigation were lower than 76.5, based on Putz and Weber (1993) recommendation, all analyzed sample had a very high ACB. Therefore, Granola was not suitable as a table potato. Application of watering every six days and 100 kg/ha could slightly minimize after cooking blackening.

Conclusion

The yield and dry matter of potato tubers cultivar Granola grown in medium altitude in Indonesia was significantly adverse affected, the reduction on yield and Dry matter was 48% and 14% respectively, compared with cultivation in highlands. Water supply and potassium fertilization have an important influence on yield. The highest yield was obtained by watering every two days and 150 kg/ha potassium fertilization.

Based on dry matter, the tubers could be used as salads, vegetables or canning, but not for chipping industry. The highest dry matter by Granola was obtained by watering every four days and 150 kg/ha potassium fertilization.

Granola was not suitable for table potato, since they had high after cooking blackening and application of watering every six days and 100 kg/ha could slightly minimize after cooking blackening.

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WHOSE FOOD IS SECURED? A CASE OF COMMUNITY-BASED CONTRACT REFORESTATION IN THE PHILIPPINES

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Abstract

Social forestry reflects one system of interaction between man and his physical environment. It assumes a more participative way of forest management by users of forest products. In this paper, one approach to social forestry known as the community-based contract reforestation (CBCR) is examined to determine its effects on the socio-economic condition of the intended beneficiaries who are 'would be' forest protectors and managers. After three years of implementation, the author conducted a project assessment study on CBCR in the province of Negros Oriental.

Three different types of contracts were awarded through CBCR program: the local government units, non-government organizations and family-based contractors. Awarding of contracts under CBCR is viewed as politically motivated. For the province of Negros Oriental, nine municipal mayors have acquired 66% of the total budget cost. Based on the working guidelines for contract reforestation, political officials such as municipal mayors do not fall under the classification of any contractor yet have acquired the biggest share of the budget by representing the local government units. Non-government organizations are given 20% share of the budget and the family-based contractors who are the target beneficiaries and should be given the largest share based on the guidelines, has acquired the least share of only 12%. Consequently, those who received the biggest financial support have developed large area of forest plantations and those who were given limited budget developed a small area. Further investigations revealed that plantation areas developed by the local government units are privately owned by the municipal mayors or their relatives. They are now maintaining hundreds of hectares of timberland worth millions of pesos. Though the family-based contractors have demonstrated efficient management of the small plantations they developed, still they could not harvest the fruits of their labor due to changes in forestry policy in the country. The forest land management agreement (FLMA) supposedly assured them of the ownership and the right of the trees they planted and maintained, but the instrument becomes invalid after 10 years when the trees are ready for harvest.

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Introduction

The rapid forest depletion and unsustainable agroforestry production in the uplands due to indiscriminate logging and excessive exploitation of forest resources significantly impelled the Department of Environment and Natural Resources (DENR) to develop a systematic program in the management and utilization of forest resources. While it is the main concern of the 25-year Master Plan (1986-2000) for forestry development to deal with the entire range of forestry affairs, it addresses the issue of reforestation as a matter of highest priority because of the existential economic benefits derived from profitable investment in forest plantation. The plan projected an estimated forest plantation coverage of about 2.9 million hectares and generated about 2.5 million new jobs for approximately 8 million upland settlers in the country (NFP Bulletin, December 1990). In the province of Negros Oriental, the site of this study, a total amount of 18 million pesos was allocated for forest plantation establishment in approximately 1,095 hectares of public and private lands in selected reforestation sites. Reforestation activities were undertaken in close collaboration with the three types of community-based contractors, namely; 1) the local government units (LGUs), 2) non-government organizations (NGOs) and 3) family-based contractors. Nine LGUs, each represented by municipal mayors, three NGOs and seventy-seven family-based contractors were awarded the contract for comprehensive site development in 1989. This paper will attempt to discuss the effects of CBCR on the social and economic condition of the beneficiaries after three years of implementation and its overall impact 10 years thereafter.

The Process of Project Implementation

Awarding of contracts during the 1989 CBCR can be viewed as politically motivated. This was obviously demonstrated by looking into the background of negotiated contractors. Nine municipal mayors acquiring 66% of the total project cost for the province is a clear indication of a bias negotiation. Per working guidelines for contract reforestation, the municipal mayors do not fall under the classification of community contractors. An officer of the Department of Environment and Natural Resources (DENR) claimed that the inclusion of LGUs in CBCR projects was the result of a negative attitude of the target project takers towards the program. Ideally, community organization is a precondition before CBCR starts its operation. However, in the actual project implementation, this basic aspect was mostly neglected. As a result, people were unprepared to accept the project. The lack of knowledge on the mechanics of contract reforestation then led to further confusion of the local population. Moreover, intended beneficiaries were upland people with low level of

understanding with respect to legal matters. For them, to enter into a written contract is a big deal which could not be taken for granted.

Awarding of contracts to three NGOs and seventy-seven family based (FB) contractors was legitimate. However, these two groups acquired only 34% of the total project cost; 22% for the NGOs and 12% by FB contractors. LGU and NGO contractors entrusted the management of the project to hired managers and/or supervisors. Most of them are not based in the community therefore their knowledge about the condition of the community where the plantation is situated was very limited. There was no attempt made by the management to identify and prioritize intended beneficiaries in the process of hiring laborers. Most of these laborers came from the lowlands and who were not the intended beneficiaries.

Obviously, for LGU contractors, quantity counts most. The more people hired the better for it helped boost the mayors' political standing in the community. Hence, instead of hiring one laborer and paying the mandated daily wage for one, three or four were hired and the equivalent wage of one person per day is being divided among them. The contractors claimed that they helped a lot of people this way. They further maintained that doing such is a remarkable accomplishment considering the number of people employed in the project. Contractors did not take into account the poor wages the laborers received. Furthermore, these laborers were virtually deprived of opportunities working in high paying jobs outside of CBCR.

Due to lack of assurance regarding ownership of the trees planted, intended beneficiaries were motivated to work in forest plantations for some amount of money paid to them. Their situation is very similar to the *sacada* workers in sugarcane plantations. Laborers are paid in accordance to the quantity of seedlings planted and/or area cultivated. The second and third year of project operation were mainly devoted to maintenance and protection of forest plantation. During this period, laborers were mostly paid on a daily basis. Sporadic releases of funds for operation were apparent starting in the second year. This situation had created an adverse effect on the workers since salaries and wages were often delayed. Those who were seriously affected expressed their anger and frustrations by burning some forest plantations. After 3 years of project operation, there were approximately 2 million surviving trees (*gmelina arborea*) in a total of 986 hectares of forest land. People called it a paper tree. It is fast growing and grows in any altitude and poor quality of soil.

Effects of CBCR after Three Years

Financial support of CBCR program runs for a period of three years. To generate income for the upland population is the main objective of the project. Does it really affect the economic situation of these people? Compensation derived from forestry related activities is an important benefit

that CBCR has given to the farmer beneficiaries. However, the amount received during the 3 year project duration (5,000 pesos on the average) is very irrelevant. This is barely 2,000 pesos per year. Worse is that, after the termination of the project, half of the workers have unpaid wages. Community organization was neglected by the contractors, hence relevant matters related to project implementation were missed by the intended beneficiaries. The Forest Land Management Agreement (FLMA) which is the backbone of the program was not fully understood. Hence, beneficiaries were not secured of their role as forest managers.

Employment and income derived from forestry-related activities are short-term effects of the program. Respondents also considered other factors affected such as community organization, participation, enhancement of knowledge on the benefits of the trees, protection and maintenance of forest plantation, peace and order condition. Farmer beneficiaries have a positive attitude towards all factors except peace and order situation. It implies that the presence of insurgency in the area was not checked by the intervention of CBCR program.

Financial support on forest plantations did not stop after three years. The family-based approach continues to operate and is open to those who own 5 hectares or more land. With the strict implementation of the Comprehensive Agrarian Reform Law (CARL) nationwide which covers all types of land except for forest lands, many big landholders opted to convert their lands, largely sugar lands into tree plantation. Since the support services of the program are channeled through NGOs, a lot of NGOs spurred up, most of them 'fly by night' or 'ghost' organizations. For some years, tree plantation became a big business as well as a means to sidestep the agrarian reform law. This bears both negative and positive effects. The drawbacks are; 1) a lot of tenants were deprived of their right to the land they are tilling for many years, since sugar lands are converted into tree plantations, 2) sugar production in the province decreases, and as a consequence, 3) many sugar workers are out of labor. The positive effects are; 1) increase in forest plantations, 2) upgrade ecology, and 3) increase supply of timber.

Impact of CBCR after Ten Years

During the last 3 years, massive harvest of trees in the plantations is apparent. But, the questions are who harvest the fruits of the labor of the upland folks and whose program is meant to upgrade their living condition? Of course, they are those who own the land where the trees are planted at the government expense- the municipal mayors and other private big landholders. The project has no impact on the socioeconomic situation of the intended beneficiaries aside from their knowledge on how to plant and maintain the trees. However, they could not apply this knowledge on their own benefit since they don't have land

for tree plantation. Most of them utilized their know-how by working as hired laborers in private plantations.

The project has great impact on the area of tree plantations as big landholders opted to plant trees than to offer their lands for voluntary option to sell under the comprehensive agrarian reform law. In the province, large sugarcane plantations were converted into tree plantations. As a consequence, temporary employment of laborers in planting and maintenance of trees in these plantations are apparent.

Prices of timber are significantly affected by the increase in supply of forest products. *Gmelina arborea* species is currently sold at 18 pesos per board foot, the cheapest of all timber available in the market. In terms of quality, it can vie the timber products which are imported from Malaysia. Consequently, furniture shops are sprawling throughout the province, since steady supply of cheap wood products is well assured.

Conclusion

The 1989 community-based contract reforestation program (CBCR) has indeed brought some changes in the physical and economic environment of the province 10-13 years after. Effects and impact of the program are not visible at the household level. Household members who are identified as the intended beneficiaries and are presumed to gain the most benefits were only used as the means to get the project and an instrument to establish the plantations. Temporary employment as hired laborers in the plantations does not help augment their living situation in fact, in some cases their employment has held them back from being employed in a much better paid labor. After 10 years when trees are harvested, the multipliers effect of the program is evident. Large track of lands, particularly sugar lands are converted into tree plantations for two main reasons; the assurance of the economic benefits derived from the sale of timber, and the retention of the land. Forest and tree plantations are exempted for distribution to tenants under the comprehensive agrarian reform law. To sum up, it gives us the impression that the program was implemented to maintain the status quo of the rich and the landed. Giving employment to the intended beneficiaries is just a mere dole out.

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SPECIAL PROGRAMME FOR FOOD SECURITY AS A CONCEPT FOR ALLEVIATE RURAL POVERTY

Entun Santosa

Abstract

The Special Programmed for Food Security (SPFS) was launched in Indonesia in year 2003 to alleviate rural poverty and food security as a response of declining agriculture production. The project was located in 10 farmer groups in 6 villages, district of Langensari Banjar, West Java province. The method used was Rapid Rural Appaisal (RRA) with Participatory Rural Appraisal (PRA) approach and continued with Focus Group Discussion (FGD).

Selection of the farmer groups was based on RRA and workshop conducted with the farmers. The selected farmer groups were those in poor food security condition with only 6 to 9 months out of 12 months in safe condition. The total amount of income per household per year from several activities both on and off farm was only US $353.05/HH/year. This income was classified as poverty.

SPFS Indonesia in cooperation with Padjadjaran University developed Farmer Group Development Plan (FGDP) for problem identification. Realistic, reliable and applicable programs were then developed and implemented. Department of Agriculture received fund from Food and Agriculture Organization. In kind fund will be given to the farmers and than revolved to others farmers within the members of the group.

The project has been assisting farmer groups in identifying their needs and making economic calculation up to Internal Rate of Return (IRR). As a result, the farmer groups received 103 cattle (IRR 0.40), 36 goat (IRR 0.40), 3,020 chicken (IRR 0.54), 1,360 duck (IRR 0.40), 18,650 gurami fish (IRR 1.05). agricultural inputs (US $ 25,105.88), 16 hand tractors (IRR 0.60) and 15 water pump (IRR 0.06). The farmers who received the revolving fund were obligated to attend the farmer field school to improve their knowledge and strengthen the farmer groups institution.

Key words: farmer group, food security, alleviate, rural poverty

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Introduction

Background

The Special Programmed for Food Security (SPFS) was launched in Indonesia in year 2003 to alleviate rural poverty and food security as a response of declining agriculture production. The project was implemented in six villages: Bojongkatong, Kujangsari, Langensari, Muktisari, Rejasari and Waringinsari. The population of the villages are between 4,927 (Muktisari) and 9,386 (Kujangsari). Technical irrigated land is found in all sites. Rainfed land and fishpond/brackish water are found in Rejasari, Waringinsari and Langensari. Upland yard/garden is only found in Rejasari. Farming is the major occupation for household in every site. The project was located at the altitude $\pm$ 16 m above the sea level. The average temperature was in the range of $27 - 31^{0}C$ with the rain intensity of 1,900 mm per year.

Most of the farmers sold their agricultural products directly after harvesting due to the urgent needs of fulfilling family consumption. At the end the farmers fell to the poverty cycle (attachment 1). The farmers were generally just able to cover the needs of food for nine months in a year so that in three months the farmers stayed in "dangerous" food condition. To fulfill the needs for the rest of the months (three months), most of the farmers did extra jobs in-out of agricultural field or borrowed money from farmers organization.

Special Program for Food Security (SPFS) was launched in Indonesia as a response to declining performance of agriculture and food security as impact of economic crisis since 1997; as well as, drought related to El Nino. The overall objective of SPFS is to strengthen food security, revitalize the rural economy and alleviate rural poverty in order to enhance economic and nutritional well being. This objective will be achieved by securing sustainable increases in productivity of major food commodities, expansion of cultivation in terms of new types or varieties of crop, diversification, and promotion of agribusiness and other post harvest value addition activities. These activities will be undertaken with full participation from local communities such as farmers organization; as well as, mobilization of group and community resources.

Langensari is a district considered to be included in SPFS program with the hope to improve the knowledge, skill, and facilities in agricultural and non agricultural activities that in turn will be able to overcome the poverty through empowering the farmers.

Problems

There are several problems faced by the farmers in the activities such as capital, water distribution, soil fertility, agricultural workers, knowledge and skill. For more detail, it's described in three problem analysis (Attachment 2):

a.   Capital

Capital is an important factor in farming activity. Meanwhile, the farmers of Langensari have a weaknesses in this case. The capital is needed to buy some agricultural input such as a good quality of seed, fertilizer, pesticides, and the cost for workers. In a limited capital, the farmers will minimize the quantity and quality of input that the impact will decrease plant productivity. The problem of capital is influenced by several factors including the daily basic need, education fee of their children, souvenir for celebration, etc.

b.   Water Distribution

The sources of water for rice field provided by an irrigation with the distribution system is still not well managed. As the result, there are some field can't be watered. This problem arises firstly because there are sedimentation in the irrigation drain which disturb the water flow, and secondly because a bad role of water user association in managing irrigation. Such a bad water distribution causes farmers to lose the chance to cultivate the land and in addition the farmers can not start the planting at the same time. As the impact, the problem of pest and diseases will arise and in turn, will decrease plant productivity.

c.   Soil Fertility

The intensive use of land (three times per year) as well as anorganic fertilizer have caused the decreasing of soil fertility in Langensari. The Residue of anorganic fertilizer and synthetic pesticides increase the soil acidity in the rice field to the level of pH 5.1 – 5.3. Such level of acidity will directly decrease the productivity of paddy. Actually, this problem can be overcome with the using of organic fertilizer such as green manure, which the source can be found abundantly in this location. For this purposes, the farmers should increase the knowledge on the using of organic fertilizer as well as botanical insecticides.

d.   Agricultural Workers

The most crucial need of workers is during the soil tillage before the planting. Today, the amount of the workers is very limited, beside many of them are in the age more than fifty. To solve this problem the farmers of Langensari try to use hand tractor. Unfortunately, the number of hand tractor is still limited so it can not cover all of the land. The distribution of water for rich field that is still unmanaged well makes the problem worse and worse because the using of hand tractor depends on the water availability.

Objectives

The objectives of this program is to improve farmers income (from US$ 353.05 to US$ 823.53/HH/Year), irrigation system, paddy productivity (from 3581 kg/ha to 4,410 kg/ha), and the role of farmers organization.

Methodology

Methodology of this project was Rapid Rural Appraisal (RRA) with Participatory Rural Appraisal (PRA) approach and continued with Focus Group Development (FGD) (Kusnaka, 2000)

Profile of Langensari district

Economically the average income of members of farmer group is not enough for fulfilling the minimum requirement of daily basic needs. The current average income of household in the group is US$ 353.05 (Table. 1) per year with the burden ± 4 people per family. This income is earned from two main sources; those are farm activities and non farm activities.

The ownership level of land area in farmer group in Langensari is very limited that is 0.166 - 0.610 ha/farmer. In addition, the education level is also not too good because most of them just graduated from elementary school.

There are several community groups exist in the village, for instance, Farmer's group, Water User Association (WUA), Village Unit Cooperative, Youth Club, Women Club/Arisan, Religious club/Yasinan, Saving and Borrowing, and Agricultural processing club. The participation of households at farmer's group, rural youth group, women group, religious group and saving group are dominant at project site.

Table 1. Existing condition of farmer groups in Langensari

No.	Village/Farmer Group		Productivity (kg/ha)		Food Security Status (month/year)		Income ($/HH/year)		Total Income ($/HH/year)
			Paddy	Secondary Crop	Safe	Crisis	On Farm	Non Farm	
	Desa Waringinsari								
1	Tunas Harapan	13.7	4,178	700	9	3	229.99	103.23	333.22
2	Karya Nyata	24	4,200	670	6	6	170.78	27.23	198.01
3	Tunggak Semi	10	4,200	660	9	3	362.82	67.65	443.47
		4	2,800						
	Desa Rejasari								
4	Karang Sari	15.5	3,100	700	6	6	210.18	42.72	252.90
5	Bagus Santri	20	2,800	700	6	6	224.75	81.39	306.14
6	Tunas Mekar	8.4	4,200	700	9	3	160.03	50.90	210.93
	Desa Langensari								
7	Muji Lestari	14	4,200	700	8	4	246.05	252.10	498.15
		23	2,800						
	Desa Muktisari								
8	Karya Sadar	8.4	4,200	630	9	3	153.86	176.91	330.77
	Ds.Bojongkantong								
9	Sri Murni	10	2,800	600	9	3	167.98	432.47	600.45
	Desa Kujangsari								
10	Sri Rahayu	43	3,500	600	6	6	160.00	209.56	369.56
Total		194	42,978	6,660	77	43	2086.44	1444.19	3,543.60
Average		16.16	3,581.5	666	7.70	4.30	208.64	144.41	353.05

Note: 1US$ = Rp 8,500.-
Source: LBDS, 2002

Project Implementation

Swot Analysis

       The discussion based on Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis including efforts that had been done to overcome the constraints. The following table is proposed strategic and ways to ensure sustainable of the project as the logical thinking as follows:

Table 2. Project Implementation Strategy regarding SWOT Result

Internal	Internal Factors	
External	**S T R O N G** 3,0 2,0	**W E A K** 1,0
H I G H 3,0 ... 2,0	**Integration Strategy** - Strengthening business management - Increase market shares Improve quality of agricultural products - Increase economic of scale - Higher technologies implementation improved farm technologies - Increase market accessibility	**Diversification Strategy** - Diversification of farm productions - Improvement water control distribution systems - Conduct field demonstration sites of improved farm technologies - Increase extension & guidance to product diversification - Intensification integrated farm productions - Increase post harvest activities and promote value added
L O W 2,0 ... 1,0	**Growth Strategy** - Modernize irrigation/distribution system - Facilitating integrated farm management - Increase accessibility to Financial Inst. - Increase extension activities in integrated farm management - Facilitating Farm cooperatives - Introduction of product diversification - Training in integrated farm management - Employ family labors in farm activities - Increase income through off farm and non farm activities for family members	**Empowerment Strategy** - Increase input availability - Improve agricultural technologies - Construction Irrigation infrastructures - Intensification crop productions - Increase business guidance & extension - Establishment and Conduct FFS - Build transportation infrastructures - Introducing farm technologies - Empowering farmer's groups - Attract FEWs or other support institutions - Establishment of functional WUAs - Facilitating input supply

Community Action Plans

       Community Action Plans (CAP) have been formulated based on organizing of problem in the village with Participatory Rural Appraisal (PRA)

(Suparman, 2000); such as, mapping, transect walk, sketch of land, historical village, seasonal calendar, daily schedule, distribution of food, venn diagram and matrix ranking. Communities problems were ordered to define the priority problems based on criteria: (i) how these problem were felt by most people; (ii) how serious and urgent these problems were and how far these problems make constrain welfare improvement.

These problems were analyzed by communities to know:
1. what cause of problems
2. how far available resource to overcome the problems
3. possible actions to solve these problems. These possible actions were ordered by communities with criteria:
   3.1. how far positive impact to communities income
   3.2. how far these actions have potential to alleviate the problems.

Finally, the priorities actions become community action plan (CAP). The CAP includes:
1. name of activities
2. location of activities
3. volume of activities
4. beneficiaries
5. type of activities (is it a new, rehabilitation or continue)
6. time of activities
7. source and amount of fund and who will be responsible for the activities

The CAP of Langensari are:
1. Training in agribusiness
2. Improving water system and canals
3. Providing additional hand tractor and operator training.
4. Hardening village road
5. Providing rat control equipments
6. Enhancing livestock, handicrafts, and craftsman

Propose activities

The farmers group propose activities to the Project Officer, the list of activities are mentioned in Table. 3

Table 3. Proposed all activities of farmer groups in Langensari

Langen Sari District	Crops			Livestock				
	Paddy	Mung bean	String bean	Cattle	Goat	Chicken	Duck	Gurame Fish
Extent Area (ha)	63.00	105	1.5	--	--	--	--	--
Productivity (kg/ha)	4,410.00	843	4,300	--	--	--	--	--
Budget ($)	108,156. 38	7,875	112.5	--	--	--	--	--
				--	--	--	--	--
Populations Increament	--	--	--	78.00	617.00	4,248	1,542	18,600
Budget ($)	--	--	--	41,200.00	28,235.26	8,390.58	2,452.64	7,720.89

Considering potential, opportunity and constraints existing in the project locations concerning natural resources, human resources, economical and technological resources, there was an agreement among the farmers to rehabilitate and reset irrigation network institutionally (to strengthen the function of Water User Association); to strengthen the capital structure in the farming; to provide the technology of soil tillage by providing hand tractor; and conducting the practice of farming technology. All of those activities will be implemented through Farmers Field School.

All of those efforts mentioned above are hoped to be able to increase the productivity of paddy in the project locations from average of 3.58 ton/ha to average of 4.41 ton/ha or the increase of about 18.90%; to increase the productivity of mung bean at four project locations from 524.58 kg/ha to 822.50 kg/ha or the average increase of 298.12 kg/ha; and to increase the acreage of planting area at five project locations from 33.3 ha to 85 ha

Because of good management of secondary crops (such as corn, cassava, kind of beans, and so on) and rice farming, there was still enough time left for the farmers to raise cattle and fish. The cattle is hoped to increase the population from 13 to 91 or the increase of 78. The increases are also hoped to occur in goat, chicken and duck (Table 3).

Beside the proposed activity planned by the farmers group, in order to support the success of the project, it is needed, at the district level, 16 hand tractors with the total budget of US$ 33,882.35, IRR 0.60; 15 water pumps, with the total budget of US$ 3,960.00, IRR 0.06. Based on discussion with farmers group, we calculated the need for the factors of production of agriculture, cattle and fishery which are applicable. They are supported by local environmental condition and profitable based on IRR calculation.

Achievement indicator

For quantified proposed activities, achievement indicator should be made as mentioned in Table. 4

Table 4. Achievement indicator of farmer groups in Langensari

Item	Total farmers group income ($) Langen Sari District
Crops	
Previous	84,665.86
Expected	215,825.63
Increment	131,159.75
Livestock	
Previous	5,532.10
Expected	21,956.47
Increment	19,548.58
Non Farm	
Previous	23,572.45
Expected	65,218.45
Increment	24,881.27
Fruit Tree	
Previous	9,623.92
Expected	24,710.68
Increment	5,199.88

The project will be evaluated every year, in the first year, total farmer group's income at Langensari District should be increase from crops US$ 131,157.70; from livestock US$ 19,546.58; from non farm US$ 24,881.27 and from fruit tree 5,199.88.

The performance of increasing production and productivity of rice and secondary crops and the increase of cattle and fish population, in turn, are hoped to be able to increase the farmer's income to the amount of US$ 823.53.-

Conclusion

SPFS is an effective program in alleviating poverty of farmers in the rural areas. The farmers participated fully in the farm planning and it can be

implemented effectively. The irrigation network management was implemented institutionally (through Water User Association). As a consequence, the farmers had enough time to raise cattle and fish. The irrigation network management increased cropping intensity.

Attachment 1:

FLOW CHART OF FOOD DISTRIBUTION IN LANGENSARI DISTRICT OF BANJAR
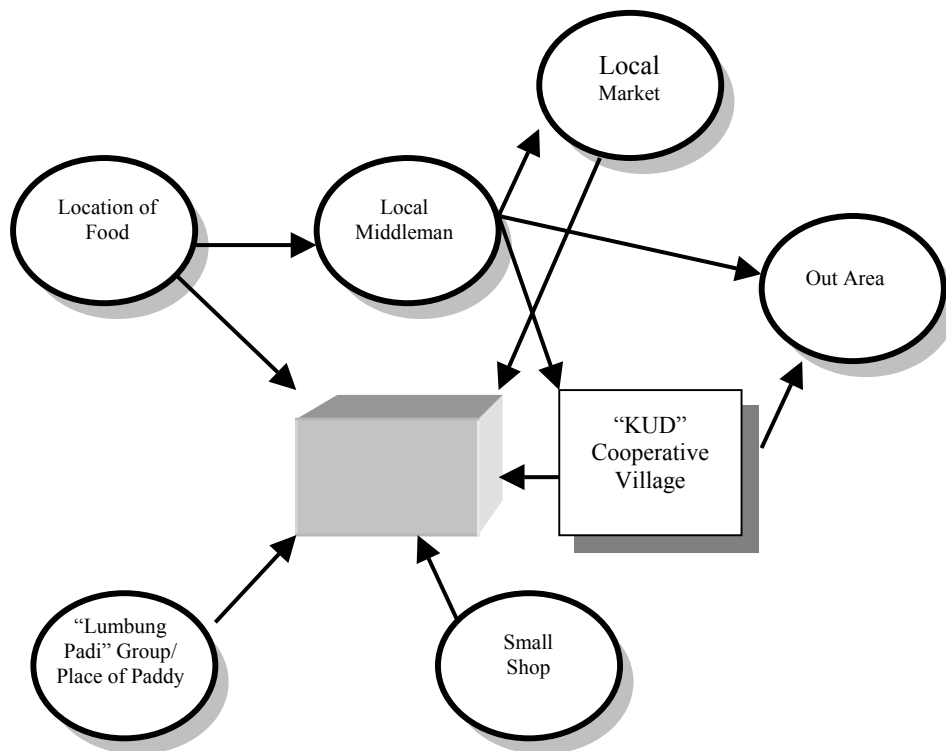
Source: LBDS, 2002

Attachment 2:
Tree problems analysis Langensari district
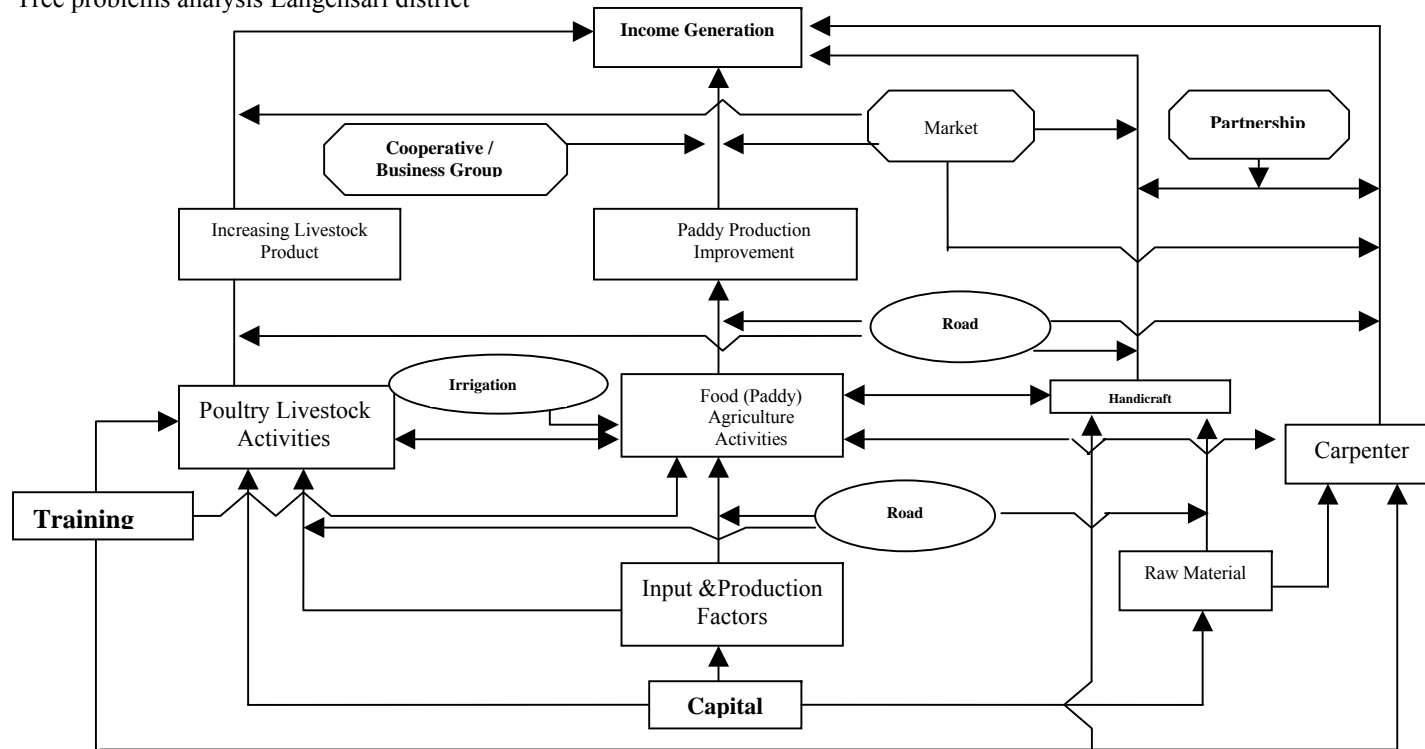
Attachment 3: Regulation to Manage Facilities in Farmer Groups

a. Crops

1. Input Production
- Paddy farmers will receive production input amount of US$ 129.41, for buying seed, fertilizer and pesticide.
- Production input of US$ 129.41 should be paid with rice grain after harvesting.
- Interest rate: 1%/month, total interest rate 5%/season
- Interest rate belongs to the farmer's organization
- Production input will be revolved to other farmers or the other farmer groups.

2. Hand Tractor Rent
- Rent cost: US$ 41.17/ha
- Operational cost: US$ 23.29/ha
  Maintenance cost: US$ 2.05
  Operator: US$ 16.47 (40% x US$ 41.17)
  Fuel: US$ 2.91/ha
  Oil: US$ 0.36/ ha
  Depreciation: 1, 7% x US$ 2,117.64 = US$ 1.49/day
- Contribution from rent hand tractor to farmer group : US$ 300.30/ month
- Farmer proposed to head of farmer group for rent hand tractor
- Head of farmer group will be given instruction to the operator for land cultivation.
- Schedule for land cultivation will be related to location and acreage of the user.
- User of hand tractor must pay for rent based on acreage of land cultivated by cash or rice grain after harvesting.
- If user pays rent by rice grain after harvesting, user has to pay an interest rate amount to 1%/month.

3. Water Pump

a.	Depreciation, Maintenance and operational cost	US$ 10.93/day
b.	Income/day	US$ 18.82/day
c.	Revenue	US$ 7.89/day

4. Water Association
- In dry season contribution from the farmers to the organization for maintain irrigation canal: 70 kg of rice grain/ ha.
- In rainy season contribution of farmer to the village: 100 kg/ ha/year

- Salary for manager of water association: 500 kg rice grain/season
- Regular meeting: once a month
- Members must participate in normalizing irrigation canal before planting season. (labor contribution)
- Manager of water association arrange water flow in irrigation canal to distribute water for paddy field evenly.

a. Livestock

Revolving schemes of Goat

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┌─────────────────────────────────────────────────┐
│                   Revolving I                     │
│               Main Group Member I                 │
│  Note:                                            │
│  The Number of Farmers: 20                        │
│  The Number of Goats: 60                          │
│  Revolving Time: January – October 2003           │
│  The Number of Born Goats: 40                     │
└─────────────────────────────────────────────────┘
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┌─────────────────────────────────────────────────┐
│                   Revolving II                    │
│               Main Group Member II                │
│  Note:                                            │
│  The Number of Farmers:  20                       │
│  The Number of Goats:  60                         │
│  Revolving Time: October 2003 – June 2004         │
│  The Number of Born Goats:  40                    │
└─────────────────────────────────────────────────┘
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┌─────────────────────────────────────────────────┐
│                  Revolving III                    │
│               Main Group Member III               │
│  Note:                                            │
│  The Number of Farmers: 20                        │
│  The Number of Goats:  60                         │
│  Revolving Time: June 2004 – February 2005        │
│  The Number of Born Goats:  40                    │
└─────────────────────────────────────────────────┘
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┌─────────────────────────────────────────────────┐
│                  Revolving IV                     │
│               Main Group Member IV                │
│  Note:                                            │
│  The Number of Farmers:  20                       │
│  The Number of Goats: 60                          │
│  Revolving Time: February 2005 – October 2005     │
│  The Number of Born Goats:  40                    │
└─────────────────────────────────────────────────┘
                          │
                          ▼
┌─────────────────────────────────────────────────┐
│                  Revolving V                      │
│              Neighbor Group Member                │
│  Note:                                            │
│  The Number of Farmers: 20                        │
│  The Number of Goats: 60                          │
│  Revolving Time: October 2005 – June 2006         │
│  The Number of Born Goats: 40                     │
└─────────────────────────────────────────────────┘
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CRITICAL REVIEW ON FOOD SECURITY AND POLICIES TOWARDS POVERTY: THE LIVING EXPERIENCE OF THE INDONESIAN GOVERNMENT

Lien Herlina

Abstract

The food security is defined as the availability of the food as many as possible with a relatively cheap price. The policies set up by the Indonesian Government tend to push an excessive number of imported products with a relatively cheap and better qualities enter the Indonesian market (due to a borderless market). As a consequence of that condition not only the decreasing of the welfare of the farmers – their products in terms of price and quality are not competitive enough - but also it has created Indonesia to become the biggest net importer country for food in the world. It was suspected that the caused of this un-favorable condition was due to the food security policies themselves.

The **main purpose** of the research was to review various policies on food security implemented by the Government and give some feedbacks for better solutions.

The **research characteristic** was exploratory-descriptive research; secondary data, primary data and information were collected through documents, literatures, and depth interviews. Then they were analyzed using the AHP (Analytical Hierarchy Process), Focus Group Discussion and Delphi **Methodologies.**

Findings: most policies regarding food security implemented by the Government were ill-designed then these have resulted in more problems especially to the farmers. Many solutions have been introduced and should be considered by the government in order to stimulate the increase of the food production and in same time produce a better welfare for the farmers, such as: (1) expansion of the area (land) for agricultural activity, (2) increase the scale of enterprise, (3) sufficient budget allocation for agriculture development, (4) decrease the number of farmers, (5) implement pricing policy through entry tariff/tax, (6) self-sufficient on rice in the year 2006, beef in the year 2010, sugar in the year 2012 and milk in the year 2015, (7) become net exporter by adopting technology, (8) develop agriculture and food industries instead of converting agriculture land for shopping mall or housing, and (9) develop food diversification based on **local resources**.

Conclusion: among the nine solutions were introduced, the most realistic and workable ones was to decrease the number of the farmers by stimulating the increase of the agriculture based industries (agro-industries) then the industries will absorb ex-farmer to be the workers, and develop

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food diversification based on local resources.

*The **lesson learnt** can be drawn from the study was sustainable resource management is the key formula for the success of implementation of food security policies effectively in the country.*

Introduction

Food security is defined as the availability of the food as many as possible with a relatively cheap price. The policies set up by the Indonesian Government tend to push an excessive number of imported products with a relatively cheap and better qualities enter the Indonesian market (due to a borderless market). As a consequence of that condition not only the decreasing of the welfare of the farmers – their products in terms of price and quality are not competitive enough - but also it has created Indonesia to become the biggest net importer country for food in the world. It was suspected that the caused of this un-favorable condition was due to the food security policies themselves.

Speaking about "food" in fact it is not deal only with what we are consumed or what we are eating but it is very much related to policies in managing production, distribution and marketing of the food itself. The failure on food policies will not only create economic dependency but it will be able to destroy the whole political governance of the nation.

The **main purpose** of the research was to review various policies on food security implemented by the Government and give some feedbacks for better solutions.

Research Methodology

The **research characteristic** was exploratory-descriptive research – combination of the explorative and descriptive research. Its goal of explorative research was to gather preliminary data to shed light on the real nature of the problem and suggest possible solutions or new ideas, whereas descriptive research was to seek to ascertain certain magnitudes, such as how many policies have been implemented relating to the food security. Primary and secondary data and information were collected through depth interviews and traced some documents, literatures and any other related academic papers. Then they were analyzed using the AHP (Analytical Hierarchy Process), Focus Group Discussion approach and Delphi methodology/Expert Judgments. The whole steps of the research conduct are presented as follows:

| Define the problems and research objectives | → | Develop the research plan | → | Collect data and Information | → | Analyze the data and information | → | Present the findings |
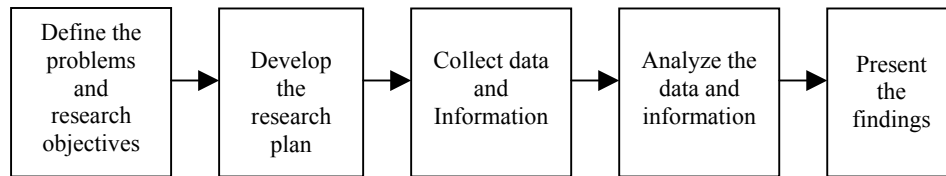
Figure 1. The steps of the research conduct

The Analytical Hierarchy Process (AHP) is the technique to support the decision making process toward alternatives, in this case alternative policies. Questionnaire or question guidance is used as an instrument to collect information from qualified respondents (experts). In this process involve qualitative judgment and also quantitative judgment of the qualified respondents. Qualitative judgment function is to define real problem and its hierarchy, while quantitative ones is for expressing their scoring and preference. To finalize the data processing then the Team Expert Choice software version 9.5 is used and all the data from questionnaires are the input.

Results

Serious efforts had been implemented by the Indonesian government to be able to stabilize economic situation over decades. It started by the end of 1960s. The government was seriously trying to stabilize economic especially in relation to stabilize the price for staple food in which during that time the price was really very high. This situation had caused some political in-stability. With the financial support from several donor countries in term of so called "a very soft loan", government succeeded to present to the people sufficient food in term of quantity. Also, and also government was able to overcome inflation. This success was continued with double efforts to reach what was called "self sufficiency" and political conflict was solved using the repressive approach. At that time, government assured that all political conflict can be overcome through the food availability, food sufficiency and food affordability.

The food security then was built through "Bimas and then Inmas" program with a very tight command system, centralistic, and to strengthen agricultural production and distribution (especially for paddy) government working together with some international agri-business companies to import seeds, fertilizer, pesticides etc. That time, Indonesia was a part of the tremendous change was very famous as "Green Revolution", as it happened in most of developing countries in the world. Problem started to arise when this revolution had caused a very stiff social gap in the villages. The introduction of modern technology to process land and agriculture product, together with the

development of the marketing conduct for agriculture product had increased the number of jobless due to losses of work opportunities. Therefore, although our (paddy) production increased, it did not mean that social welfare of the farmers in the village was also better. This situation was even worse due to tremendous corruption and collusion done by elite group of the village who were acted as government agents.

Beginning the year of 1990s, government policies shifted from food producer-oriented to become food consumer-oriented (especially for rice). This shift was very much related with the stressing of macro-economic change from development of industry with import substitute orientation to the development of industry with export-orientation. This policy change was marked by removing or decreasing some terms of subsidies for agriculture development sector, to support the growth of the industries. Then, this situation had created more problems to the farmers in general; farmer organization and voluntary sector for agriculture had lost their bargaining position at all. This was in contrast with what have stated in the GBHN that food security in the country is formulated relying on variability of the resources, organization/management, and local culture.

To compensate the above change, the Government implements new policy regarding agriculture product price; it was called the floor price policy. As far as the public understanding was concerned, this floor price policy was translated as cheap price policy meaning that whenever harvesting time was due in which supply exceeded demand, government would protect the agriculture product with the floor price. The main goal of this policy was to give farmer more incentive and at the end, their welfare would be increased. However, some study conducted by USAID in the 2000 revealed that although farmer could gain high profit this did not mean that their welfare would automatically be better because all the profit will go only to the farmers who have their own land, for those who rent the land for farming will need a very high cost of production – renting land is very costly - whereas most of the farmers in Indonesia are not land owners.

To support food security and to reach what has been stated in the GBHN, several solutions in relation to increase food production and also to make better welfare for the farmers have come into consideration of some agriculturists, economists and agriculture observers. Among them is Ir. Siswono Yudo Husodo (former Trasmigration Minister Republic of Indonesia) who suggested several policies that has to be implemented by the Indonesia Government such as: (1) expansion of the area (land) for agricultural activity, (2) increase the scale of enterprise, (3) sufficient budget allocation for agriculture development, (4) decrease number of farmers, (5) implement pricing policy through entry tariff/tax, (6) self-sufficiency on rice in the year 2006, beef in the year 2010, sugar in the year 2012 and milk in the year 2015, (7) become net exporter by adopting technology, (8) develop agriculture and food industries

instead of converting agriculture land for shopping mall or housing, and (9) develop food diversification based on **local resources.**

The FGD (focus group discussion) and the AHP technique revealed the first priority for government of Indonesia to be able to reach self-sufficiency and to do the land expansion for agriculture activities. However, for this purpose will need huge financial support and take some time and therefore this policy is not operation-able. The second priority is to develop agro-based industries and food industries instead of converting agriculture land for shopping mall or housing. By developing this industries possibility is opened for transforming farmers to agro-based industry workers. Another priority is to develop food diversification based on local resources; this is partly an implementation of the resource management.

The above proposed solutions are strengthened by the previous experience obtained from the past regime in which that time the government heavily supported the *high-tech industry* and put aside the agriculture development in building up the country economic. Almost all agriculture products were positioned as less-economical value primary product because we did not equip with sufficient technology to process them for better economical value products. For example; in the case of palm oil plantation, government exported heavily in the form of CPO (crude palm oil) only whiles its derivative product; such as, *Oleo-chemical*, the product with a very high price, was exported by Malaysia. As a result from this policy, farmers never experienced to enjoy or to receive the term of trade. Learning from this, it is proven enough that agro-based industries are promising and being prospective to overcome tremendous problems faced by the Indonesian Government as long as Government took them serious and committed to its economic recovery.

Conclusions

Among the nine solutions were introduced, the most realistic and workable program were to decrease the number of the farmers by stimulating the increase of the agriculture based industries (agro-industries) then the industries will absorb ex-farmer to be the workers, and develop food diversification based on local resources.

The **lesson learnt** can be drawn from the study as a sustainable resource management which is possible be key formula for the success of implementation of food security policies effectively in the country.

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THE SIGNIFICANCE OF APPROPRIATE FARMER'S ORGANIZATIONS FOR SUSTAINABLE RURAL DEVELOPMENT AN EXAMPLE FROM PAKISTAN

Winfried Manig

From 1983 to 1994, the German Agency for Technical Cooperation supported on behalf of the Federal Republic of Germany a rural development project to generate income for farming households in Punjab in Pakistan. The target households were either primarily landless or had only very little land at their disposal.

What lessons can be learned for other developing countries from the project in Pakistan? Sustainable development requires a certain economic and social structure in which human beings can make decisions and act. The NGO farmer's organization is such a structure. In the following sections, a few of the conditions and end results will be evaluated that served to make the development concept a success and at the same time sustainable.

The Situation

The Punjab region in Pakistan is dominated by irrigated farming, while at the same time the farming systems are heterogeneous. The main crops are wheat, rice, sugarcane, cotton, oil seeds, and various fodder crops. The fodder is needed for the extensive dairy-animal keeping (buffalo and cattle) which is an integral part of the farming systems. Goats and sheep are raised and kept in the non-irrigated zones of the region.

A large percentage of the farms have only small quantities of cropping land (2–5 acres) at their disposal, and many of the farmers are tenants. The elevated population growth (3% annually) and the lack of alternative employment opportunities outside the agriculture sector in the rural regions have progressively led to an increase in the number of landless households (approximately one-third of the population) and households that own only little land in the form of marginal fields.

The development and introduction of modern yield-increasing forms of technology (high-yielding varieties, fertilizers, pesticides) in the domain of irrigated farming in the 60s and 70s led to considerable increases in yields and productivity (the "green revolution"). This development took place primarily on those farms that possessed an at least average amount of land that was farmed by the owner himself. More and more tenants were dismissed in the wake of the increasing employment of tractors and the mechanization of agricultural, and the land was taken over and cultivated by the owners themselves instead.

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The change led to an growing number of extremely small farms with only marginal fields at their disposal, as well as an increasing number of landless. The landless and very small farms were, in addition, limited in their access to income-increasing forms of technology because in order to be able to employ them, land was a necessary prerequisite. This, on the other hand, resulted in escalated impoverishment in many of the households that were burdened by numerous members if they were unable to find alternative employment in Pakistan or the Arab countries.

The socio-economic conditions in the rural regions in Punjab and other areas of Pakistan deteriorated at an accelerated pace. Additional problems were caused by the catastrophic health care situation, the deficiencies in the school education, and the problem-aggravating lack of any family planning.

In Punjab in Pakistan, dairy-buffalo (and dairy-cattle) keeping is a widespread phenomenon. All of the rural households try to keep dairy animals to satisfy their own subsistence requirements. In order to feed the animals, it is the necessary to crop fodder plants; utilize leftover, fallow fields; or collect fodder along the waysides, from the boundaries between the fields, or along the banks of the canals. Dairy-animal keeping is, thus, labour intensive, but at the same time the productivity is very low.

Milk is regarded as a staple foodstuff in Pakistan, and, therefore, there is a continual demand for milk in the urban centres as well as the rural regions. In the past as a result, small amounts of milk were distributed to and marketed in the cities through a traditional milk-collection system.

In the rural households, milk-buffalo keeping fulfils multiple functions: it is a source of income, a capital investment, risk diversification, a source of draught power, a provider of fertilizer to improve the fertility of the land, a source of fuel, or even the basis for supplying a dowry when children marry. It is estimated that 50% of the households in central Punjab derive a monetary income from buffalo keeping.

The Concept and Plan of the Project

The group-specific effects brought about by the new seed-fertilizer-tractor technology "green-revolution technology" and the resulting changes in the local society led to increasing impoverishment among a large percentage of the rural population in Punjab and other regions in Pakistan. On the other hand, the labour-intensive production of milk presented an enormous income-generating potential because surplus manpower was employed productively. This provoked the idea of introducing income-generating measures to the very small farms and the landless households by promoting the production of milk in a project because the employment of otherwise unemployed or underemployed people in the animal-keeping sector would improve the income and nutritional

situation in the participating households considerably, at least according to the hypothesis upon which the concept was based.

An intensive experimental phase confirmed the hypothesis. However, the positive effects were only discovered if an extensive promotional programme was established along with complementary measures. The package of measures, which were tuned to harmonize with one another (Section 3), was an indispensable prerequisite for achieving the desired effects.

The **overall goal** was, therefore, to increase the income of the small farmers and landless by the general promotion of animal-keeping and, in particular, milk production. In order to stabilize the most important promotional measures and effects and make certain that they would continue to remain sustainable after the project ended, the **project objective** was to create and develop a cooperative organization (capacity building). This cooperative organization was to be a self-help organization designed for the target group (see above) in which the influence of the state authorities was minimized.

On the one hand, the buffalo-milk production offered unexploited potentials that could be taken advantage of if the conditions under, which the animals were kept, were to be improved. On the other hand, there was also an unexploited human potential due to unemployment and underemployment in the rural regions in Punjab while at the same time an acute shortage of land dominated the scene. At the time there was a large demand for milk, especially buffalo milk (which is rich in fats) that could not be met and satisfied in the rural and urban centres.

Promotional Instruments

The following complementary instruments were developed and introduced in order to achieve the development and project goals:

- Measures to intensify the cropping of fodder as part of the succession of crops or on left-over and unexploited land. The most important fodder plants are Egyptian clover and grains.
- Promotion of the collection of fodder along the waysides, along the boundaries between the fields, or along the banks of the canals.
- Improvement of the animal-keeping management (techniques, feeding).
- Creation/development of veterinary services to improve the health of the animals, particularly with respect to the birth of the first calf and the inter-calving periods, fertility, and mortality rate of the calves.
- Measures to improve the access to farm inputs and knowledge concerning animal husbandry techniques, feeding, and fodder cropping (extension services).
- Promotion of small-animal keeping (sheep, goats, chickens).
- Development of a milk-collection and marketing system. The first approach included traditional milk collectors as a measure to create

additional jobs. The project administration organized its own collection system following a number of negative experiences. The milk was processed in modern processing and refrigeration facilities (a milk pasteurization plant) and sold in the cities in small stores and supermarkets.

- Development of a health service for the rural population with health centres and family-planning activities.
- Adult education programmes.
- Special programmes for women in the fields of animal-keeping and social and health services (female village workers).
- Development of a cooperative, two-stage village and union-council level self-help organization for the milk producers. The plan foresaw that this farm organization – called *Idara-e-Kissan* – was to continue the activities after termination of the project as the directly responsible instance.

The project's target groups in a previously defined region of the province Punjab were:

- all of the buffalo and dairy-cow producers: however, primarily the poor animal-keepers that were either landless or had only little land at their disposal.
- consumers in the urban centres.
- project workers and staff members in the villages. The great intensity of the programme led to the creation of many jobs in the villages for workers and staff members (milk collectors, veterinary assistants, male and female extension workers, etc.). When selecting the people for the various jobs connected with the project, priority was given to suitable members of the poor strata in the individual villages.

The Organization of the Project

The Punjab province government's "Livestock and Dairy Development Department" backed and supported the rural development project "Pattoki". The activities were promoted and sponsored in the form of personnel and financial help by the German Federal Ministry of Economic Cooperation through the channels of the *German Agency for Technical Cooperation*.

Subsequent to a short preparatory phase (1982 – 1983), the project was sponsored by the German Agency for Technical Cooperation over a period of eleven years in the following phases:

1st Phase: Implementation of the Project, 1983 – 1986
2nd Phase: Institutionalization of the Activities, 1987 – 1990
3rd Phase   Establishment of the Farmer's Organization, 1990 – 1993
4th Phase: Closing stages and Consolidation Phase, 1993 – 1994

The multiple activities pursued by the complex approach took place in the following subdivisions, or sections of the project:

- Extension section
- Fodder section
- Female section
- Veterinary section
- Marketing Section
- Management section of the main project: which coordinated all of the activities and administered the project.
- The monitoring section was responsible for the permanent evaluation of the work.

The concept behind the establishment and development of a farmer's organization was the creation of an organization which was to continue all (!) of the activities on its own and be directly responsibility after the termination of the support from without. Because of the strategic significance, the project administration was responsible for the establishment of the organization along with the management section.

Two factors were important prerequisites for the establishment of the farmer's organization. On the one hand, the participation of the milk producers had to be ensured and their interest could only be assured, on the other hand, if the organization was attractive to them. To be so, however, surpluses had to be generated to finance the activities. The key economic unit of the farmer's organization consisted of the above-mentioned milk pasteurization plant and the marketing facilities. This economically self-sufficient and viable unit were necessary as the total subsidies from the state had ceased and it was necessary to earn the funds to pay the essential field activities. On the other hand, the farmer's organization was not allowed to make a profit in order not to lose its special status as a cooperative organization.

The farmer's organization (Idara-e-Kissan) is directed by an appointed general manager and professional experts at the head of four departments:

- Field Services
- Milk Processing
- Distribution Department
- Administration

The Field Service Department is the largest department and carries out all of the activities to promote the production and collection of milk.

All of the activities are controlled by an elected Board of Directors. The Board is supervised by elected representatives of the participating milk producers (one representative per village). The members of the Board are chosen from among the representatives of the milk producers. The farmer's organization was officially registered in 1989.

Project Costs and Earnings

The original calculation of the total costs was made on the basis of the real prices in 1981 and was estimated at 19 million German Marks. According to the planning at the time, the following economic success parameters were calculated:

Benefit-costs relation (12% discount rate) 3.70

Internal rate of return, approximately 46%

Through changes in the concept – such as the construction of a pasteurizing and packaging plant for milk and an extension of the duration of the project – the costs increased by approximately 2 million additional German Marks. In some cases, the earnings increased likewise. The author has, however, no new calculations for the total costs, earnings, and success parameters at his disposal. The internal rate of return is in all likelihood lower than the one given above.

Conclusions

The eleven-year project along with the complementary, comprehensive promotion approach considerably improved the economic situation of the target group – farmers with little land and landless farmers – during the duration of the project. The goal was to increase the production noticeably while minimizing the risks. This made participation and cooperation attractive for the target group. Thus, the ***overall goal*** of the project was achieved to make a significant contribution to improving the incomes of the target group.

Despite the conservative calculations during the planning stage, the costs were underestimated and the earnings presumably overestimated. Exact data are, however, not available. It is difficult to understand why a cost-benefit analysis was not carried out after the termination of the project. A so-called "Planning and Evaluation Cell" was foreseen as a division of the Punjab province government's "Livestock and Dairy Development Department." Originally the division was, according to the plan, to also carry out the project evaluation.

Closely connected with the achievement of the overall goal was the development of an integrated, sustainable concept for promoting the keeping of animals which could be transferred to other regions in Pakistan as well. This led directly to the ***project objective*** which was the development and establishment of an appropriate organization that, on the one hand, could continue to carry out the project activities on its own and, on the other hand, could be transferred to other regions.

The farmer's organization (Idara-e-Kissan) was developed and established as a model-organization creating a completely new organizational form in Pakistan. The self-help organization designed for the participating milk producers was placed under professional management and the influence of the state minimized. The professional management is necessary because the milk

processing and marketing activities have to achieve a profit in order to finance the other activities. The membership in the farmer's organization is attractive because the members receive a better price for the milk they deliver, in addition to other advantages. In order to achieve that goal, the management of the organization has to make certain that the milk-processing plant – the technological key aspect of the farmer's organization – continues to run at full capacity.

The farmer's organization contributes significantly to the sustainability of the promotional activities, although it actually only has an instrumental character with respect to achieving the overall goal. This approach, which is completely new in Pakistan, provides the farmer's organization with a value of its own relating to the self-help of the target groups, sustainability, and the activities and transferability of the concept.

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Forestry, Agro-forestry System

EXPLORING AGROFORESTRY SYSTEMS TO ATTAIN SELF SUFFICIENCY: SOME STRATEGIES AND ACTIVITIES

Herminia C. Tanguilig

Abstract

Agroforestry is considered as a basic approach to provision of food and alternative livelihood for upland farmers. In response to this concept, various agencies and institutions have conducted researches/studies on agroforestry systems, and have developed technologies for upland development. These researches/studies conducted range from finding/testing alternatives to unsustainable slash-and-burn agriculture and income generation for uplands; to the promotion of conservation practices. Side-by-side with the innovations to stabilize soil resources is the technology on the use of fast-growing tree species.

The paper explores the agroforestry systems: strategies and activities, identifies the factors influencing adoption of agroforestry systems, and the conditions/imperatives for an agroforestry system development.

Research results of agroforestry system studies published locally and internationally covering the period 1993 to 2001 were considered in the paper. Research highlights of these studies were determined underlining the strategies, activities, and the conditions/imperatives related to development of an agroforestry system; and the factors influencing adoption.

The paper contains the agroforestry systems/schemes developed by various institutions actively undertaking agroforestry projects/researches. These institutions develop, evaluate, and validate sustainable, profitable and acceptable technologies through on-station and on-farm studies/experiences, and develop a methodology for evaluating agroforestry technologies. The methodology for evaluating agroforestry schemes is the result of review of several related evaluation tools.

Since it is necessary to study the upland beneficiaries' perceptions, attitude, and behavior towards the use of improved technologies for any upland development program, the paper also documents the factors influencing adoption of agroforestry systems of three studies.

From the studies considered, it is evident that an approach to rehabilitate badly denuded uplands is the integration of fast-growing tree species and annual crops. Furthermore, fast-growing tree species can

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be planted with agri-crops. The problem of shading and root competition maybe overcome by appropriate use of alley cropping concepts.

For an agroforestry development to be successful, important conditions to be provided include presence of market, availability of financial institutions, provision of information, education and communication, and security of land tenure.

Introduction

Sustainable development stresses the need to strike a balance between environmental protection and economic development. This implies that society's needs and the carrying capacity of ecosystems are satisfied.

One way to operationalize the concept of sustainability is for development projects to be carried out and should alleviate pressure on the natural resource unit. The end goal of these development projects should be to achieve maximum protection of the resource possible while providing for the basic needs of the disadvantaged sector of the community.

At the helm in restoring ecological stability to upland areas, the Department of Environmental and Natural Resources (DENR) is undertaking agroforestry as an alternative to unsustainable upland farming. Agroforestry is the combined production of agricultural crops, forest trees, and/or livestock simultaneously or sequentially on the same unit of land.

For its part, the University of the Philippines Los Banos (UPLB) has been in the forefront of agroforestry research not only in the Philippines but also in the Southeast Asian region for almost two decades now (Lasco, 1997). The UPLB Agroforestry Program (UAP) develops, evaluates, and validates sustainable, profitable and acceptable technologies through on-station and on-farm studies/experiences, and develops a methodology for the effective promotion of agroforestry technologies.

Accordingly, the Farming Systems and Soil Resources Institute (FSSRI) of UPLB has been developing responsive and perceptive strategies to promote sustainable farm development to help improve the farm productivity and income of the small-holder Filipino farmers.

Studies (Vergara, 1987; ICRAF, 1997) increasingly show that improved agroforestry systems are alternatives towards mitigating deforestation, land depletion, and rural poverty. Agroforestry has been popularized among decision makers as a conservation farming solution to sustaining the productivity of uplands. There is enormous demand for sound upland agroforestry technology (Garrity, 1997).

According to Garrity (1997), the astounding array of agroforestry systems in Asia evolved in response to market changes, new technical options, and the inexorable pressure of more people on the land. At present, government

agroforestry programs include not only responding to staple food production problems in the lowlands but also finding a solution for the ecological and poverty crises in the uplands.

Methodology for Evaluating Agroforestry Systems (MEAS)

Several related evaluation tools were reviewed in the formulation of MEAS. The indicators used were soil erosion rate and soil fertility for soil conservation; land equivalent ratio (LER) for productivity; net income, surplus, agroforestry system efficiency ratio (ASER) for farm income; and number of adoptors for social acceptability. The agroforestry system satisfying all indicators was considered "potentially sustainable" (Lasco *et al.*, 1997).

Agroforestry systems

Sloping Agricultural Land Technology (SALT)

In line with the effort to stabilize soil resources on hillslope farmlands, the sloping agricultural land technology (SALT) has been tested and proven to be effective to reduce soil losses. SALT is the use of contour hedgerows of pruned leguminous trees. But the intensive labor requirements to install and periodically prune and maintain the hedgerows limited widespread adoption (Garrity, 1997).

SALT which was developed by the Mindanao Baptist Rural Life Center (MBRLC) is a package of technology of soil conservation and food production that integrates several soil conservation measures in just one setting. Basically, SALT is a method of growing field and permanent crops in bands 4 – 5 m wide between contoured rows of nitrogen-fixing trees and shrubs (NFT/S). SALT is a system where a farmer could plant trees, and at the same time, produce agricultural crops in his hillyland. The upland farm which is devoted to about 40% agriculture and 60% forestry can effectively reforest the hillside and conserve the soil. This "food-wood" integration can also provide sustainably abundant food and income to the hilly land farmers. Its return on investment (ROI) is 196% and its benefit-cost ratio (CBR) is 2.96.

Another innovation to exploit the hedge concept is the use of contour strips of natural vegetation (SNV). SNV provides excellent erosion control with negligible installation and maintenance costs and competition with associated annual crops (Ramiaramanas, 1993) and provide a foundation upon which to build agroforestry-based conservation farming (Garrity, 1993).

Side-by-side with the innovations to stabilize soil resources is the technology on the use of fast-growing tree species. Actually, this is the focus of Asian Multipurpose Tree Species (MPTS) Network with an ultimate goal to further diversity species that are adapted to fire-prone and nutrient-poor grassland environments, forest margins, and sloping infertile farmlands (Garrity, 1997).

From among the MPTS in the study by Calub (1997), B. monandra, G. sepium, and L. leucocephala had relatively good persistence to regular pruning.

Farming Systems and Soil Resources Institute (FSSRI) Technology

The combined used of bio-organic and inorganic fertilizers was proven feasible and profitable in an area characterized with a dry and wet climate, and silty loam soil. The pest management practice which is through pesticidal sprays and furadan granule application at the whorl stage of corn showed no differences with the pest management practices that relies in Trichogramma evanescens releases and detasseling.

Alley Cropping Scheme for Hilly Land Farming in Semi-Arid Zones

The alley cropping package of technology was developed after a five-year conduct of experiments. The technology involves establishment of hedgerows along the contour lines using either Gliricidia sepium or Desmanthus virgatus. Gliricidia hedgerow is established using 2-month old seedlings planted in double row (alternate hills) at a distance of 25 cm between hills. Desmanthus hedgerow is established through seeds, preferably soaked in hot water, at a seeding rate of 10 to 20 seeds per linear meter.

The alleys between the double-row hedgerows are planted with agricultural crops following rice-mungbean-fallow and rice-fallow cropping sequences. The agricultural crops are planted following traditional way. The hedgerows are pruned during planting and the loppings are spread on the cropped alleys (Agustin *et al.*, 2001).

PICOP Resources Inc. (PRI) Tree Planting

Fast growing species such as E. deglupta (bagras), P. falcataria (falcate) and A. mangium (mangium) at 3 x 2m, 3 x 3m or 1 x 10 m plant spacing were planted in marginal or less marginal 2-ha area. These trees are also grown in existing coconut and coffee plantations and are planted for pulpwood lumber, and poles.

Bagras and mangium trees are spaced 1m x 10 m when they are planted with different agri-crops; such as, abaca, ubi, broom, corn, and fruit trees suitable in the area.

A tree seedling nursery with a capacity of 1.8 billion seedlings exists to support seedling needs of farmers. A loan assistance is also made available to farmers as capital for small enterprise or IGP. A farmers' store provides market for farm products which are directly sold to PRI employees.

International Institute for Rural Reconstruction (IIRR) Strategies

The IIRR'S agroforestry activities are being implemented on selected tropical uplands of the Philippines, Ghana-West Africa, Karnataka, India, Uganda, Cambodia, and Honduras.

Considering that people participation remains very critical to ensure the continuous leadership and capability building to effect project continuity and sustainability, the program is basically implemented using a participatory action research strategy. All interventions are focused on the farmer's major problem, soil and environmental degradation. An agroforestry option or set of options is tested in a chosen impact village.

Areas of intervention include improving the agricultural productivity of upland farmers while simultaneously addressing the problems of soil erosion, shortages of timber for construction, fuel wood for cooking, and fodder for livestock.

Corn and Upland Rice in an Alley Cropping System

An approach to rehabilitate badly denuded uplands is the integration of fast-growing tree species and annual crops. The problem of shading and root competition maybe overcome by appropriate use of alley cropping concepts where tree branches are pruned periodically and cut materials are applied either as green manure or surface mulch at planting or during cropping period.

Studies (Gonzal, 1977; Solera, 1997) increasingly show that upland rice and corn can be grown with fast growing tree species (e.g. Gmelina arboria, leguminous trees) in a contour hedgerow system. Strategies under such scheme include lateral pruning every 2 weeks, plowing the alley twice before sowing to eliminate light competition and root competition respectively. A hedge row height of 50 cm is optimum for alley cropping system.

Gabi and Camote (Ipomea batatas) in an Alley Cropping System

From a study which evaluated the potentials of Flemingis (Flemingia congesta), kakawate (Gliricidia sepium), and Sesbania (Sesbania sesban) and camote, it was found out that Flemingia influenced the growth and yield of gabi and camote.

Strategies used includes double hedgerows with a density of 10 seedlings/cuttings per linear meter in an alley with a 5 m width; the tree hedgerows were regularly pruned to a height of 50 cm and the prunings were incorporated to the soil in the alley as organic fertilizer (Baya, 1997).

Factors Influencing Adoption of Agroforestry (AF) Systems

Involving the beneficiaries of any upland development program necessitates study of their perceptions, attitude, and behavior toward the use of improved technologies.

Adopters of AF systems are those who are knowledgeable on the specific provisions of the stewardship agreement; have high level of aspirations and awareness in the importance of trees to ecological balance, and knowledgeable of the interplay of climatic conditions, soil type, and topography of the area (Virtudazo, 1997). In addition, the indigenous cultural communities (ICCS) are generally predisposed towards holistic and sustainably productive resource management practices (Sayami et al., 1997).

Furthermore, according to Sayami et al. (1997), the attitude, perception, farming experience, farm size, land tenure, educational attainment, and social participation are determinants of agroforestry adoption. Critical factors towards adoption are attitude. One way to create favorable attitude towards adoption is to adopt an extension strategy designed to create favorable attitude.

Contrasting the farmer-cooperators and non-cooperators in terms of perceptions, attitude, and behavior towards adoption of agroforestry farming, cooperators have readiness to experiment with the new or improved agroforestry technologies and perceived the old farming methods as needing improvements and should be replaced while the non-cooperators were curious and have the desire to learn more about the technology (Nasayao, 1997).

Some Research, Development and Extension Imperatives

For an agroforestry development to be successful, among the important conditions to be provided include: presence of market areas of agroforestry products within the immediate vicinity; availability of financial institutions to upland communities; provision of information, education and communication; training is an effective approach to motivate and mobilize farmers; security of land tenure; involvement of the farmers and family members in planning and decision-making; use of indigenous system and resources; and the incorporation of income generating projects and livelihood activities in project development.

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MANAGEMENT DER BAUMART DIOSPYROS CELEBICA BAKH. (EBENHOLZ) IN INDONESIEN

Adam Malik

Abstrakt

Diospyros celebica Bakh. ist auf der Insel Sulawesi (früher Celebes) beheimatet und kommt mit anderen kommerziellen und nicht-kommerziellen Baumarten zusammen in Mischbeständen vor. Heute sind viele Ebenholzmischbestände übernutzt und befinden sich in einem vernachlässigen Zustand. Trotz der großen wirtschaftlichen Bedeutung des Ebenholzes ist immer noch waldkundlich sehr wenig über die Struktur, Mischungsform, Konkurrenzverhältnisse, und Wachstum der Mischbestände mit Ebenholzvorkommen bekannt. In der vorliegenden Arbeit wird daher versucht, einen Beitrag zu waldwachstumskundlichen und waldbaulichen Grundlagen für eine ökonomisch und ökologisch nachhaltige Bewirtschaftung von Ebenholzmischbeständen in Sulawesi zu liefern. Die Untersuchungen wurden in Ebenholzmischbeständen, die 20 Jahre lang von Konzessionsfirmen in Mauro und in Mesua in der Provinz Mittelsulawesi intensiv exploitiert worden sind, durchgeführt. Auf einer Fläche von 60 ha wurden jeweils 30 systematisch verteilte klumpenformige Stichproben in beiden Untersuchungsbeständen angelegt. Eine Klumpenstichprobe besteht aus drei Aufnahmekompartiment mit einem folgende Parameter aufgenommen: Lokaler- und botanischer Name, Brusthöhendurchmesser, Total- und Kronenansatzhöhe, Lagekoordinaten, Konkurrenzsituation, Kronenform, Stammqualität, Schlinggewächsbefall und Schäden. Die Stammzahl- und Grundflächenanteile des Ebenholzes im Bestand wurden mit 6,3% und 5,5% in Mauro bzw. mit 4,7% und 2,3% in Mesua bestimmt. Bei der BHD-Klasse $\geq$ 50 cm betragen die Stammzahl und Grundfläche des Ebenholzes 0,4 Bäume und 0,1 m² bzw. 0,1 und 0,02 m². In beiden Beständen wurden keine Ebenholzbäume mit einem BHD $\geq$ 60 cm beobachtet. Voraussetzung für Anreicherungsmaßnahmen sind das Vorhandensein von ausreichend und genetisch geeignetem Saatgut. Daher muß auf bestimmten Flächen eine Anzahl der gut veranlagten Bäume von der Holzernte ausgenommen werden, damit diese zur Blühreife erlangen und Samen mit einer guten genetischen Veranlagung liefern können.

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Einleitung

Die indonesischen Regenwälder weisen eine große Ausdehnung und biologische Diversität auf. Sie sind für die ökologischen, ökonomischen, politischen und sozialen Aspekte des Landes von großer Bedeutung. Offiziell werden sie seit Anfang der siebziger Jahre nach einem indonesischen Konzessionssystem bewirtschaftet und sind eine für das Land wirtschaftlich äußerst wichtige Einnahmequelle. Dabei spielt das Ebenholz (*Diospyros celebica* Bakh.) als ein begehrter und wertvoller Exportartikel eine sehr wichtige Rolle.

Diospyros celebica Bakh. ist auf der Insel Sulawesi (früher Celebes) beheimatet und kommt mit anderen kommerziellen und nicht-kommerziellen Baumarten zusammen in Mischbeständen vor.

Seit Anfang des Jahrhunderts wird das Ebenholz von Privatbetrieben mit Genehmigung der Regierung exploitiert. Heute sind viele Ebenholzmischbestände übernutzt und befinden sich in einem vernachlässigten Zustand.

Die Exploitation erfolgte zunächst nach dem sogenannten "Indonesischen Selektionsverfahren "(Tebang Pilih Indonesia) durch ein Dekret des "Forst General Direktors" 1972. Demnach wurde eine Mindestanzahl der zu verbleibenden Bäumen (Pohon Inti) je Hektar und ein Mindesthaubarkeitsdurchmesser (MHD) zur Sicherung der Verjüngung und nachhaltigen Holzerträge festgeschrieben. Dies galt für alle kommerziellen Baumarten. Der MHD betrug 50 cm BHD und die Anzahl der zu verbleibenden Bäume belief sich auf mindestens 25 Individuen/ha mit einem BHD von 35 cm. Die reservierten Bäume bestanden aus wirtschaftlichen Baumarten, die für den nächsten Nutzungszyklus je nach Waldtypen als hiebsreife Bäume zu erwarten waren.

1980 wurde das Verfahren geändert. Da die wirtschaftlich reservierten Bäume mit einem BHD über 35 cm selten waren, wurde ihr BHD auf 20 cm herabgesetzt. Außerdem regulierte man die Mischbestände von Ramin (*Gonistylus bancanus)* und Ebenholz (*Diospyros spp*). In einem Ebenholzmischbestand, mußten 25 Bäume/ha erhalten bleiben, davon 19 Ebenholzbäume mit einem BHD von mindestens 20 cm.

Ende 1989 ersetzte man das TPI - Verfahren durch das Selektionsverfahren für das Fällen und Pflanzen von Bäumen (Tebang Pilih Tanam Indonesia). Dies legte fest, dass der BHD der Reservebäume für Ebenholz von 20 auf 15 cm und MHD von 50 auf 35 cm herabgesetzt wurde. Die Anzahl der zu verbleibenden Individuen beträgt dann nach diesem Verfahren in einem Ebenholzmischbestand mindestens 25 Bäume/ha. Die Festlegung der Anzahl von Ebenholzbäumen, die als Zukunftsbäume in einem Mischbestand erhalten bleiben soll, basiert nicht auf wissenschaftlichen Erkenntnissen.

Da das Ebenholz, lange bevor die indonesische Regierung die Wälder durch ein Konzessionssystem verteilte, weitgehend unkontrolliert eingeschlagen wurde, wurden Ebenholz- Bestände so stark reduziert, dass *Diospyros celebica* heute zu den bedrohten Baumarten gehört (Tantra, 1983; und Oldfield, 1998).

Ebenholz ist ein sehr wertvolles - und begehrtes Holz. Seine Färbung ist schwarz oder dunkelstreifig mit einer fast metallisch glatten Oberfläche. Durch seine lebhafte und dezent bildhafte Zeichnung gehört es zu einer der attraktivsten Holzarten. Es wurde seit Beginn der menschlichen Kultur besonders beachtet (Gottwalld, 1984).

Untersuchungsgebiete und-Bestände

Die Untersuchungen wurden in Ebenholzmischbeständen, die 20 Jahre lang von Konzessionsfirmen in Mauro und in Mesua in der Provinz Mittelsulawesi intensiv exploitiert worden sind, durchgeführt. Diese Areale wurden 1994 und 1995 in Mauro und Mesua von der Regierungsfirma PT. INHUTANI I übernommen.

Der Untersuchungsbestand in Mauro liegt ca. 200 km südöstlich und der in Mesua ca. 150 km nördlich von der Provinzhauptstadt Palu. Die durchschnittlichen Jahresniederschlagsmengen betragen 2359 mm in Mauro und 2179 mm in Mesua. Die Jahresdurchschnittstempraturen liegen zwischen 26,1°C und 27,3°C in Mauro und zwischen 25,1 und 27,7°C in Mesua. Die Luftfeuchtigkeit ist in den beiden Untersuchungsgebieten fast gleich, sie beträgt 74,7 – 83,1% in Mauro und 77,5 – 89,4% in Mesua.

Untersuchungsmethode

Dichte und Verteilung der Ebenholzbäume in einem Mischbestand sind meist nicht gleichmäßig. Für eine ausreichende Genauigkeit ist ein relativ großer Stichprobenumfang erforderlich. In der vorliegenden Untersuchung wurde eine geklumpte Stichprobe aus quadratischen Probeflächen herangezogen. Obwohl das Ebenholz (*Diospyros celebica*. Bakh.) auf der Insel Sulawesi beheimatet ist, gibt es zur Zeit in Mittelsulawesi sehr wenige Mischbestände mit einem Ebenholzvorkommen, da fast alle Flächen, auf dem das Ebenholz wächst, von Konzessionären bewirtschaftet wurden. PT. Gulat (Mauro) und PT. Sinar Kaili (Mesua) exploitierten rücksichtslos die beiden Untersuchungsgebiete. Die Untersuchungsfläche in Mauro liegt an der Ostküste und die in Mesua an der Westküste Mittelsulawesis. Die Auswahl der Untersuchungsgebiete erfolgte in Zusammenarbeit mit Mitarbeitern der Firma PT.INHUTANI I.

Auf einer Fläche von 60 ha wurden jeweils 30 systematisch verteilte klumpenformige Stichproben in beiden Untersuchungsbeständen angelegt. Der Abstand zwischen den einzelnen Stichproben ist 150 m und die Unterflächen

innerhalb einer Klumpenstichprobe haben einen Abstand von 30 m. Eine Klumpenstichprobe besteht aus drei Aufnahmekompartimenten A, B und C. Im Kompartiment A (2700 m²) wurden an allen Bäumen mit einem BHD ≥ 20 cm folgende Parameter aufgenommen: Lokaler- und botanischer Name, Brusthöhendurchmesser, Total- und Kronenansatzhöhe, Lagekoordinaten, Konkurrenzsituation, Kronenform, Stammqualität, Schlinggewächsbefall und Schäden. Im Kompartiment B (900 m²) wurden allen Bäumen mit einem BHD ≥ 10 cm folgende Parameter aufgenommen: Lokaler-und botanischer Name, Brusthöhendurchmesser, Total- und Kronenansatzhöhe, Lagekoordinaten, Konkurrenzsituation. Im Kompartimen C (300 m²) wurden Bäume mit einem BHD < 10 cm und einer Höhe > 30 cm nach Baumarten getrennt gezählt.

Ergebnisse und Diskussion

Waldmeßkundliche Parameter von *D. celebica*

Die Stammzahlen und Grundflächen betragen für alle Baumarten mit einem BHD ≥ 10 cm pro Hektar 318 Bäume und 21,5 m² in Mauro bzw. 359 Bäume und 25,3 m² in Mesua. Für diese Bäume wurde ein Gesamtvolumen von 338,4 m³ je ha für Mauro bzw. von 389, 2 m³ je ha für Mesua bestimmt. Die Stammzahl- und Grundflächenanteile des Ebenholzes im Bestand wurden mit 6,3% und 5,5% in Mauro bzw. mit 4,7% und 2,3% in Mesua bestimmt. Bei der BHD-Klasse ≥ 50 cm betragen die Stammzahl und Grundfläche des Ebenholzes 0,4 Bäume und 0,1 m² bzw. 0,1 und 0,02 m². Der Volumenanteil beträgt demnach etwa 4% in Mauro und etwa 2% in Mesua an den Gesamten Holzmasse. In den beiden Untersuchungsbeständen wurden keine Ebenholzbäume mit einem BHD über 60 cm beobachtet.

In verschieden Ebenholzmischbestände in Mittelsulawesi stellt Steup (1930) eine Stammzahldichte von 60 bis 340 Bäume/ha mit einem Volumen von 231 bis 584 m³ und davon 60 bis 275 m³ für die Bäume über 60 cm BHD fest. Steup (1935) beobachtete in einigen Ebenholzmischbestände in Mittelsulawesi, dass 90% der Bäume aus Ebenholz bestanden. Sidiyasa (1989) fand in Sausu (Mittelsulawesi) eine Stammzahldichte für Ebenholzbäume mit 265 Bäumen/ha. Bei einem Vergleich der Stammzahldichte und Grundflächenanteile des Ebenholzes von den Untersuchungen Steup aus den 30-er Jahren und meinen jetzigen Erhebungen, deutet dieses auf einen erheblichen Rückgang des Ebenholzes durch Übernutzung der Bestände hin. Die hohe Stammzahldichte bei Sidiyasa ist auf eine andere Methode zurückzuführen. Er wählte besonders stark besetzte Ebenholzbestände aus, die jedoch auch hier nur noch kleinflächig vorkamen. Daher können seine Ergebnisse nicht direkt mit meinen verglichen werden.

In der vorliegenden Untersuchungen konnte eine sehr geringe Dichte und ein entsprechend geringes Volumen des Ebenholzes festgestellt werden. Nach den indonesichen Bewirtschaftungsvorschriften dürften in den 30 er Jahren

Ebenholzbäume nur über 60 cm BHD eingeschlagen werden. Anfang der 70 er Jahre wurden die Ebenholzmischbestände nach dem "Indonesischen Selektionsverfahren" (TPI) bewirtschaftet. Dabei war vorgesehen, dass die Ebenholzbäume über 50 cm BHD gefällt werden durften. Ende der 80 er Jahre wurde das Verfahren geändert und der Minimum Haubarkeitsdurchmesser (MHD) für Ebenholzbäume herabgesetzt, da die Ebenholzbäume über 50 cm selten waren. Die Ebenholzbäume mit BHD 35 cm können seitdem eingeschlagen werden.

Nach den Richtlinien des indonesischen Selektionsverfahrens für das Ebenholz müssen in einem exploitierten Ebenholzmischbestand mindestens 25 Ebenholzbäume mit einem Mindestbrusthöhendurchmesser von 15 cm je Hektar erhalten bleiben. Diese Vorschrift wird jedoch in der Praxis kaum eingehalten. Die Anzahl der verbliebenen Ebenholzbäume mit einem BHD $\geq$ 15 cm betrug in Mauro 17 und in Mesua 10 je Hektar.

Die Festlegung der BHD für die Reservebäume ist mit der Erwartung verknüpft, dass nach einem Nutzungszyklus von 45 Jahren die Reservebäume die Hiebreife erreichen. Das Verfahren geht von einem durchschnittlichen jährlichen Durchmesserzuwachs von 1 cm aus. Seran (1992) stellte fest, dass das durchschnittliche Durchmesserwachstum der Ebenholzbäume 0,2 cm/Jahr beträgt. Aus eigener Erfahrung besitzen die Ebenholzbäume darüber hinaus bei einem BHD von 35 cm ein sehr schmales schwarzes Kernholz.

Die Festlegung der MHD und der Anzahl der Reservebäume als einzige waldbauliche Maßnahme kann nicht eine nachhaltige Bewirtschaftung der Naturwaldproduktion sichern (Roach, 1974; Appanah und Weinland, 1990). Das andere wichtige Kriterium auf einem polyzyklischen System beruhender Holzeinschlag sind die Kenntnisse über das Zuwachsverhalten und die Regenerationsfähigkeiten der verbleibenden Vegetation je nach Baumarten oder Baumartengruppen (Weidelt, 1989; Vanclay, 1994).

Kronenkonkurrenz von _D. celebica_

Die Ergebnisse zeigen, dass in Mauro etwa 71% und in Mesua etwa 77% der Ebenholzbäume von einer seitlichen bzw. seitlichen und oberen Konkurrenz betroffen sind. Sie wachsen unter ungünstigen Entwicklungsbedingungen für ihre Baumkronen auf. Die waldbauliche Behandlung von Zukünftbäumen des Ebenholzes sollte auf die Beseitigung direkter Bedrängung durch eine Auslesedurchforstung "Liberation Thinning" gerichtet werden. Weidelt und Banaag (1982) sowie Sutrisna (1990) haben bei so behandelten Zukunftsbäumen in exploitierten Dipterocarpaceen-wälder Zuwachssteigerungen nachweisen können.

Die Verjüngung von *D. celebica*

Die Verjüngung mit einer Höhe > 30 cm und einem BHD < 10 cm wurde innerhalb von Kompartiment C (10 x 30 m) aufgenommen. Die kommerziellen Baumarten haben mit Hektarpflanzenzahlen etwa 2700 in Mauro und von etwa 2500 in Mesua eine voll ausreichende Dichte. Die Verjüngung der Ebenholzbäume beträgt in Mauro 48 Individuen/ha und 14 Individuen/ha in Mesua. Steup (1930) berichtete von inselartigen Ebenholzvorkommen in G. Muta (Mittelsulawesi), wo das Ebenholz vorherrschte und ebenso eine starke Verjüngung zeigte. Eine Exemplarische Erhebung von 0,08 ha ergab dabei eine Verjüngungsdichte von 250 Individuen/ha. Auch wenn diese Erhebung heutigen modernen waldkundlichen Methoden nicht enspricht, so dürfte sie vermutlich doch die damaligen Verjüngung gut wiedergeben, da er darauf hinweist, dass auch in der Umgebung der Probefläche eine hohe Verjüngung vorkam. Auf den 10 gezielt ausgewählten Stichproben kam in Wotu (Südsulawesi) eine Verjüngung mit 225 Individuen/ha vor (Sidiyasa, 1988). Vergleichbare Ergebnisse wie in der vorliegenden Untersuchung hat Effendi (1980) im exploitierten Wald in Kasimbar (Mittelsulawesi) mit 10 Individuen/ha.

Die schwache Verjüngung der Ebenholzbäume in den beiden Untersuchungsbeständen kann unter anderem damit begründet werden, dass die Verjüngung im Laufe ihre Entwicklungsstadien zu wenig Licht bekommen hat, obwohl die Ebenholzverjüngung in der Anfangsphase Schatten benötigen. Santoso und Misto (1995) untersuchten die drei Monate alte Sämlinge bei 70-80% Schatten und die sechs Monate alte Sämlinge bei 40-60% Schatten und fanden diese vorgehensweise am förderlichsten. Mit zunehmender Bestandesdichte und bei den sich verschlechternden Lichbedingungen für die Verjüngungsentwicklung kann eine Abnahme der Verjüngungszahlen erwartet werden.In einer Untersuchung in Tabalo (Mittelsulawesi) zeigte sich, dass die Sämlinge zwei Jahre nach der Keimung auf offener Fläche gut wachsen können. Zweieinhalb Jahre nach der Keimung sterben die Sämlinge, die unter der Beschattung sehr wenig Licht bekommen. Dagegen wachsen die Sämlinge, die in diesem Alter nur wenig Schatten erhalten, gut (Soerianegara, 1967). Dies kann durch Beobachtungen während der terrestrischen Aufnahmen der vorliegenden Untersuchung bestätigt werden, da sich auf einer Fläche wo das Licht durchdringen kann, eine gute Verjüngung der Ebenholzbäume festgestellt wurde. Der Untersuchungsbestand in Mauro hat eine lockere Struktur als der Bestand in Mesua. Die Früchte, die schon länger am Boden liegen, ergeben eine schlechtere Saatqualität und werden von dem Pilz *Peniciliopsis clavariaeformis* befallen.

Da in beiden Untersuchungsbeständen nur eine unzureichende Naturverjüngung der Ebenholzbäume vorkam, wird eine künstliche Anreicherungspflanzung auf den genutzten Ebenholzmischbeständen empfohlen. Auf diese Weise kann eine nachhaltige Bewirtschaftung der Ebenholzbäume auf

den bereits genutzten Flächen ermöglicht werden. Voraussetzung für Anreicherungsmaßnahmen sind das Vorhandensein von ausreichend und genetisch geeignetem Saatgut. Daher muß auf bestimmten Flächen eine Anzahl der gut veranlagten Bäume von der Holzernte ausgenommen werden, damit diese zur Blühreife erlangen und Samen mit einer guten genetischen Veranlagung liefern können. Bisher liegen keine genauen Informationen im Untersuchungsgebietüber den Zeitpunkt vor, an dem die Ebenholzbäume die Blü hreife erlangen.

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EFFECTS OF FOREST ACTIVITIES ON RUNOFF

Pham Thi Huong Lan[1] and Vu Van Tuan[2]

Abstract

With present work, an approach for the simulation of forest activities on runoff in watershed is submitted. Main objective of this work is determining the effect of forestland use on flooding and floods damage. Hydrologic study for a 43-year period (1953-1995) on the 26,800-km^2 SongDa watershed in north west Vietnam showed the effect of reforestation on streamflow hydrograph and its peak. When the forest area decreased to 20% on the SongDa watershed, flood flow increased 12%. When the forest area creased 10% on the SongDa watershed, flood flow decreased 20%. On the other hand, the study found a 30% increase in direct runoff across the year, with larger increases in summer than in winter. The correlation between runoff and area watershed and rainfall is:

$Q_{lu_{tb}} = 0,161 \cdot F_{rung}^{-0,108} \cdot X^{3,307}$ *(R^2 = 0.54). The correlation between peak runoff and area watershed and rainfall is is:* $Q_{\max_{tb}} = 11,99 \cdot F_{rung}^{-0,628} \cdot X^{1,497}$

(R^2=0.52). The study findings as follows: Forest is the best cover for minimising overland flow and erosion; The hydrograph of direct runoff rises more quickly because of reduced time to peak; The flood reduction role of forest can be maintained through reforestation of abused land; Forest management, especially harvesting and regeneration, affects water quality in ways other than increasing sediment concentration.

Introduction

The immediate effect of forest activities is changed vegetal cover. Under impact of human, the flora coverage will be changed. When a forested area is deforest and the forest litter removed the interception of precipitation is virtually eliminated. Litter removal changes infiltration capacity of soil and has a pronounced effect on raindrop impact and the resulting soil erosion. With the loss of forest mulch, the infiltration capacity is reduced and the erosion (interrill) increased. With the loss of vegetation, evapotranspiration is generally decreased. These changed amount to increased production of direct runoff, reduced surface roughness, and decreased recharge to ground water for the same rainfall event. The hydrograph of direct runoff rises more quickly because of reduced time to peak. In this study an approach for the simulation of forest activities on runoff in watershed is submitted

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Data requirement and research methods

Collected data consists of:
- Geographical map of Da river basin (Figure 1)
- Landuse map of Da river basin in the years 1983, 1993, 1995
- River network map of Da river basin (Figure 1)
- Hydrological stations network map in Da river basin
- Data of daily discharge, rainfall, sediment from hydrological stations in Da river basin
- Livelihood and socio-economic data in Da river basin

Figure 1. Geographical map of Da river basin and river network.

Research methods

In order to study and quantitative estimate influence of forest cover change over basin to current and erosion, the statistic method was used to calculate the correlation of multi variables function between current and erosion with other factors. The hydrological data taken periodically and forest data corresponding. The large Da river basin is divided into branch basin by overlap mapping method uses the GIS technique.

Forestry, Agro-forestry Systems

Basin description

The total area of the Da River catchment is 52,900 km^2 of which some 50% is in Vietnamese territory (48% is in China, 2% is in Laos). The Vietnamese part of catchment including 22 districts of 5 provinces namely Lai Chau, Son La, Lao Cai, Yen Bai and Hoa Binh with the population about 1.2 million in which there are 21 minority peoples. The main purposes of Hoabinh Reservoir are flood control, hydropower generation, water supply for irrigation, improvement of waterborne navigation, fishery, tourism... Hydrologic study for a 43-year period from 1953 to 1995.

The results of research
The correlation function as follows:
Q (average flood) = f {F $_{forest}$ (%), X daily (mm)
Q (average dry) = f {F $_{forest}$ (%), X daily (mm)
Q (maximum flow) = f {F $_{forest}$ (%), X daily (mm)
Q (minimum flow) = f {F $_{forest}$ (%), X daily (mm)

The discharge noted y, % forest area is x1, daily rainfall is x2. We have correlation between discharge, forest and daily rainfall are presented as follow function:

$$y = a_o x_1{}^{a1} x_2{}^{a2} \qquad (1.1)$$

Above function is re-writhed under logarith form as follows:

$$\log y = \log a_o + a_1 \log x_1 + a_2 \log x_2 \qquad (1.2)$$

or under as follows:

$$Z_y = \log a_o + a_1 Z x_1 + a_2 Z x_2 \qquad (1.3)$$

in which the coefficient a_o, a_1, a_2 are calculated as follows:

$$\mathbf{a}_1 = (S^2{}_{Zx1} * S_{Zx1Zy} - S_{Zx1Zx2})/S^2{}_{Zx1} * S^2{}_{Zx2} - S^2{}_{Zx1Zx2}) \qquad (1.4)$$

$$a_2 = (s^2{}_{z_{x_1}} \cdot s_{z_{x_2}z_y} - s_{z_{x_1}z_{x_2}} \cdot s_{z_{x_1}z_y})/(s^2{}_{z_{x_1}} \cdot s^2{}_{z_{x_2}} - s^2{}_{z_{x_1}z_{x_2}}) \qquad (1.5)$$

$$\log a_o = z_y - a_1 z_{x_1} - a_2 z_{x_2} \qquad (1.6)$$

Considering the influence of forest cover change to current, silt and sand in the basin is based on the calculation of multi variables function correlation of current, forest area and daily rainfall. Based on above correlation function, establish the correlation coefficients with data of Na Hu and Mu Cang Chai basins, we have the correlation between average flood discharge percentage of forest area, average daily rainfall as follows:

$$Q_{\text{average flood}} = 0.161 * F_{\text{forest}}^{-0.108} * X^{3,307} \text{ (r=0.522)}$$

The result is showed in Figure 2
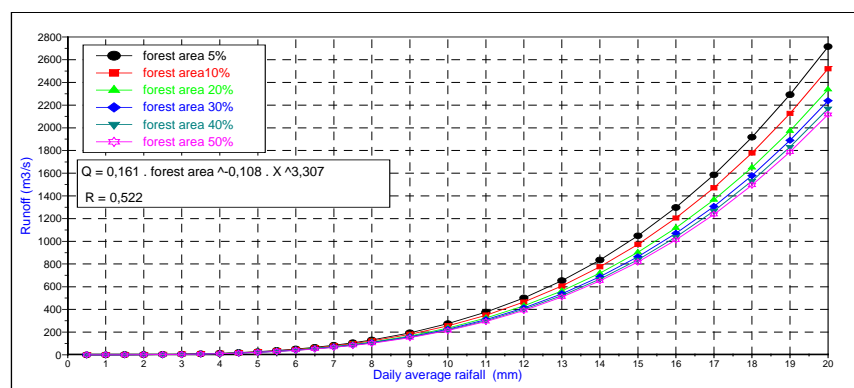
Figure 2. Correlation between average daily flood discharge, forest cover and daily rainfall

The correlation between average dry flow daily discharge, percentage of forest area and average daily rainfall as follows:

$$Q_{\text{average dry flow}} = 0.011 * F_{\text{forest}}^{2.732} * X^{-0.246} \text{ (r=0.504)}$$

The result is showed in Figure 3
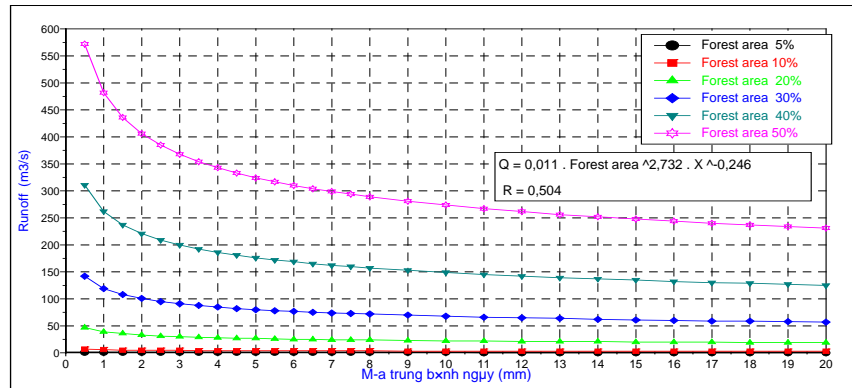
Figure 3. Correlation between average dry flow daily discharge, percentage of forest area and average daily rainfall

The correlation between maximum discharge, percentage of forest area and maximum daily rainfall as follows:

$$Q_{\text{maximum discharge}} = 11.99 * F_{\text{forest}}^{-0.628} * X^{1.497} \ (r=0.515)$$

The result is showed in Figure 4
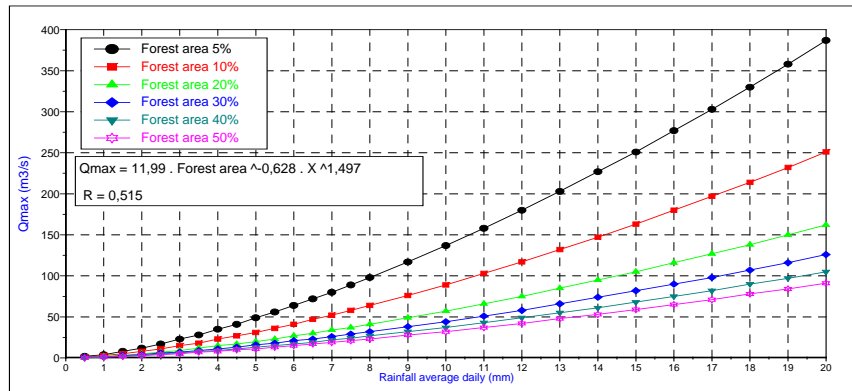
Figure 4. Correlation between maximum flood discharge, forest cover and daily rainfall

By the obever figure indicating that, with the same daily rainfall, the forest cover area in the basin is increasing, the maximum flood discharge is decreasing and when the forest cover area in the basin is decreasing, the maximum flood discharge is increasing. The basin have forest cover is small then the maximum discharge is big and vice versa. The correlation is R = 0.515

Considering the data of main river basins belong to Da river system and branch rivers basin such as Lai Chau, Ta Bu, Hoa Binh, Nam Muc, Nam Giang, Na Hu, Mu Cang Chai, Ban Cung, due to lacks of daily rainfall data the correlation is only one variable, means the correlation between discharge and change in forest cover area, with hypothetical of no change in forest area in China. The result is presented in the figure 5 and 6.
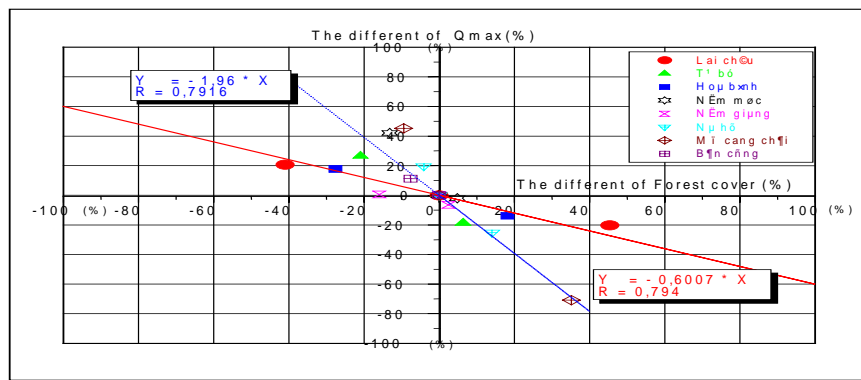
Figure 5. The correlation between the mean maximum peak flood and the different of forest cover
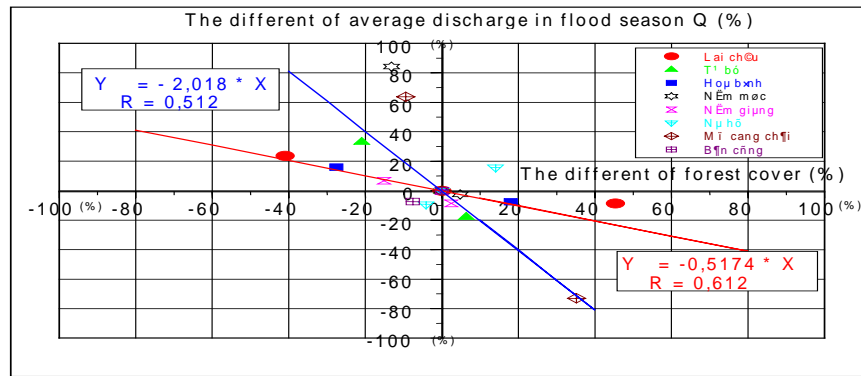
Figure 6. The correlation between the average discharge in flood season and the different of forest cover

Results and Discussions

From the results, we may have some comments as follows: The forest has been effecting strongly to flood peak discharge and flow in the flood season. This is illustrated clearly for medium and small basins. The forest area is decreased by 20%, the average maximum flood peak discharge of large basins is increasing by 12%, while average maximum flood peak discharge of medium and small basins is increasing by 40%. The forest area is increased by 10% the average flood discharge of large basins is decreased by 5%, while discharge of medium and small basins is decreased by 20%. The correlation coefficient between current discharge and differential of forest area in the medium and small basins is higher than the large one. The forest is best cover layer to mitigate the runoff discharge and erosion over basin. The forest has been effecting considerably to flood peak discharge and current in the flood season.

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STUDY OF SANDALWOOD (Santalum album, L) REGENERATION PROGRAMMES IN EAST NUSA TENGGARA INDONESIA

Y. Sinlae and A.P.N. Lango

Introduction

Background

It is regretful to say that during the very long exploitation history of sandalwood (*Santalum album, L*) in East Nusa Tenggara, the attempt of local government to produce such sound sandalwood management programmes were mostly failed. Data proved that all sandalwood logs traded ever since were harvested and gathered by the people from the blessing of the nature- either from forest or naturally grown and preserved sandalwood in agricultural fields of the society. Consequently, the sandalwood standing stock has felt rapidly on annual bases and currently has lost almost all its economic contribution.

Despite its critical state nowadays, the government and the society as a whole should put forward all sandalwood regeneration, conservation and rehabilitation programmes as prime priorities to accommodate its struggling process to regain its cultural and economic value as it was in the past. Some of the regencial government have moved one step ahead by launching a new regulation on sandalwood in the autonomous era. However, it is not so ease for the government to put it down into a real action in the field. It is mainly due to the lack of interest and awareness of the people towards sandalwood.

Objectives

The objectives of the study comprised:
1 To review and to assess all sandalwood regeneration programmes that have been executed in order to find out the strengths and weaknesses of all sandalwood regeneration programmes;
2 To assess all existing (on going) sandalwood programmes.

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Methodology

Data Sources
      A six months field research has been conducted to collect data from various departments and institutions ranging from Forestry Department both at provincial and regencial levels, Department of Land Rehabilitation and Soil Conservation, Research and Development Section of Forestry Department, to Central Management Units for Sandalwood Development Programmes at all level in the region.
      Data encompassed primary and secondary data. The former was collected through an interview based on structural questionnaire prepared, while the later was gathered from many series of annual reports on sandalwood, research reports and journals on sandalwood.

Data Analyses
      Data were analysed descriptively. The description was endeavoured to explain all phenomena and constraints in overall project steps. Numerical information was further calculated to get total value, average and percentage.
Result and Discussion

      There were two important periods in respect to sandalwood management history, i.e. Period of Timoris King's Reign and Government period after Independence.

Timoris King's Reign
      Description on the history of sandalwood activities during Timoris King's period can be perceived from two different periods – the visit of Chinese Merchants and European Merchants.

The Visit of Chinese Merchants
      The first script denoting a real trade relationship between Timoris and Chinese was written by Hsing-Ch'a Sheng (1436) in Dynasty "Ming" time, quoted by Groeneveldt (1880) and was re-quoted by Parera (1994; 131). The quotation explained as follows: .... Timor island was full covered by sandal trees and no other commodities were produced from the island. There were 12 seaports used by Chinese merchants to collect sandalwood from Timor, namely Kupang, Naikliu, Oekusi, Atapupu, Betun, Boking, Kolbano, Bitan, Elo Abi, Bijeli, Oepoli,dan Nefokoko. Another important points were raised by Tung Hsi Yung K'au (1618) in Parera (1994) which stated that ..... whenever the merchant ship ported, the King came down to the port accompanied by his wife, children, concubines and some of house slaves. The tax charged for one day port was not expensive. The people would come to the port whenever the King had left the

port for home. They brought sandalwood to be traded to the Chinese merchants mainly in barter.

This was a prosperous era of sandalwood in Timor. The harvest of sandalwood was overcompensated by natural sandalwood ability to regenerate and to propagate. The people had no concern at all, on sandalwood protection and conservation as well as rehabilitation throughout this period.

The Visit of European Merchants

Some historical notes showed that after Malaka- Central Area of Trade in South Asia- was successfully conquered by Portuguese, Portuguese expanded its power over to the eastern part – to Maluku for its spices and to Solor and Timor islands for Sandalwood (Netti, 1997). According to Fox's note (1977) in Netti (1977), it was clearly explained that "a Dutch fleet led by *Apollonius Scotte*, ported at Kupang Harbour in 1613, which was 11 years after the establishment of VOC". Then, in 1953, the Dutch was successfully took over "Congcordia" – a Portuguese fort in Kupang – without struggle. The Dutch leader in Kupang was held by *Hendrik ter Horst* (an Opperhoofd) from 1653 to 1660. Since then, Dutch leader started to control all the Kings in Timor, Rote and Savu islands. This condition yielded in such consequences by which every King in Timor and its surrounded islands had to pay a tribute to, and obey all rules generated by Dutch leader at Kupang. The tribute should be paid in the form of gold and slave besides annual tax, paid in the form of farm products and forest products such as sandalwood and honey.

A positive contribution made by Dutch leadership was done since 1663, i.e. to promote the expansion of agriculture in Timor. Maize was introduced by Dutch leader and was well adopted by the entire society. Thus, in the few years time, Maize was accepted far till remote areas of Timor and the surrounded islands as well. Maize became main staple food for most people in these islands until the beginning of 1980.

Underlying about 450 years of Dutch colonization, the attempt to preserve sandalwood trees was just begun since 1924 in District of Timor Tengah Utara (TTU). This effort was initiated by Timoris King in this District under Dutch controlled. This effort was considered well prospect by other Kings in the whole Timor. Several other sandalwood regeneration activities were proposed in District of Timor Tengah Selatan (TTS) of about 17 projects, only 1 project by District of Belu and 1 other project by District of Kupang. There were 20 projects being executed during Dutch colonization, with total areas of 137.4 hectares. This effort, however, were considered very low in comparison to the total possible annual harvest during this period, which had no recorded at all. However, nothing left from all of the attempts, due mainly to bush fire, drought and illegal harvest by society.

Government Period After Independence

There were 3 important posts of time throughout the period of independence, i.e., Old Decade (Orde Lama), New Decade (Orde Baru), and Reformation period respectively.

Old Decade (1945 to 1967)

There were two historical events connected to sandalwood management perspective, namely (1) the establishment of sandalwood regulatory format (1968) and (2) successful conduct of the first sandalwood inventory stock checking throughout the region (1965 to 1968). The former was designed to address issues of government authority on sandalwood, sandalwood price and its marketing mechanism as a leading commodity of East Nusa Tenggara Province. While the later resulted sandalwood figures according to its growth level – main tree of 131, 687 trees and young tree of 375,085 trees. It was estimated that this figures was far under the exact figures due to the lack of officials in charge and the level of difficulties faced by the officials in searching, counted and labelled the sandalwood trees in its habitat. The figures used by the local government as the main indicator to calculate the annual allowable cut for 5 years ahead.

The sandalwood regeneration programmes, on the other hand, were done in two districts – one project (60 ha) in District of Belu in 1948 and one project (15 ha) in district of Kupang in 1967. While the exploitation of sandalwood was continuously done mainly by Chinese merchants who had well dwelt in the region and fully controlled sandalwood marketing system. There was no record on sandalwood marketing volume during this period.

New Decade (1969 to 1998)

There were quite a number of sandalwood regeneration programmes being executed throughout the region during this period. These programmes were mostly in West Timor. The attempt was also expanded to newly areas as District of Manggarai. The detailed regeneration programmes was presented in Table 1.

There were 90 sandalwood regeneration projects executed during the New Decade, with the total areas of 1,899 hectares. The sandalwood trees were in general well growing in the first two years. This is because the joint farmers were still occupied the areas by growing food crops and take care the whole area as well. They then left this area as soon as the project was finalized.

Reformation Period (1999 to now)

It is recorded that there were about 13 sandalwood regeneration projects executed by local government with total areas of 399 hectares. These projects experienced the same level of failure. This was mainly due to the

project mechanism, which was only in tightly controlled during the execution period, but was left behind and even forgot soon after the term of the project was administratively ended. The farmers who joint the project were also left the cultivated areas. Sooner or later the whole sandalwood growing trees in the entire areas would easily consumed by unexpected bushfire. Ironically, in all the case no one felt guilty. From one project to another and from year to year and even from decade to decade, the mechanism seemed to persist and everybody was happily panned and executed the same model of programme.

Now everybody understand that sandalwood has almost disappear from the region. The provincial government has handed down the responsibility to preserve sandalwood to the regencial (District) government. In this stage, each regencial government is trying, in a great struggle, to prepare a proper rules and regulations on sandalwood in order to regain the social awareness of the entire society to preserve sandalwood species from being extinction.

Table 1. Sandalwood Regeneration Programmes According to the District

District	Planted Areas (Ha)	Number of Project	%
Kupang	450	17	23.69
T.T.S.	490	15	24,17
T.T.U.	330	17	17.38
Belu	278	16	14.64
Sumba Timur	132	9	6.95
Sumba Barat	135	9	7.11
Manggarai	115	7	6.05

Source: Primary Data calculated in 2002.

Conclusion

Some conclusions are to be derived from the result including:

1   Starting from 1924, sandalwood regeneration programmes were highly dramatized by the government both in colonial time and in time of independence, which may covered at least 121 projects with total areas of 2,510.4 hectares.

2   Constraints of the programmes covered factors such as high susceptibility of the environment to bushfire, drought, failure at nursery level, unchanging project oriented based mechanism, enlargement of agricultural and pasture zones as well as the lost of community awareness towards sandalwood.

3   The district Government has yet prepared regulation on sandalwood for a better regeneration programmes in the future.

Recommendations

1   In the autonomous era, local government has to raise global community awareness towards sandalwood by preparing a better regulations and proper management system of sandalwood regeneration programme.
2   Sandalwood regeneration campaign has to be incorporated within all dry-land agricultural development programmes in the most potential areas of sandalwood.

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ANIMAL LOGGING: AN ENVIRONMENTALLY FRIENDLY TECHNOLOGY IN SUSTAINABLE FOREST RESOURCES MANAGEMENT

Ujang Suwarna

Abstract

The study was carried out to provide possible solutions to promote the sustainable forest resources management by implementing an appropriate technology that friendly to the environment. It is a technique of timber skidding by using animals, called animal logging. Methods for reaching the objective are investigating some literatures and collecting data directly in the field. It was stressed to present the efficiency in terms of productivity and costs and analyze the environmental aspects. The results showed that animal logging is a challenge and option that could be considered the most appropriate logging method for the sustainable management of forest resources. In environmental aspects, it avoids soil erosion and soil compaction, reduces damage to the residual stand and young seedling, and also assists ecological processes such as seed dispersal and germination. Since no skidding road is needed, it gives economical benefits such as low cost of skidding. In addition, it provides job opportunities for the local people.

Key words: animal logging, sustainable forest resources management, appropriate technology.

Introduction

Animals have been used for hauling logs in forest operations and are now used in combination with machines. When felling and bucking are done with power saws and transport is by truck, animals are used for skidding to roadside. The term skidding is used when all or a portion of the tree is dragged on the ground. Skidding is likely the oldest method of **off-road-transport**. It requires only a device to attach the log or tree to the power sources such as human, animal or **machine**. Animal skidding has been established as a traditional method of short distance transportation of timber. After being crosscut, the logs will be skidded to a concentration point along the skid trail. The logs will then be bundled with a chain attached to the harness system of the animal and further skidded to the roadside landing.

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The animals most commonly used in logging operations are horses, elephants, oxen and mules. Animal logging, which was once the predominate form of ground-based extraction of logs from stump to landing had been almost completely replaced by mechanized logging operations. While animal logging is not competitive with mechanized harvesting in most standard situations, it can be the only viable alternative in certain situations such as partial cuts, small tracts, and where access by large, heavy machinery is restricted due to environmental, aesthetic, or logistic constraints.

The main advantage of animal skidding is the very low level of damage to the residual trees and the forest soils. The main disadvantage is the low limit on skidding distance for which draft animals are economical. Uphill skidding on grades steeper than 10% is generally not feasible. Animal logging are not economical for skidding trees long distances. Therefore, truck roads or forwarder roads need to be built to reduce skidding distances for these systems. The main advantages of ground skidding machines are their speed and ability to operate under all but the most adverse conditions. The principal disadvantages are the relatively higher levels of damage to residual stands and skid roads, plus increased soil compaction.

Log extraction with draught animals continues to be an economically attractive choice in many areas. Animal skidding is particularly advantageous for thinning or for pulpwood harvesting, where relatively small logs are to be extracted or where products from pit sawing or other on-site processing are to be transported. It is suggested that they should be used in the thinning of industrial plantations on flat ground.

This study was carried out to provide possible solutions to promote the sustainable forest resources management by implementing an appropriate technology that friendly to the environment. It is a technique of timber skidding by using animal, called animal logging. Methods for reaching the objective are investigating some literatures and collecting data directly in the field. It was stressed to present the efficiency in terms of productivity and costs and analyze the environmental aspects.

Productivity and Cost of Animal Logging

Factors that affect the productivity include the distance during skidding, the roughness of the ground, the steepness of slopes and the strength of the ground. Each of these factors can either increase or decrease the cycle time of the off-road transport machine depending upon their effect on mobility to the machine.

Skidding is generally limited to short distances; less than 50 meters for humans, less than 200 meters for animals and less than 1,500 meters for mechanical skidders. The speed and hauling capacity are the major factors in determining the distances. As a rough guide, the productivity of industrial

mechanical skidders is somewhere between 5 and 15 m^3 per hour. Animals produce about 1 to 5 m^3 per hour.

Skidding costs vary from place to place and depends on conditions of terrain, trees removed and maintained, operation system, and organization. Animal skidding is more economical than machine skidding if the skidding distance x ranges $0<x<1,769$ m, otherwise machine skidding would be better. The values used are based on the following parameters of operating conditions: removed stem size 0.2 to 0.6 m^3; removed timber volume per hectare 20 to 60 m^3; and slope, 15% to 27%. Results of field investigations show that rubber-tired skidders, under operation cost criterion, work slightly better than crawlers but not as good as animals in selective cutting and thinning operations.

These are some conditions for animal skidding: (1) planning for animal skidding must allow for short extraction distance and relatively gentle slopes; (2) proper harnesses are essential in order to prevent injury to the animals and to avoid commutative discomfort over long working periods; (3) devices such as skidding pans, sledges and sulkies can greatly improve productivity in animal skidding; (4) in natural forest it is usually necessary to clear skidding paths for the animal; (5) cutting must normally be coordinated with skidding, and both should start at the back of the cutting unit and proceed towards the landing; (6) animals must be fed, watered and rested at regular intervals while working or they will refuse to continue; (7) depending upon climatic conditions, terrain and other factors, animals may not be able to work every day and they may require relatively short working days.

In terms of practical operations, the typical classification of operation conditions for animals is suggested here as an example: (1) timber volume removed from site: 20 to 60 m^3/ha; (2) average skidding distance: less than 1,700 m; (3) average slope: less than 28%; (4) average timber volume per stem: less than 0.5 m^3; (5) cutting method: selective cutting; (6) operation period: soil frozen period.

There are several factors that can limit the use of animal skidding. Ideally, the slope of the skid should be moderate with a favorable grade. An uphill pull for an extended distance on just a 3% slope can cause a severe strain on the animal, especially for horses. Heavy brush can slow down an operation, as can rocky ground or swampy conditions which may hang up or mire the animal possibly causing injuries. Depending on the type, size, and number of animals used, there is a limited pulling capacity. An animal can repeatedly pull close to its own weight under favorable conditions. The maximum distance of the skid, which is approximately 500 feet under favorable conditions, can limit an animal logging operation economically and physically.

Where the distance between skid roads is approximately 300 feet. The horse is used to bunch the stems at roadside while the forwarder picks up the bundles. This type of system has potential environmental and economic

advantages for thinning and selective harvests because the forwarder or skidder can stay on more widely spaced skid rows, without having to enter the woods, so less stand area is lost to skid roads and fewer residual trees are damaged. A combination system could be adaptable to most any situation, and that money could be saved by reducing the number of spur roads. The use of animals for prebunching has been slightly studied. The horse team was found to be more productive over short skid distances that the other systems used which were a radio controlled winch and a small logging tractor. Bunching systems need to be small and maneuverable enough to minimize soil disturbance and tree damage. With the larger equipment only operating on the designated skid trails, such a system may improve productivity and reduce site impact enough to justify the extra cost of the bunching system.

Horse logging is slower than tractor logging. Tractors can move faster and are able to skid several logs at a time. A tractor's daily production on this operation is estimated to be 2.5 times more than the five horses' combined daily production of 6,280 brd. ft.

Unless skidding distances are very short, draft horse skidding will cost US$ 20- US$ 30/Mbf more than skidder work (i.e., US$ 90- US$ 110/Mbf as compared to US$ 70- US$ 90/Mbf for skidders). Crawler skidding will cost at least US$ 10- US$ 20/MBF more than skidder work (i.e., US$ 80- US$ 100/MBF as compared to US$ 70- US$ 90/MBF for skidders). Such careful skidder operation would have a cost at the high end of the US$ 70- US$ 90/MBF range indicated previously.

The maximum skidding distance recommended is 800'. Beyond this distance, it becomes uneconomical to work. Maximum skidding distance for this horse logging operation was 935 feet with the average being 380 feet. On days when the average skidding distance was about 800 feet, the operator was just making his expenses. The operator preferred skidding on favorable slopes up to 30 percent because the slope made log pulling easier. Slopes greater than this can be dangerous, as the log may start moving on its own and run into the horses pulling it. There was no uphill skidding on this operation. McGonagil* recommends that uphill skidding not exceed 100 feet and on no more than a ten percent slope.

Advantages to using horses: (1) Low overhead and investment costs; (2) Lower move-in costs; (3) Damage to the residual stand is light; (4) Stands do not have to be cut as heavily; (5) Little damage to indigenous reproductive stock, no restocking necessary; (6) Soil disturbance is low. Disadvantages of Horselogging are: (1) Takes longer to log an area; (2) Horses cannot pull logs uphill for long distances; (3) Horses are limited to working in smaller trees (24" DBH or less); (4) There are not many horse loggers; (5) Horses cannot work on rocky ground.

The carabao, or water buffalo, is dubbed the beast of burden in Southeast Asia because of its various uses in agriculture and forestry. In many remote areas of the Philippines, the carabao is not only the farmer's or indigenous people's trusted helper but also a very effective hauling partner in small-scale logging activities. Six to eight carabao harnessed in tandem can skid large logs (60-70 cm diameter, 5-7 m in length) a distance of 300-500 meters in 4-5 hours, especially in wet conditions. One carabao can haul forest products such as lumber or flitches in a small cart loaded with about 50-80 board feet of lumber per trip a distance of up to one kilometre. Carabaos are also used to skid small diameter, tree length pulpwood logs, especially *Paraserianthes falcataria*, to help meet the pulpwood requirements of the corporation's paper mills.

In India, elephants begin work dragging poles and small sized logs at the age of six years, graduating to larger logs at about twelve years. According to statistics from the state of Karnataka, a fully grown male elephant can drag about 13 tones of logs per day over distances of 100-200 metres. Fully grown female elephants can drag up to ten tones a day while younger elephants (6-12 years) average less than eight. Elephants generally work six hours a day and six days a week during the harvesting season which in most states lasts seven months, from November through May. In the Andaman islands elephants continue to harvest timber well into the rainy season when tractors cannot be used. At night, the elephants are let out into the forest, with one foot chained to limit the distance covered. They are retired at the age of 60 after which they are fed and looked after in elephant camps.

Young fully grown elephants (18-25 years) can skid logs weighing about one tone, elephants 25-30 years old about 1.5 tones and healthy elephants 30-45 years old can handle logs weighing about two tones each (Hla, 1995). The estimated cost of operating and maintaining a fully grown elephant averages around 105,000 kyats (US$ 1,000) per year.

Trained 25-year-old elephants in Sri Lanka cost about US$ 15,000 each, increasing in value to around US$ 20,000 at age 45. Elephants 5-10 years old are sold for around US$ 7,500. The annual cost of hiring an elephant in Sri Lanka with *mahout* and choker-man is about US$ 5,200 for a 200-day working year. The cost of skidding logs by elephant based on a two-km round trip is estimated at US$ 3.25 per m^3 (Jayasekera, 1995).

Based on field investigations in PT. INHUTANI V Jambi in Indonesia, the results of 29 cycles showed that total working time of skidding by using a male elephant at the skidding distance of 100 meters is about 14.6 minutes/cycle consisted of 9.8 minutes (67%) of productive time and 4.8 minutes (33%) of delay time. The productive time consists of 2.7 minutes (18%) of walk to the felled tree, 1.3 minutes (9%) of manoeuvre, 1.3 minutes (9%) of belt the log, 3.2 minutes (22%) of skid the log, 0.6 minutes (4%) of stack the log, and 0.8 minutes (5%) of unbelt the log. The delay time consists of 1.9

minutes (12%) of meal, 0.8 minutes (6%) of hooked, 0.5 minutes (4%) of detached, 0.5 minutes (4%) of talk, and 1.0 minutes (7%) of stop.

The results of 29 cycles showed that total working time of skidding by using a female elephant at the skidding distance of 65 meters is about 14.7 minutes/cycle consisted of 10.7 minutes (72%) of productive time and 4.0 minutes (28%) of delay time. The productive time consists of 2.7 minutes (18%) of walk to the felled tree, 0.9 minutes (6%) of manoeuvre, 1.3 minutes (9%) of belt the log, 4.4 minutes (30%) of skid the log, 0.7 minutes (5%) of stack the log, and 0.6 minutes (4%) of unbelt the log. The delay time consists of 1.3 minutes (9%) of meal, 1.4 minutes (9%) of hooked, 0.4 minutes (3%) of detached, and 1.0 minutes (7%) of talk.

The results showed that skidding productivity of a male elephant is about 6.6 m^3/hour and a female elephant is about 7.2 m^3/hour at the skidding distance of 100 meters. The average log volume skidded by a male elephant is about 0.6 m^3 at the skidding distance of 100 meters and the slope of 5%. For a female elephant, the average log volume skidded is about 0.9 m^3 at the skidding distance of 65 meters and the slope of 4%. The operational cost of skidding by using a male elephant is about 0.47 US$/$m^3$ and a female elephant is about 0.43 US$/$m^3$.

Environmental Aspects

It is evident that the direct damage rate of machine skidding on residual stands and young seedlings is much higher than animal skidding due to the machine's big size, high power, and low flexibility.

Animal logging is used in areas which are too sensitive for or inaccessible to tractor skidding and on tracts too small to be feasibly logged by conventional methods. The animals cause low soil disturbance and light damage to residual trees compared to mechanized skidding systems. Other advantages of animal logging are the animal ability to memorize routes and obstacles and to work by voice command. Lower noise pollution is an appeal of animal logging which is favored by the public. But along with these advantages are limitations, such as the longer time required to cut the tract.

Of the two types of cutting done on a forest stand, partial cutting and clearcuttting, animal skidding is more suited to partial cuts. Large rubber-tired skidders would be the choice for a clearcut when high production is a priority and aesthetics is secondary. When a stand is being partially cut, equipment is needed that will minimize damage to the soil and residual trees. Animals work well in this situation, especially on level ground, by offering increased maneuverability and smaller size and weight over rubber-tired skidders. Another partial cut that may benefit from the use of animals is the extraction of seed trees and scattered windthrown trees. It is usually less expensive to harvest these

small volumes per area with animals than with capital-intensive mechanized systems.

During the animal logging operation, ground disturbance exposing mineral soil was slight. Sometimes soil disturbance is needed for natural regeneration but this stand was already adequately stocked. This harvest was designed to thin the stand and promote growth on the residual trees. A slight "trough" occurred on some main skid trails used for three or more days, but was not considered a problem in the loamy soils. Damage to the residual stand from the horse logging seemed less than it would have been from tractor logging. Skidding removed bark from the boles of eight leave trees but only one was damaged enough to be removed. Low skidding damage is due to the animals ability to maneuver in tight places. A team of horses can pass through a 6-foot wide area as compared to the 10 to 12 foot area needed for a tractor. An Additional benefit of this maneuverability was the ability to leave heavier densities of trees in some areas. Falling damage seemed about the same as it would be in any dense stand.

The results show that changes of soil physical properties depend greatly on the degree of disturbance. Soil disturbance caused by ground machine skidding is stronger than that by animal skidding, since the difference of each criterion between skidding trail and reference forest caused by machine skidding is significantly larger than by animal skidding. Of course, not all data obtained show the same conclusion due to heterogeneity of soil distribution.

Chemical properties of soil at the skidding trail also differ significantly from that of site soil and reference soil. It is explicit that many more nutrient elements in the skidding trail soil had been lost due to more heavy disturbance, and that more water-soil run-off had occurred along the trail. According to the results, disturbance by machine skidding is slightly more severe than animal skidding in spite of the heterogeneity of soil distribution.

Elephant skidding causes little or no damage to the forest floor, or to the surrounding vegetation; as such it is without doubt, the most environmentally friendly method of log extraction. Elephants are therefore looked upon as being "Guardians of the Environment". As long as elephants are abundantly available, they will always be the backbone of timber extraction operations in Myanmar. In order to ensure their sustainability, Myanmar's elephants have been designated as being endangered, and listed in the totally protected category.

Some argue that elephant extraction has its drawbacks, but when one looks at it from the point of view that they are amphibious, weatherproof, multipurpose, free from the need for maintenance, spare parts, fuel, or lubricants; have the ability to work for a life span equal to three generations of machines; are self-reproductive, intelligent and environmentally friendly; then there will not be a need to further debate the fact that they are effective not only

costwise, but also from the conservation point of view. They are without doubt, guardians of one of our most precious national heritages, our natural forests.

When elephants are used, skid trails in the logging area are not required, greatly reducing the amount of mineral soil exposed. In addition, elephants are a natural component of most ecosystems in which they are used; their use may not only reduce soil disturbance but also assist ecological processes such as seed dispersal and germination. Elephants are highly versatile and can carry out extraction, sorting, loading and other (such as clearing or road building) functions.

On the other hand, elephants can cause soil compaction as they tread repeatedly over defined logging trails through the forest, although the area affected is much less than that under conventional tractor logging. They may also trample or eat young regenerating trees, bamboos and palms. Forests around permanent elephant camps can be damaged by the regular browsing of a large number of elephants, particularly in times of fodder shortages when they may resort to peeling bark off trees. Nevertheless, their continued use in places like Myanmar, India and Sri Lanka suggests that log extraction by elephants may be well suited to the sustainable management of some tropical forests.

Conclusion

Animal logging is significantly superior to heavy machine skidding in selective cutting or thinning operations under evaluation criteria such as operation cost, damage to residual stands and seedlings, and disturbance to soil, but slightly inferior to machine skidding only considering accident rate and regeneration. The results of a comprehensive assessment under evaluation criteria (operation cost, damage on residual stands and seedlings, and disturbance to soil) showed that animal logging is a first preference among skidding alternatives in the moderate and steep terrain conditions. The wheeled skidder had advantages over other ground skidding methods in longer distance skidding.

Since no skidding road is needed, soil erosion and soil compaction can be avoided. Damage to the remaining trees and the soil are minimal. There is no doubt that animal logging provides one of the most environmentally friendly practices. When employment opportunities for the rural people are taken into account, animal logging could be considered the most appropriate logging method for the sustainable forest resources management.

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TREND IN THE ROLES OF FORESTER TOWARDS SUSTAINABLE FOREST MANAGEMENT IN INDONESIA (1993-2002)

Iskandar Z. Siregar

Introduction

Sixty-eight percents of Indonesia's land surface consist of forests. Since the 1960's Indonesia, along with other countries, has relied very heavily on wood and other related products for its national development. In this regards, forestry graduates have played significant roles in managing and utilizing the forest resources. A number of forestry educational institutions have provided a great number of graduates working in this field; especially graduates of first-degree program.

Until the end of Second World War II, the highly trained Indonesian foresters were very scarce. The Second World War cut the country off from new technology for the duration. Then, independence created a vacuum of highly trained foresters, especially the Dutch foresters who left the country. Realizing the pressing need to engage in the creation of forestry manpower at the various levels, forestry education was then initiated in 1945 and has been developed to the current situations. Various levels of forestry study programs have been set up among others undergraduate education (first degree) that has been an important source of trained foresters.

Economic followed by social and political crisis that hit the country in the late 1990's has changed significantly the national situation on many aspects. It had also severe impacts on forestry sectors including roles of foresters. In order to understand the changing roles of foresters towards sustainable forest management, a study has been carried out.

Methodology

The target groups of this study were tertiary educational institutions that offered forestry study programs at undergraduate level. A representative sample of forestry education institutions (n=7) was selected both private and state educational institutions (Table 1).

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Table 1. Educational Institutions, Abbreviation, locations and programs offered

No	Name of educational institution	Abbreviation	Status	Island
1.	Nusa Bangsa University	UNB	Private	Java
2.	Bogor Agricultural University	IPB	State	Java
3.	Winaya Mukti University	UNWIM	Private	Java
4.	Gadjah Mada University	UGM	State	Java
5.	Lambung Mangkurat University	UNLAM	State	Kalimantan
6.	Tanjungpura University	UNTAN	State	Kalimantan
7.	Mulawarman University	UNMUL	State	Kalimantan

Data was collected through distributing the questionnaire to an identified key person in the selected institutions. The replied questionnaires were then checked and any clear answers were then followed up via telephone interviews. A preliminary analysis of the data was done using classification and distribution patterns (qualitative and quantitative) including the graphic presentation of both distributions.

Results and Discussion

Number of forestry graduates in the last 10 years (1993-2002)

First degree or S1 program is offered in seven universities in which two are private and the remaining is state universities. In total, UNWIM and IPB produced more than 2,000 graduates, followed by UNMUL, UGM with more than 1,000 graduates and UNLAM, UNTAN and UNB with approximately 800, 500 and 250 graduates, respectively. During the economic crisis, especially in 1996/1997, the number of graduates started dropping as observed in IPB, UNWIM, UNMUL, and UGM, while the others were relatively stagnant (Figure 1). The increasing trend has been observed in UNTAN since 1998, while the remaining showed decreasing numbers, especially after 2001.
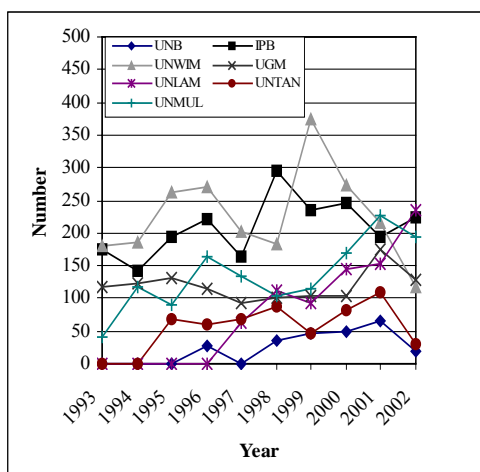
Figure 1. Number of S1 graduates by university (n=7).
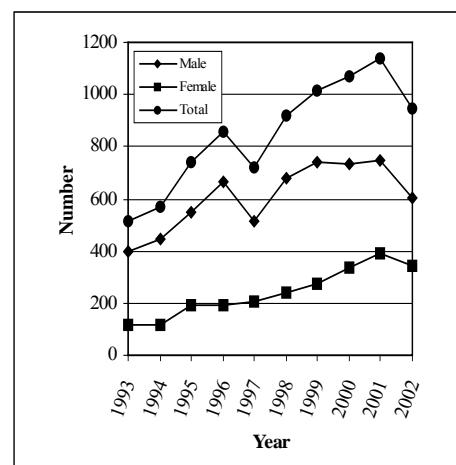
Figure 2. Total number of S1 graduates and gender gap (n=7).

In total, it seems that the number of graduates have increased. Female graduates, especially, show increasing trend irrespective of economic crisis (Figure 2). Overall drops were observed in 2002. In this year, the employment opportunities in the forestry sectors were bad due mainly to the complexity of forestry problems in Indonesia. To overcome these problems, the ministry of forestry has developed its five year strategic plan for up to year 2004 which consists of five priorities addressing factors that most threaten Indonesia's forestry sectors: combating illegal logging, controlling forest fires, restructuring forestry sectors, forest rehabilitation and conservation and decentralization (Rusli, 2003).

Employment

Of various employers, main priority of graduate's work was in the ministry of forestry and forestry enterprises (state and private). Typical works assigned to forestry graduates are to manage natural forest, plantation to manage forest product industries as well as to carry out research and development. In these institutions, the graduates took a wide range of positions ranging from supervisor, planner, middle level manager (camp, silviculture, logging etc.), research assistant, researcher, deputy head of forest districts, etc.

Secondary priority was still to work within government but in other ministries such as ministry of fishery and marine, education ministry/universities, environmental agency, ministry of finance etc. or to work in non-forestry companies such as banks, advertising agency, news agency etc. Working in NGOs and consulting firms were other type of work being sought by the graduates. Last priority of work was other such as own business or private business.

The role of foresters

The changing role of foresters over the last ten years are summarized as follows:

1. New paradigm in forestry from conglomerations to community based forest management. In this sense, foresters must understand social and environmental problems including knowledge of local culture (anthropology). This change has been incorporated into curricula through the introduction of courses or special subjects; such as, agroforestry, non-timber forest products, indigenous knowledge, social forestry and anthropology.

2. From forest exploitation to forest conservation. This change has a significant impact on the curricula and even on the name of study program.

3. Foresters must understand forest accountancy and have good entrepreneurship, leadership and communication skills as well as a good understanding of the code of ethics of forestry. Entrepreneurship and

accountancy are incorporated into curricula, while leadership and communication skills are enhanced through extracurricular activity such as forestry student association (national and international). Code of ethics of forestry is encouraged and should be adjusted in the delivery of any forestry course.

4. Globalization, decentralization (devolution) and national reform. These external factors significantly influence forestry sectors and have to be matched and adopted in the future role of foresters.

The vast majority of the responses indicate that these changing roles are being included in curricula as an example, agroforestry education (Widianto, 2002). Indeed, forestry education is in a stage of change throughout the nation.

Conclusions

It is very clear that there is significant on-going shift from traditional forestry towards social/community forestry, agroforestry, environmental conservation, etc. These changes demand competencies among foresters in human aspect of forestry, multi-disciplinary approaches, and participatory tools in order to achieve sustainable forest management. Within the forestry sector, a broader spectrum of competences is also in demand, such as economics, entrepreneurship and leadership.

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Plant Production, Irrigated Agriculture

CULTIVATION OF *Pleurotus ostreatus* AND *Lentinus edodes* ON LIGNOCELLULOSIC SUBSTRATES FOR HUMAN FOOD AND ANIMAL FEED PRODUCTION

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Abstract

Ligninolytic microorganisms, mainly white root fungi are able to colonize different plant residues and increase the digestibility. Lignocellulosic wastes can also be used for the cultivation of edible mushrooms. Therefore, this study was set up to assess the suitability of wheat straw and sugarcane bagasse supplemented with various levels of wheat bran, as substrates for 2 fungi species. Milled wheat straw and sugarcane bagasse were placed in jars and supplemented with 0%, 5%, 10% and 15% of wheat bran. Deionized water (75%) was added to the jars, which were then sterilized (121°C; 30 min). The substrates were inoculated with mycelium of Pleurotus ostreatus and Lentinus edodes, and then incubated (25°C; 45 days). During the colonization period, the pH, water soluble substances, organic matter (OM) loss, lignin content and in vitro digestibility (IVD) of the substrates were measured. After the colonization period, the jars were placed in an incubator (18°C; RH 80-90%) for fructification. The fruiting bodies were collected until 150 days. The IVD of spent substrate after mushroom cultivation was measured. Generally, the fungi colonized better wheat straw than sugarcane bagasse. P. ostreatus degraded OM of substrate and lignin faster than L. edodes. The highest loss of organic matter of wheat straw after incubation with P. ostreatus and L. edodes for 60 days were 28.9% and 23.7% respectively. The substrate pH was lower on substrate incubated by L. edodes than by P.ostreatus (3.8 vs 4.3). It was corresponding with the water soluble substances of substrates. The digestibility of both substrates was 3.8% - 24.2% higher than the control. The supplementation of wheat bran on the substrates increased the fruiting bodies yield. The yield of P. ostreatus growing on wheat straw with supplementation of 15% wheat bran was highest (8.3% in DM). The in vitro digestibility of spent substrate after cultivation of L. edodes was 68%. The upgrading of lignocellulosic wastes into food and animal feed is possible. However, the appropriate technology for this bioconversion is needed.

Key words: lignocellulose, lignin, digestibility, animal feed, white rot fungi

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Introduction

Ligninolytic microorganisms, mainly white root fungi are able to colonize different plant residues (Zadrazil, 1979) and increase the digestibility of the substrate. In addition, lignocellulosic wastes can also be used for the cultivation of edible mushrooms (Zadrazil and Grabbe, 1984). Therefore, the cultivation of white root fungi has beneficial not only for human food but also for animal feed production.

In the present study, the *in vitro* digestibility of wheat straw during fungal colonization and the influence of supplementation of wheat bran on wheat straw and sugarcane bagasse as substrate for fruiting bodies production of *Pleurotus ostreatus* and *Lentinus edodes* were determined.

Materials and Methods

Fungi

The edible fungi of *Pleurotus ostreatus* and *Lentinus edodes* were used in the present study. The fungi were grown on malt extract agar medium at 25°C.

Substrate degadation

Twenty five gram of milled wheat straw (particle size $\pm$ 1 mm) were placed in 500 ml erlenmeyer flasks and added with 75 ml of deionized water. The flasks were closed with a cotton stopper and sterilized at 121°C for 30 min. After cooling, three replicates were inoculated with two agar plugs (7-mm diam.) per flask, and incubated at 22, 25 and 30°C for 30 and 60 days. After each incubation period the substrate were dried at 105°C and milled to homogeneity. Loss of organic matter, loss of lignin, pH, water soluble substances and *in vitro* digestibility of the substrates (Tilley and Terry, 1963) were determined.

Fruiting bodies production

Fifty g of substrate (wheat straw and sugarcane bagasse) was placed in 1,500 ml jars. The substrates were supplemented with 5, 10 and 15% of wheat bran. Substrate without supplementation was used as control. Deionized water (150 ml) was added to the jars, which were then sterilized at 121°C for 30 min. Under aseptic condition, four replicates were inoculated with 3 agar plugs per jar, sealed with polypropylene and incubated in the dark at temperature 25°C for 45 days.

After the colonization period, the jars were opened and placed in a light incubator at temperature $\pm$18°C and relative humidity 80-90%. The fruiting bodies were collected until 150 days. The yield of fruiting bodies was

determined after drying at 105°C, and was calculated as percent dry matter mass at the original substrate.

Results and Discussion

Loss of organic matter, loss of lignin, pH and water soluble substances

The fermentation process with white root fungi is completed in two stages. At the first stage, the fungus colonizes the substrate and utilizes easily degradable carbohydrates (Zadrazil, 1977). At the second stage, lignin is degraded relatively faster than other components. In this experiment *P. ostreatus* completely colonized the substrate in 12 days, while *L. edodes* colonized the substrates in 14 days under standard aerobic conditions.

Table 1 shows the influence of temperature and incubation time on organic matter decomposition, lignin degradation, pH and water soluble substances. The decomposition of organic matter of wheat straw with *P. ostreatus* was optimal at 30°C, while with *L. edodes* at 25°C. The highest loss of organic matter of wheat straw after incubation with *P. ostreatus* and *L. edodes* for 60 days were 28.9 and 23.7% respectively.

The trend of lignin degradation is similar to that loss of organic matter. The highest lignin decomposition occurred in substrate fermented with *P. ostreatus* (55.9%) at 30°C for 60 days. At 30°C, lignin decomposition began earlier than at 22 or 25°C, therefore, at highest temperatures, more lignin was decomposed than at lower temperature.

Table 1. Loss of organic matter (LOM), lignin degradation (LD), pH and water soluble substances (WSS) of substrates after fermentation with *P. ostreatus* and *L. edodes* at 22, 25 and 30°C for 30 and 60 days.

Fungi	Days	Temp. °C	LOM (%)	LD (%)	pH	WSS (%)
P. ostreatus	30	22	11.8	17.8	4.4	14.1
		25	12:8	26.8	4.3	14.2
		30	15:3	33.1	4.5	13.8
	60	22	25.2	39.5	4.4	18.8
		25	28.0	49.5	4.5	17.1
		30	28.9	55.9	4.7	17.5
L. edodes	30	22	10.1	12.3	3.8	17.6
		25	10.5	21.3	4.3	19.0
		30	13.4	29.9	4.5	19.4
	60	22	21.2	39.6	3.9	25.5
		25	23.7	46.4	4.1	26.4
		30	20.4	44.5	4.1	19.7

During fermentation the pH of substrate decreased until 4.3 (*P. ostreatus*) and 3.8 (*L. edodes*). After 30 days incubation with *P. ostreatus*, the concentration of water soluble substances in the substrate had decreased, due to mycelium production, but the concentration increased after 60 days of incubation. With *L. edodes,* the water soluble substances had increased after fermentation for 30 and 60 days.

In vitro digestibility

In vitro digestibility is the important parameter to determine the feed quality. The *in vitro* digestibility of wheat straw without fermentation was 45.8%. After fermentation with the both fungi, the *in vitro* digestibility increased (Table 2).

Table 2. Change of *in vitro* digestibility (ΔIVD) and process efficiency (PE) of substrate after fermentation with *P. ostreatus* and *L. edodes* at 22, 25 and 30°C for 30 and 60 days

Fungi	Days	Temperature °C	ΔIVD (%)	PE*
P. ostreatus		22	+ 4.6	0.39
		25	+ 5.2	0.34
		30	+ 5.6	0.20
		22	+ 10.6	0.90
		25	+ 11.1	0.73
		30	+ 3.8	0.14
L. edodes	30	22	+ 13.4	1.32
		25	+ 9.1	0.68
		30	+ 22.3	0.94
	60	22	+ 24.6	2.44
		25	+ 23.6	1.76
		30	+ 24.2	1.02

* PE is calculated from change of *in vitro* digestibility divided by loss of organic matter.

In general, the *in vitro* digestibility of the substrates after fermentation with *L. edodes* was higher than with *P. ostreatus.* The change of *in vitro* digestibility correlated with the increasing of the incubation time. But, there was no correlation between the temperature and the change of *in vitro* digestibility. It was also difficult to make correlation between the loss of lignin and the change of digestibility. The amount of lignin decomposed does not always correlate with a change of digestibility (Zadrazil, 1980).

The process efficiency for *in vitro* digestibility decreased with the increasing of the incubation time, but decreased with the increasing of the

temperature. The highest process efficiency (2.44) occurred in fermentation with *L. edodes* at 22°C for 60 days.

Yield of fruiting bodies

The first fruiting bodies of *P. ostreatus* were formed after 57 days on sugarcane bagasse and 103 days on wheat straw. The first fructification was earlier by the supplementation with wheat bran. The *L. edodes* grew well on wheat straw and produced the fruiting bodies after 86 days of inoculation, however the fungus did not form fruiting bodies on sugarcane bagasse.
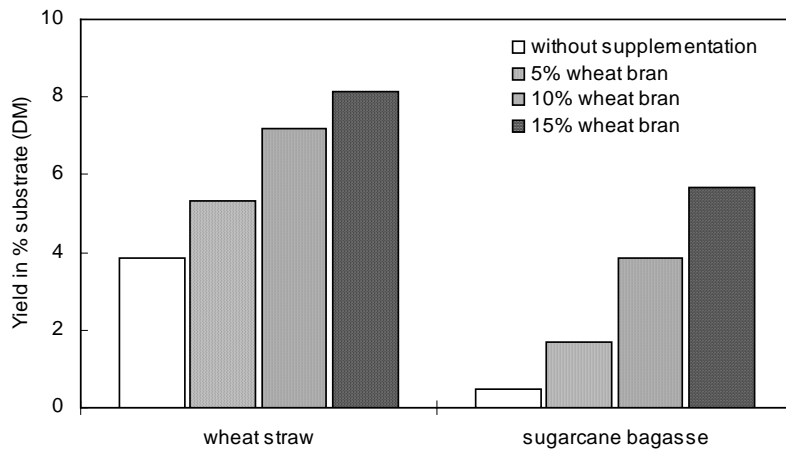
Figure 1. Effect of supplementation of wheat bran on fruiting bodies yield of *P. ostreatus* growing on wheat straw and sugarcane bagasse.
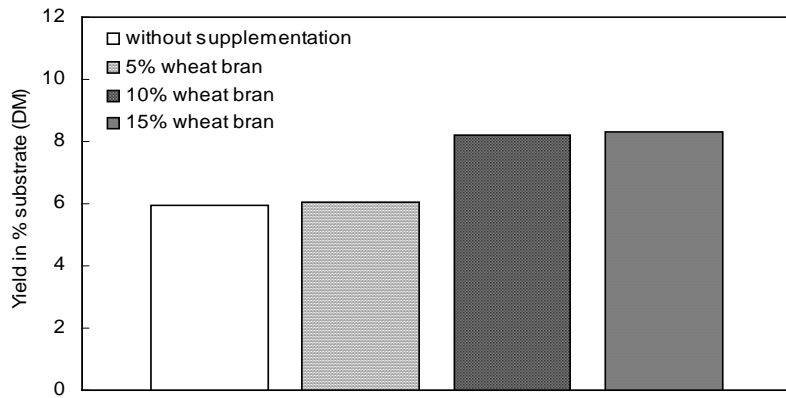
Figure 2. Effect of supplementation of wheat bran on fruiting bodies yield of *L. edodes* growing on wheat straw.

The supplementation of wheat bran increased the yield of fruiting bodies of *P. ostreatus* and *L. edodes*. The lowest yield of *P. ostreatus* (0.5%) was obtained using sugarcane bagasse and increased to 5.7% after supplementation with 15% wheat bran. The yield of *P. ostreatus* growing on wheat straw with supplementation of 15% wheat bran was higher (8.2%), this result related with Permana *et al*. (2000). The yield of *L. edodes* growing on wheat straw supplemented with 15% wheat bran was 8.3%, as compared with substrates not supplemented (5.9%).

In vitro digestibility of spent substrate

As shown in Table 3, the *in vitro* digestibility of substrate after cultivation of *L. edodes* was significantly higher compared to the digestibility of substrate after cultivation of *P. ostreatus*. The best value of digestibility was 68.0% in used wheat straw with addition of 10% wheat bran. The addition of wheat bran increased the *in vitro* digestibility of spent substrate.

Table 3. *In vitro* digestibility of spent substrate after mushroom cultivation.

Mushroom	Level of Wheat bran (%)	Substrate	
		Wheat straw	**Sugarcane bagasse**
P. ostreatus	0	47.4^a	13.8^a
	5	50.2^b	21.5^b
	10	56.2^d	28.7^d
	15	54.1^c	25.1^c
L. edodes	0	65.4^b	48.9^a
	5	65.4^b	51.2^b
	10	68.0^a	57.4^c
	15	62.0^c	55.7^c

Values with different subscripts in the same column are significantly different (p<0.05).

Conclusions

The fermentation of wheat straw with *P. ostreatus* and *L. edodes* increased the *in vitro* digestibility. The supplementation of wheat bran on wheat straw and sugarcane bagasse increased the yield of the mushroom.

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INCREASING PRODUCTIVITY OF ULTISOLS WITH GREENMANURE AND PHOSPHATE FERTILIZER; A CASE WITH UPLAND-RICE IN AGROFORESTRY SYSTEM IN CENTRAL KALIMANTAN

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Abstract

Ultisols is soil type with acidic character, so that the soil pH has to be raised with liming practice. The problem is that lime is expensive and difficult to obtain in this region. It is therefore very urgent to look for a cheaper alternative to make ultisols more productive.

The study started by determining the best green manure's incubation time. Then was followed by field experiments using Randomized Block Design arranged in a Split-split Plot pattern. As main plots were three levels of sengon (Paraserianthes falcataria L. Forsberg) density {(3x1), (3x2) and (3x3)} m; as sub plot were five levels of green manure (0, 5, 10, 15, and 20 t ha^{-1}); and as sub-sub plots were five levels of phosphate fertilizers (0, 13.1, 26.22, 39.33 and 52.44 kg ha^{-1} P). This experiment was followed by the third experiment to test the residue, so that the design and layout of the experiment just the same as the second. The upland rice used was Cirata, a cultivated variety which was bred for acidic soil.

Based on the first experiment, the time of the sowing for the second experiment was 21 days after green manure placement. All variables measured tend to increase with the increasing of green manure and phosphate fertilizers. The highest yield of rice was 3.90 t ha^{-1} at sengon density of (3x3) m, and at the dosage of green manure of 16.53-t ha^{-1}, combined with the phosphate fertilizer of 50.75-kg ha^{-1}. This yield is relatively high comparing to the yield of the local farmer of 1.5 ton ha^{-1} and the national average yield of 2.167-ton ha^{-1}. This reached also the breeder yield potential of 3 – 5 t ha^{-1}.

It can be concluded that liming practice could be replaced by cheaper technology, that is using green manure, combined with phosphate fertilizer and cultivar adapted for acidic soil. Since this was carried out in agroforetry system, so it could be justified as a proper technology not only just for food security program, but also for sustainable resource management.

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Introduction

Most of the forestland that is converted to be agricultural land, shifting cultivation, estate and transmigration area is ultisols (Puslittanak, 1992). In Kalimantan, ultisols occupy 156.645 km^2, or about 28% of the total acreage of this land. Ultisols are acidic soil with less desirable physical properties, and low native fertility (Sanchez, 1976). In the course of food security and in agricultural development program in general, therefore, a considerable attention has to be paid. Due to its acidic character, the soil pH has to be raised with liming practice. The problem is that lime is expensive and difficult to obtain in this region. It is therefore very urgent to look for a cheaper alternative and more environmental benign to make ultisols more productive.

An alternative that can be utilized as a source for soil amendment replacing liming practice is fallow vegetation, that is found in and surround forestland (secondary forest). Organic materials can alter physical properties of the soil and in turn affect the chemical and biological condition of the soil. Obatolu and Agboola (1993) showed that organic materials may improve cation exchange capacity, total nitrogen and available phosphate until eight months after planting time in Coffee and Cacao

plantation. The nutrient content of biomass is usually high enough especially for Nitrogen and Potassium, but relatively lower in phosphate content (Karimuna, 1999). Furthermore, the phosphate content of ultisols is naturally low. It means that to make green manure more effective in replacing liming practice, some phosphate fertilizer should be added to the soil.

So it can be suspected that using slashed fallow vegetation as green manure, combined with phosphate fertilizer and plant varieties bred for acidic soil could be a cheaper alternative replacing liming that is a usual practice in acidic soil such as ultisols. To test this hypothesis, an experiment using upland rice in agroforestry system with sengon (*Paraserianthes falcataria* L. Forsberg) was conducted.

Site Description and Methods

The field experiment was conducted in the Experimental Field for Horticultural Crops (belonging to Department of Agriculture) from February 2000 up to September 2001, in Keruing Village, Cempaga Region, Kota Waringin Timur, Central Kalimantan, Indonesia.

The average rainfall, relative humidity and temperature during field experiment were 216 mm month^{-1} (2,599 mm year^{-1}), 86 percent, and 27^{0}C respectively.

The soil was ultisol, characterized by the following chemical and physical properties: pH H$_2$O, 4.9; pH KCl 4.1; C-organic 0.14 percent; N-total

0.03 percent; P-Bray-1 12.73 mg kg^{-1}; CEC 6.6 cmol kg^{-1}; sand 1.6 percent; dust 19.6 percent; and clay 72.4 percent.

      The study started by determining the best green manure's incubation time. This experiment was conducted in green house, with culture medium ultisols mixed with organic materials coming from secondary vegetation around, equal to 20 t ha^{-1} in pot (polybag). The design used was fully randomized, with seven incubation times as treatment that were 0, 1, 2, 3, 4, 5, 6, 7 weeks. Then was followed by field experiments using Randomized Block Design arranged in a Split-split Plot pattern. As main plots were three levels of sengon (*Paraserianthes falcataria* L. Forsberg) density {(3x1), (3x2) and (3x3)} m; as sub plot were five levels of green manure (0, 5, 10, 15, and 20 t ha^{-1}); and as sub-sub plots were five levels of phosphate fertilizers (0, 13.1, 26.22, 39.33 and 52.44 kg ha^{-1} P). This experiment was followed by the third experiment to test the residue, so that the design and layout of the experiment just the same as the second. The upland rice used was *Cirata,* a cultivated variety which was bred for acidic soil.

Results and Discussion

The Best Incubation Time

      Figure 1 shows the quadratic regression curve between yield (g plant^{-1}) and incubation time. The highest yield was found at about 3 weeks incubation time with yield of 30.49-g plant^{-1}. This figure also shows that if green organic (plant) materials place to the soil six weeks or more (see the curve!), its function as organic fertilizers (green manure) would be no value at all. This fact envisage a vary rapid decomposition process, comparing for example the optimum incubation time of 4-6 weeks reported by Mursyid (1990), or 6-10 weeks reported by Becker *et al.* (1995). It is may be due to the high temperature and humidity during the experiment.

The Effect of Green manure and Phosphate Fertilizer

      Based on the first experiment as reported above, the time of the sowing for the second experiment was 30 days after green manure placement.

      Table 1 shows the maximum yield and its optimum green manure and phosphate fertilizer for each sengon density. Annex shows the figure of the surface-response curve, and may illustrate these facts better.

      The highest yield of rice was 3.90 t ha^{-1} at sengon density of (3x3) m, and at the dosage of green manure of 16.53-t ha^{-1}, combined with the phosphate fertilizer of 50.75-kg ha^{-1}. This yield is relatively high comparing to the yield of the local farmer of 1.5 ton ha^{-1} (Badan Pusat Statitik, 1999) and the national average yield of 2.167-ton ha^{-1} (Biro Pusat Statistik, 1997). This reached also the breeder yield potential of 3–5 t ha^{-1} (Department Pertanian, 1999). That is also to

be noted that this yield is yield of rice in agroferestry system with sengon (*Paraserianthes falcataria* L. Forsberg). The rice population ha^{-1} was less than rice population in monoculture.

The rice yield in sengon density 3 x 2 m that is 3.48 t ha^{-1}, is not significantly different with the rice yield in sengon density 3x3 m, but the dosage of green manure needed was fewer. Thus also the optimum dosage of green manure for sengon density 3 x 1 m, which was the maximum yield only 2.29 kg ha^{-1}, was fewer. It means that if the dosage is added the yield will decrease. It may correlates with low photosynthetic capacity due to the low irradiation in a more denser sengon population.

These finding are in accordance with the extensive studies carried out by La Karimuna (2002) and Abdullah (2002) in South Sulawesi in the same soil type that is ultisol. They evaluate the nutritive value of secondary vegetative biomass by field experiment using maize as test plant. They show that secondary vegetative biomass has a high potential use as green-manure, especially for nitrogen and potassium, and although the total phosphate content were low, but this organic matter could increase the dynamic of P movement in the soil. The application of fallow vegetation could increase Bray-P, especially the younger one (three year old fallow vegetation comparing to the seven-year-old fallow vegetation).

Is the residue of green manure and phosphate fertilizer has still any effect on the next vegetation? The third experiment has the result as follows (Table 2).

The graph shows yield data with the fitted curve:
$$y = -1{,}1957x^2 + 7{,}6863x + 17{,}592$$
$$R^2 = 0{,}9017$$
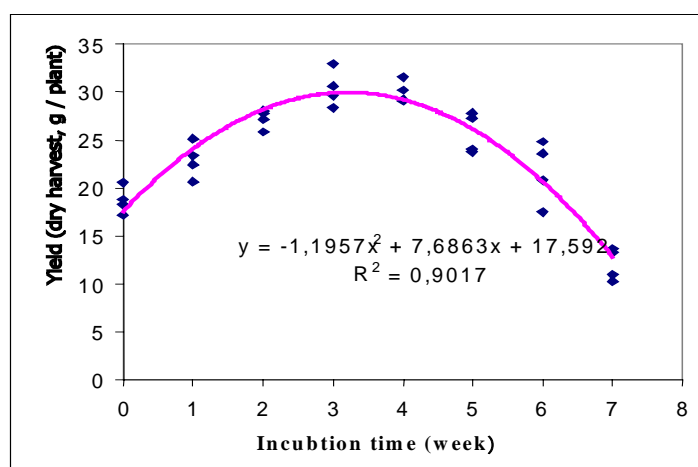
Figure 1. Yield (grain dry harvest g plant[-1]) of the fertilized pot with green manure with increasing incubation time.

Table 1. The Sengon Density, Maximum Yield, Optimum Phosphate Fertilizer and Greenmanure and its Equation

Sengon Density	Opt. P Fert.	Opt. Greenm	Max. Yield	Equation (R^2)
3 x 1 (D_1)	52.44	13.54	2.29	$Y_{D1} = 0.7881 + 0,447P + 0.0334O - 0,0004P^2 - 0,0017O^2 + 0.0002PO (R^2 = 0.5732**)$
3 x 2 (D_2)	52.44	15.57	3.46	$Y_{D2} = 0.9331 + 0.0607P + 0.0954O - 0,0005P^2 - 0.0032O^2 + 0,0001PO (R^2 = 0.4204**)$
3 x 3 (D_3)	50.75	16.53	3.90	$Y_{D3} = 0.9833 + 0.0082P + 0,010O - 0.0030P^2 - 0.0065O^2 + 0.0002PO (R^2 = 0.5339**)$

Table 2. The Residual Effect on Yield of Rice (Sengon Density, Maximum Yield, Optimum Phosphate Fertilizer, Optimum Greenmanure and its Equation)

Sengon Density	Opt. P Fert.	Opt. Greenm	Max. Yield	Equation (R^2)
3 x 1 (D_1)	52.44	12.47	0.17	$Y_{D1} = 0.0710 + 0,0006P + 0.0069O - 0,00001P^2 - 0,0004O^2 + 0.0004PO (R^2 = 0.5732**)$
3 x 2 (D_2)	52.44	16.08	0.64	$Y_{D2} = 0.1224 + 0.0038P + 0.0343O - 0,00001P^2 - 0.0011O^2 + 0,00005PO (R^2 = 0.4204**)$
3 x 3 (D_3)	52.44	14.16	0.82	$Y_{D3} = 0.3038 + 0.0049P + 0,0282O - 0.0000003P^2 - 0.0013O^2 + 0.0002PO (R^2 = 0.5339**)$

Table 3. Soil Chemical Properties after Second Field Experiment of Some Selected Plot at Sengon Density 3x3 m

Greenmanure (t ha^{-1})	PhosphateFertilizr (kg ha^{-1} P)	Soil Chemical Properties				
		P (mg kg^1)	Total N (%)	Organic C (%)	C/N Ratio	pH
0	0	4.52	0.22	2.22	10.1	3.71
	52.4	12.89	0.26	2.60	10.0	4.53
10	0	6.16	0.29	1.97	7.4	3.42
	52.4	14.95	0.33	2.14	6.5	4.74
20	0	7.9	0.30	2.05	6.8	4.32
	52.4	16.97	0.33	2.49	7.5	4.91

The Table 2 shows that the residue of the green manure and phosphate fertilizer has no effect at all; the yield of rice only about one fourth of the rice yield in the second experiment. Indeed there may be some other causes, such as low soil humidity (the third experiment was carried out in dry season), but the following Table 3 confirms that low residual effect is one of the cause. That Table shows that P content and C:N ratio of the soil is very low. It is in accordance with the result of the first experiment (incubation time), that the decomposition of organic materials is very fast.

Conclusions

The hypothesis has already been proved. In some limits the liming practice to make acidic soil such as ultisol more productive, could be replaced by using green manure, phosphate fertilizer and cultivated variety that was bred to adapt acidic soil. Nevertheless the green manure placement has to be renewed every planting season, since decomposition process occur rapidly.

Since this was carried out in agroforestry system, so it could be justified as a proper technology not only just for food security program, but also for sustainable resource management. The farmers surround the forestland may have reasonable income from forest activity.

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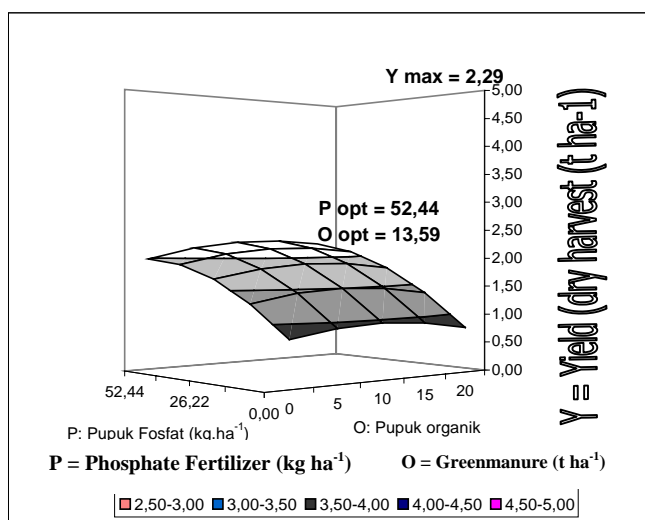
$$Yd_1=0.7881+0.0447P+0.0334 O-0.0004P^2-0.0017O^2+0.0002PO; (R^2=0.5732**)$$

Annex 1. Response Curve of the rice yield ha^{-1} fertilized with increasing greemanure and phosphate in Agroforestry system with sengon in density (3 x 1) m
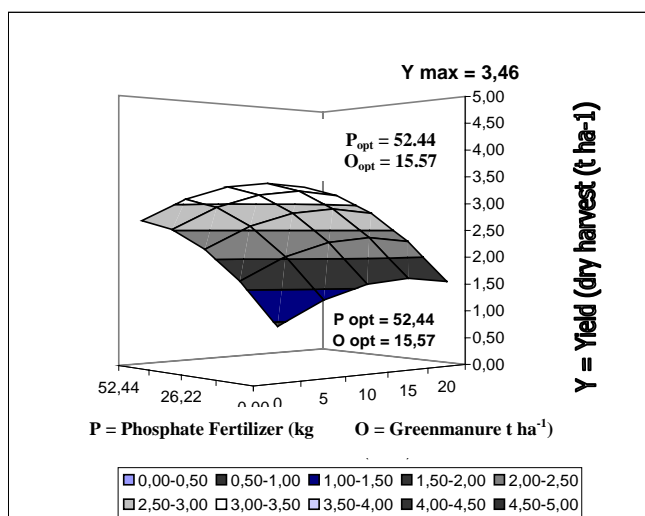
$$Yd_2=0.9331+0.0607 P+0.0954 O-0.0005P^2-0.0032O^2+0.0001PO (R^2=0.4204**)$$

Annex 2. Response Curve of the rice yield ha^{-1} fertilized with increasing greemanure and phosphate in Agroforestry system with sengon in density (3 x 2) m
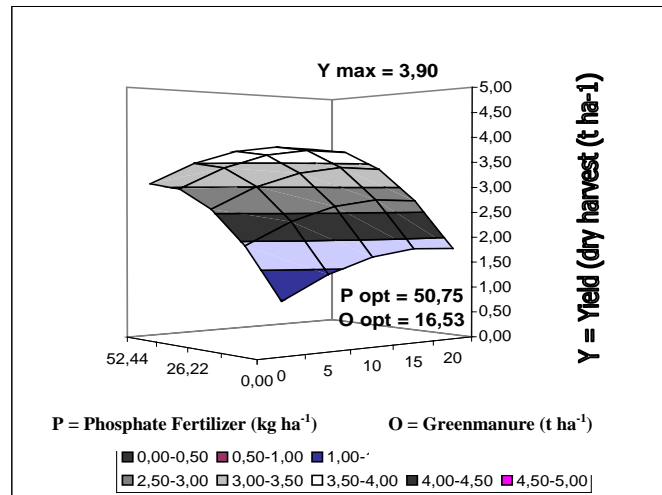
$Yd_3 = 0.9833 + 0.0822\,P + 0.1010\,O - 0.0030\,P^2 - 0.0065\,O^2 + 0.0002\,PO;\ (R^2 = 0.5339**)$

Annex 3. Response Curve of the rice yield fertilized with green manure and phosphate fertilizer in Agroforestry system with sengon in plant density (3 x 3) m

ENHANCING CONSERVATION OF INDIGENOUS AND UNDERUTILIZED PLANTS FOR FOOD

Emilia Boadilla Abalos

Abstract

According to the International Plant Genetic Resources Institute (IPGRI) food security is threatened by increase in world population and extinction of plant species. Indigenous and underutilized plants are reportedly becoming extinct. Lack of knowledge of these plants and their importance are contributory factors. Conservation is imperative. Conservation in the name of genetic conservation alone may not be an effective motivation to save the plants. Immediate benefits and uses must be realized.

A survey was conducted to identify indigenous plant in the region. Other studies were done to assess nutritional and medicinal value of indigenous and underutilized plants.

Stratified random sampling was done in urban and remote provinces in the region. Personal interview was conducted using interview guide followed by actual identification and photo documentation of plants cited by the respondents. Nutrition analysis and literature search as to food and medicinal uses were also done.

Results showed that respondents in remote province were able to identify about 60 indigenous plants while 34 were identified in urban province. Only about 30% of the total number of listed plants were marketable. Seasonality and limited *supply were constraints in utilization.*

Based on the study, 92-95% of both consumers and vendors used indigenous plants as food, 35-50% for medicine and 3% for feed. Indigenous plants were used for food because of their perceived nutritional and therapeutic values besides being cheap source of food.

Chemical analysis and literature search confirm the claimed nutritional and therapeutic properties of some indigenous plants.

Knowing these indigenous plants as well as their nutritional and therapeutic values certainly increase peoples' awareness of the importance of these plants, thereby, leading to their conservation. Conservation of indigenous plants will not only mean food security but also a cheap and healthy source of medicine.

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Introduction

Food security is a major condition in achieving development and improvement in the standard of living of the people. However, food security is threatened by two factors namely: increase in world population and extinction of plant species (IPGRI).

The Philippines ranks 4th in the world in species diversity but biodiversity is alarmingly decreasing to a level of extinction. According to the International Plant Genetic Resources Institute (IPGRI) about one in five (5) plants became extinct in year 2000.

The lost of some genetic resources is accounted to deforestation, slash and burn farming in hilly or forest areas, thereby destroying genetic materials due to ignorance and lack of knowledge of their importance, siltation, intensive and monocroppings and overexploitation by some.

The study on the "Survey of Indigenous, Underutilized Plants for Food" has been conducted in northern Philippines to identify the plants used as foods, sources, reasons and problems for utilizing- indigenous plants. The survey was conducted to identify indigenous plants in the region as a enchmark information and guide in conservation.

Methodology

The study was conducted in two types of location, the rural or remote area and the urban areas. Urban refers to the province that is basically agricultural but have urban amenities such as cemented roads and bridges, electrification, educational, recreational and market centers. Remote or rural areas refer to undeveloped areas not yet readily reached by transport facilities, located in mountain areas. A stratified random sampling was done in the selection of areas and respondents. There were two groups of respondents, namely: the consumers and the vendors. There were eighty consumers and twenty vegetable vendors as respondents, a total of one hundred per province. An interview guide/questionnaires was used. Analysis of results was by percentile rank.

Result and Discussion

Demographic Profile

Most of the respondents from both locations were female. This result show that female customarily engages in selling and prepares the food of the family. Majority of the respondents were aged 40-59 years old. Only few (8-22%) from younger generation (aged 19 and below) were familiar with indigenous plants either by eating or selling.

All of the respondents were literate. No one among the college graduates in the urban areas engaged in selling. In remote areas, vocational or college graduates sell indigenous plants. This may be due to lack of employment opportunities which lead them to engage in selling agricultural produce including indigenous plants to become productive.

Identification of Indigenous Plants

There were more than 60 wild plant species used as food in remove areas, indicating the presence of rich biodiversity still in the mountainous areas. Respondents in urban area were able to identify only about 25 species. Of the number identified in both locations, about 10-15 species were marketable.

Table 1 shows the common plant species that are indigenous, underutilized and growing in the wild which are used as food, their scientific name and parts used as food.

Sources of Indigenous/Underutilized Plants

The respondents, both the consumers and vendors in both locations identified the mount/forest, river banks and the main sources of indigenous plants. Some indicated wastelands and fields. Indigenous plants ordinarily are taken from the wild but some are being seen planted in their back yards. These are the plants that have importance for them.

Uses of Indigenous/Underutilized Edible Plants

Most (92%) of the consumers in urban areas stated that they eat edible plants because of their distinctive taste and perceived nutritional values. Fifty eight percent (58%) of them use these plants as medicine while 3% of them utilized these plants as feeds. Similarly, 95% of the vendors use wild plants as food and indicated that indigenous plants are saleable. In remote areas, abundance and cheap price of wild edible plants are the main reasons for eating and selling. Unique taste and medicinal values are also recognized.

Problem in the Supply of Indigenous Plants for Food

Difficulty of gathering was identified by 69 and 65% of both consumers and vendors respectively as reason for the limited supply. Seasonality of supply was pointed by 45 and 50% of both the consumers and vendors. Vanishing or decreasing species is indicated by 35 and 60% of both consumers and vendors.

Nutritional Value of Some Indigenous Plants Used as Food

The respondent's claim of nutritional and therapeutic values of indigenous plants was investigated. Literature search on the nutrient content analysis showed that some have higher nutrient content than cultivated vegetable such as cabbage.

Table 1. List of some indigenous/underutilized plants used as food

Local Name	English Name	Scientific Name	Parts Used as Food
HERBS			
Busibusi	-	*Alternanthera ficoides L.*	Young shoots
Buslig*	-	*Eleacharis dulcis Trin.*	Rhizomes
Kolitis**	Slender amaranth	*Amaranthus gracilis Desf.*	Young plant, shoot & flowers
Kulasiman	Purslane	*Portulaca oleracea L.*	Young plant,shoots
Pakpako	Edible fern	*Anthyrium esculentum*	Fiddle heads
Papaet**	Mollugo	*Glinus offisitifolia*	Young plant. Shoots
Maraotong	Indian nettle	*Acalypha indica L.*	Young plant
Pansit-pansitan		*Peperomia pellucida*	Young plant, shoots
Pungapung	Giant taro	*Amorpophallus campanulatus (Roxb) Blume*	Leaf stalks
Saluyot**	Jute	*Cochorus olitorius, C. capsularia*	Young shoots/leaves
Sago*	-	*Canna indica*	Rhizomes
Sili-silihan	Wild celosia	*Celosia argentea L.*	Young plants
Tapilan*	Rice bean	*Phaseolus calcaratus Roxb.*	Leaves, pods, flowers
Urai**	Spiny amaranth	*Amarantus spinosus L.*	Young plant, shoot
VINES			
Banag*	Sarsaparilla	*Smilax bracteata Prest.*	Young shoots
Lima-lima*	Buck yam	*D. pentaphylla L.*	Tubers
Nami*	Hispid yam	*D. hispida*	Tubers
Pukinggan	Blue pea	*Cliktorea ternatea*	Flowers, pods
Ubi-ubihan	Air potato	*D. bublifera, L.*	Aerial tubers
Ubag/Buga*	Batatas yam	*D. divaricata*	Tubers
Yam bean **	Singkamas	*Pachyrrhizus erosus*	Pods, roots
SHRUBS			
Panalayanapen*		*Glycosmis platyphylla*	Young leaves
Sileng labuyo**	hot pepper	*Capsicum frutescens*	Shoots, pods
TREES			
Anonang*		*Cordia dichotoma Forst.*	Young shoots
Allagat (Bago)*		*Gnetum gnemon L.*	Ripe fruit
Bungon**		*Allianthus luzonicus*	Young leaves, flowers
Bugnay*		*Antidesma bunius (L) Spreng.*	Fruits, young shoots
Duhat	Black plum	*Syzygium cumini*	Ripe fruits
Katuray **	Sesbania	*Sesbania grandiflora*	Flowers, young pods
Kamias**		Averrhoa balimbi	Fruits
Kakawate	Madre de cacao	*Gliricidia sepium*	Flowers
Labong**	Giant bamboo	*Giganthochloa levis (Blanco)Merr*	Young shoot
Mabolo*	Kamagong	*Diospyrus blancoi*	Fruit, seed
Makopa	Wax apple	*Syszygium samarangense (Blume)*	Fruit
Manzanita	Jujube	*Ziziphus jujube Lam*	Fruit
Malungay**	Horse radish	*Moringa oleifera Lam*	Fruit
Anibong**	Fishtail palm	*Caryota cumingi Lodd.*	Palm cabbage
Sampalok*	Tamarind	*Tamarindus indica L.*	Flowers, pods, seeds
Sapote*		*Diospyrus ebenaster*	Fruit
Saging**	Banana	*Musa sapientum*	Flower buds
Ulnaris *	Plantain	*Musa sp.*	Fruit

- *- vanishing. These plants are seldom seen even in their usual habitat due to
- "slash and burn" farming encroaching the forest, river siltation and intensive monocropping in the fields.
- **-sometime sold in the market
- common but underutilized

Medicinal Values of Some Indigenous Plants

Amti (Common nightshade) – *Solanum nigrum, Linn*.
       Found throughout the Philippines, in open, waste places. It is an erect branched, smooth woody vine with slender, smooth and slightly hairy branch lets, thin leaves. The flower and young pod are cooked like any vegetable. The infusion of the leaves cleanse wounds, scabies and skin ulcers.

Kulitis (Slender amarantgh) – *Amaranthus viridis*
       Commonly found throughout the Philippines at low and medium altitudes. It is an erect, smooth and unarmed herb growing from 30-60 cm in height. Tender tops are cooked as a nutrition's vegetable, rich in calcium and iron. It is a good source of Vitamin B and C. Poultice from leaves are effective against boils and abscesses. An infusion of the plant is diuretic.

Melon-melonan – *Trichosanthes cucumeria. L.*
       A climbing herbaceous vine, 5-6 m high with hairy four anglek stem and faintly disagreeable odor. The red riope pulp of the fruit is eaten and has distinctly emetic and purgative effect.

Nami – *Dioscorea hispida, Dennst*.
       Growing wildly in thickets and forest, rarly cultivated. It is twining vine arising from tuberous roots with few short and sharp spines. The flesh and sap of the tubers are used for bleaching. Tubers can be processed and cooked and eaten as snacks and flour. Raw or cooked tubwers are used against arthritic pains.

Pansit-pansita – *Peperomia pellucida Linn*.
       Grows in moist places usually found growing in earthen pots and walls. Very tender and succulent with shiny green leave. The succulent tops are cooked like any vegetable. It has diuretic and antihypertensive and analgesic properties.

Saluyot – *Corchorus Sp*.
       Grows mostly in clearings, rice paddy banks in open and wet places. When cooked, it is mucilaginous and slimy. It is cooked with other vegetables. A tea of dried leaves is good for dysentery and as tonic for children with cough. The fruits are used as laxative while its oil from the seeds is used for treatment of skin diseases.

Singkamas (Yam bean) *Pachyrrhizus erosus Linn.*

   These are usually found in thickets throughout the Philippines at low and medium altitude. It is coarse climbing, herbaceous vines growing from large, edible, turnip shape, fleshy roots. The fleshy root of the cultivated variety is eaten fresh as refreshing snack. The young pods are cooked as vegetable. The leaves contain poison to animals. The tincture of seeds cures herpes.

Ubi-ubihan – *Dioscorea bulbefera Linn***.**

   Found in thickets at low and medium altitudes. It has smooth, unarmed vine, tubers are rounded and not larger than a man's fist. Tubers when cooked taste like potato but poisonous when raw. It contains poisonous glucoside, a remedy for dysentery, syphilis and boils.

Table 2. Vitamin content of the leaves of some underutilized plants/100 g edible portion.

Sources of leaves	Vit. A (I.U.)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
Wild ampalaya (Momordica charanthis Linn.)	9530	0.12	0.40	1.60	169
Cassava young leaves (Manihot utilissima	13155	0.25	0.43	2.00	127
Wild pepper (C. frutescens)	12395	0.47	0.28	1.5	24
Horseradish (Moringa oleifera Lam.)	12450	0.20	0.73	3.7	232
Jute (Corchorus olitorius)	12510	0.13	0.21	1.4	81
Purslane (Portulaca oleracea)	6660	0.60	0.16	1.0	51
Slender amaranth (A. gracilis Desf.)	12860	0.01	0.37	1.8	120
Spiny amarant (A. spinosus L.)	11100	0.01	0.34	1.1	28

Source: FNRC Handbook No. 1 and Knott and Deanon (1978)

Conclusion

   The survey on indigenous and underutilized plants used as food is very important in plant genetic resources for food and agriculture program of any country. Knowledge of these plants and their nutritional and medicinal values and uses is good incentive for wider participation of people in conservation of these plants.

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ASSESSMENT OF LAND SUITABILITY FOR SUSTAINABLE AGRICULTURE PRODUCTION IN SE SULAWESI, INDONESIA
La Karimuna

Abstract

In Southeast Sulawesi, Indonesia, the increasing population density and the rapid increase in land demand for resettlement result in shifting of agricultural land uses to non agriculture purposes, that gradually causes the declining of potential agricultural land annually. Consequently, agriculture development increasingly shifts towards steep sloping land and stony areas. Furthermore, the increasing land and water shortages forces the farmers to shorten the traditional fallow periods more and more. These factors caused a trend to declining site productivity and increasing food deficiency for the smallholding population. Therefore, maintaining productivity and creating technological options for development are the most important issues to agricultural research. In order to improve the country's self-supply with food, to meet the sustainability of resource management and to guarantee the most favorable and stable crop yield in semi or permanent pieces of agricultural land, the assessment of land suitability for sustainable agriculture production is compulsory. The main objective of this activity was to assess the potential areas in Tiworo district (329 km^2) which are suitable for peanut (Arachis hypogaea L.) – a local most beneficial cultivated plant species of the region. This assessment was based on physical and chemical soil properties and climate, and envisaged parameters to calculate potential areas of peanut for further development. Thirty-three land units were identified and then classified according to their land suitability for the potential growth and yield of peanut into five groups such as very suitable, moderately suitable, marginally suitable, currently not suitable and permanently not suitable. The information was analysed and visualized with a GIS and revealed that 76.3% of Tiworo district (20,386.7 ha) is marginally suitable for peanut with limiting factors of low pH, nutrient deficiencies, texture and drainage problems, and the rest is currently not suitable. The results showed that 30.5% (8,149.7 ha) and 69.5% (18,562 ha) of Tiworo district were identified as moderately and marginally suitable, respectively for the potential land suitability of peanut with drainage and pH limiting factors. It is suggested that the application of liming, drainage creation, organic substances, and fertilizer are recommended to improve agricultural production and to promote the sustainable resource management.

Key words: *agriculture production, fallow period, land suitability, limiting factors organic farming, peanut*

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Introduction

Muna regency is one of the five regencies in Southeast Sulawesi provinces situated in the Southern part of Kendari with mainland areas of 4,887 km^2 in total while Tiworo district has the areas of 329 km^2 or about 6.7% out of the total areas of Muna regency. In 1980's Muna island was inhabited by 174,057 people with around 60% of the mainland areas are covered by forests (Biro Pusat Statistik, 1997) and more than 80 percent of the population are engaged in agriculture sector.

By 2001 the total population of Muna regency were increasing to a number of 289,820 people (Biro Pusat Statistik, 2002) in which most of population are engaged in agriculture cultivation as farmers and predominantly practicing a conventional agriculture system, which is now unable to be maintained due to low crop production.

In Southeast Sulawesi, Indonesia, the high increasing population density per unit area of land and the rapid increase in land demand for resettlement result in shifting of agricultural land uses to non agriculture purposes, that gradually causes the declining of potential agricultural land annually. By 2000, each farmer of the region belongs to only 2-4 ha, or even less (Karimuna *et al.,* 2001). The yield of existing crop for staple food is very much lower compared with its potential yield, for example; maize production in the farmer level is only 1.2 t ha^{-1} but its potential yield may produce 7 t ha^{-1}. Furthermore, the increasing land and water shortages forces the farmers to shorten the traditional fallow periods more and more. These factors caused a trend to declining site productivity and increasing food deficiency for the smallholding population. Therefore, maintaining productivity and creating technological options for development are the most important issues to agricultural research.

In order to guarantee the most favorable and stable crop yield in semi or permanent pieces of agricultural land in the study region, the assessment of land suitability for the growth of a crop is compulsory of each region to be carried out for the agricultural development and meet the sustainability of land-use system in the future. The objectives of this research are to evaluate and determine land suitability level for peanut (*Arachis hypogea* L.) - local most economical annual plants of the region, to decide a sort of improvement treatment in order to guarantee continuous quality and quantity production of crop and to indicate the form of land utilization for further development of sustainable peanut production.

Material and Methods

2.1. Location and Time

        Tiworo district is located at 4°19' South Latitude and 122°32′ – 122° 18′ East. This research was carried out at Tiworo district, Muna regency Southeast Sulawesi, at the altitude range from 50 – 250 m above sea level, held from February to June 2002. The vegetation cover is classified into five main divisions such as primary forest, secondary forest, dominant shrubs-*Chromolaena* species, dominant grass-*Imperata* species areas, *ladang* areas-dominant cashew and other plantation trees-situated in resettlement (Karimuna *et al*., 2001). The most popular endemic tree species found in Muna regency is teak (*Tectona grandis* L., Verbenaceae) - a high quality wood in the tropics. Soil type under cultivation was dominated by mediteranean, cambisol and sediment soil. Land formation of Tiworo district is based on altitude and slope factors, consisting of flat, hilly, and mountainous areas. The predominating bad rock is ultra-basis and sediment.

        Climatic data of Tiworo district during study was figured out represented by the data collected from Marobea and Dana meteorological stations. The annual, monthly, daily data of rainfall, and temperature were recorded and analyzed. According to Oldemann climatic classification (wet month means the average rainfall > 200 mm month^{-1}; dry month means the average rainfall < 100 mm month^{-1}), the agro-climate of Tiworo district is classified as C and D/E.

        Present land use of the region is mainly covered by forests, followed by mixed garden and shrubs. The dominant floristic compositions of trees found in the secondary forests of the study areas are the species from Family Euphorbiaceae, Moraceae, Verbenaceae, Fabaceae Ateraceae, Poaceae and Tiliaceae.

2.2. Data collection and analysis

        Qualitative and quantitative surveys were applied for data collection. This approach was carried out using topographic map on semi detail scale of 1: 50.000. In order to simplify the land evaluation of a certain crop for the whole study region, the land was classified into land unit. Thirty three land units were identified for Tiworo district based on the overlay of six principal maps such as Geological map, Topographical map, Land satellite TM September 1997, Land exploration map, Land use map of Muna regency, and Regional Administrative map of Muna regency. Within these land units, free survey with analytical approach for data collection was used to determine the characteristics of the soil.

        Soil physical properties were directly identified in the field such as effective soil depth, flood threat, potential intensive mechanization, soil tillage and erosion threats, while chemical contents using composite samples collected in three different soil depth (0-15 cm, 15-20 cm and 20-50 cm) were determined

in the laboratory, like soil pH (pH meter, H_2O), total-N (Kjedhal), P_2O_5 (Bray II), exchangeable-K (NH_4.Oac pH 7.0), CEC ((NH_4.Oac pH 7.0), salinity (Conductivity meter), organic-C (Walkey and Black). These chemical analyses were analyzed in Biotrop, Bogor, Indonesia.

Simple limiting method was used to assess land suitability of peanut by matching between the biophysical land properties of each land unit and the criteria of land suitability for its growth and yield. The results of this evaluation were determined using the minimum law (highest limiting factor) referred to the implication of CSR/FAO system, 1983. The classification of land suitability for peanut was based on the framework of FAO system (1996) in Hardjowigeno *et al.* (1999) and Widiatmaka, *et al.* (2001). All identified land units were then classified according to their land suitability for the potential growth and yield of peanut into five groups such as very suitable, moderately suitable, marginally suitable, currently not suitable and permanently not suitable. This classification was conducted on semi detail scale of 1: 50.000 similar to the topographical map up to the land suitability of sub class level. The results of this classification with indicating limiting factor were shown into two scenes such as actual and potential land suitability that were visualized with a GIS. The improvement treatment of limiting factor to each land unit to attain the potential land suitability was generated by highly looked into farmer's capability. In this study, medium level of treatment was applied.

Results and Discussion

a. Social and economic of the farmer

The results of social and economical condition of the region showed that conventional agricultural system is being dominantly practiced by the farmers in the study region. Working together is a farmer habit consisting of five or more people to do each step of agricultural activities with applying principal mutual beneficiaries. The number of person per family mostly consisted of 3-4 people. The area for cultivation of each family was only 3-8 ha, but some might have more than 10 ha per family and most of the farmers graduated from Junior High School, indicating lower education level of the farmer, even though they are able to understand the new innovation of agricultural development. The crop productivity for staple food remained low, like annual crop amounted to less than 1 t ha^{-1} for upland rice (Karimuna *et al.,* 2001), and 0.8 t ha^{-1} for peanut. This yield could not support the needs for staple food of people to the region. The need to assess the actual and potential land suitability of land unit for all Tiworo district suitable for peanut is compulsory.

b. Actual and potential land suitability

The results of study showed that some farmers had practiced to plant peanut in their pieces of land. Based on the evaluation and analyses of land suitability concluded that there is no land unit suitable for peanut with highest

suitability (S1). This indicates that there is a limiting factor influencing the growth and yield of peanut, so improvement treatment is needed to meet the requirement of plant growth. The limiting factors identified in this study were drainage problems, slopes, nutrient deficiencies and water shortages. Field survey and analyses of laboratory for all parameters were collected and recorded in each land unit and indicating the class of land suitability for peanut as shown in Table 1.

Table 1. Results of actual and potential land suitability assessment for peanut in all land units of Tiworo district

Land Unit	Land suitability assessment		Area (ha)	Percentage (%)
	Actual	**Potential**		
1	2	3	4	5
1	S3fn	S2f	10.6	0.03
2	S3fn	S2f	20.1	0.08
3	S3rfn	S3r	57.5	0.21
4	S3fn	S2rf	7.5	0.02
5	S3fn	S2f	110.0	0.41
6	N1r	S3r	325.0	1.22
7	N1f	S3f	2,750.0	10.29
8	S3rfn	S2rf	340.0	1.27
9	S3rfn	S2rf	425.0	1.59
10	S3rn	S3r	7,797.5	29.19
11	S3rn	S3r	672.5	2.53
12	S3n	S2r	190.0	0.71
13	N1f	S3f	70.0	0.26
14	N1r	S3r	425.0	1.60
15	S3rn	S3r	1,770.0	6.63
16	S3n	S2r	330.0	1.24
17	S3fn	S2f	62.5	0.24
1	2	3	4	5
18	N1f	S3f	245.0	0.92
19	N1f	S3rf	72.5	0.28
20	S3rfn	S2rf	307.5	1.15
21	S3rn	S3r	1,570.0	5.87
22	S3rfn	S2rf	77.5	0.30
23	N1r	S3r	82.5	0.31
24	N1r	S3r	1,490.0	5.58
25	N1r	S3r	320.0	1.19
26	S3rfn	S2rf	315.0	1.18
27	S3rn	S3r	32.5	0.12
28	N1r	S3r	545.0	2.04
29	S3fn	S2f	332.5	1.24
30	S3fn	S2f	397.5	1.49
31	S3fn	S2f	4,915.0	18.40
32	S3fn	S2rf	309.0	1.16
33	S3fn	S3r	337.0	1.26
	T o t al		**26 ,771.7**	**100**

In this study, the assessment of a crop species would be optimal if what is selected by the farmers is in line with the characteristics of biophysical land properties. This is similar to the recommendation suggested by Momberg *et al.* (1995). On the other hand, actual land suitability was assessed based on the quality and current available land characteristics and there is no improvement treatment on the limiting factor affected to each land unit. Therefore, when improvement treatment is applied to a certain limiting factor to acquire a better soil condition, the potential land suitability is being assessed.

The classification of actual and potential land suitability evaluation are divided into two main classes for both, they are marginally suitable (S3) and currently not suitable (N1) refers to actual land suitability and moderately suitable (S2) and marginally suitable (S3) refers to potential land suitability (Table 2 and Table 3). The information is analysed and visualized with a GIS and revealed that 76.3% of Tiworo district (20386.7 ha) is marginally suitable for peanut with limiting factors of low pH, nutrient deficiencies, texture and drainage problems, and the rest is currently not suitable (Table 2).

Level of improvement consists of three types: low, medium and high, indicating the level of cost invested if one wants to manipulate a limiting factor to grow a certain crop. In this study, medium level of improvement is finally opted considering the levels of farmers income that can be afforded.

The improvement of a limiting factor resulted in the increasing one or two classes of land suitability. This is, however, limited to a certain limiting factor that can be improved, like nutrient deficiency through application of fertilizer, and water shortages through using watering. These treatments produced potential land suitability evaluation (Table 3). The results of study showed that 30.5% (8,149.7 ha) and 69.5% (18,562 ha) of Tiworo district were identified as moderately and marginally suitable, respectively for the potential land suitability of peanut with drainage and pH limiting factors.

Table 2. Results of six classes of actual land suitability for peanut in all land units of Tiworo district

Legend	Sub class	Land Unit	Area (ha)	Percentage (%)
1	S3fn	1, 2, 4, 5, 17, 29, 30, 31, 32	6,164.7	23.08
2	S3rn	10, 11, 15, 21, 27, 33	12,179.5	45.06
3	S3rfn	3, 6, 8, 9, 20, 22, 26	1,522.5	5.70
4	S3n	12, 16	520	1.95
5	N1r	14, 23, 24, 25, 28	3,187.6	11.9
6	N1f	7, 13, 18, 19	3,137.5	11.74
		T o t a l	**26,711.7**	**100**

In fact, all selected plant species had been developed by the local farmers in the study region, either cultivated in monoculture or in mixed cropping pattern. Most of annual crops can be planted two or more species in a certain area per unit time and distributed generally in dry land agriculture system. The biggest problem faced by the local farmers or government is the lacking of water during dry season, and exceeding of water in rainy season. This is claimed to be the main limiting factors to the selection of crop species in the study region. This is similar to finding of Akyas (2001), climate is one of the main limiting factors to be considered for the selection of a crop to widespread.

The interconnected institution related to agricultural development has a task to implement the result of research in order to improve agricultural production in the study region. A plant has a minimum requirement to grow with high potential to achieve its maximum yield. Therefore, a plant is no need to expand to a region that is not suitable for that plant. A certain crop is developed in such a way that a plant has highest potential of yield. It is suggested that the application of liming, drainage creation, organic substances, and fertilizer are recommended to improve agricultural production and to promote the sustainable resource management. Moreover, in order to improve the country's self-supply with food, to meet the sustainability of resource management and to guarantee the most favorable and stable crop yield in semi or permanent pieces of agricultural land, the assessment of land suitability for sustainable agriculture production is needed.

Table 3. Results of six classes of potential land suitability for peanut in all land units of Tiworo district

Legend	Sub class	Land Unit	Area (ha)	Percentage (%)
1	S2r	12, 16	250	1.95
2	S2rf	4, 8, 9, 20, 22, 26, 32	1,781.5	6.67
3	S2f	1, 2, 5, 17, 29, 30, 31	5,848.2	21.90
4	S3r	3, 6, 10, 11, 14, 15, 21, 23, 24, 25, 27, 28, 33	15,424.5	57.74
5	S3f	7, 13, 18	3,065.0	11.47
6	S3rf	19	72.5	0.27
		T o t a l	**26,711.7**	**100**

Conclusion and Recommendation

From the above results can be concluded that:
(1) Most of Tiworo district or about 69.5% (18,562 ha) were identified as moderately and marginally suitable, respectively for the potential land suitability of peanut with drainage and pH limiting factors.
(2) The growth and yield of peanut in a certain land unit of the whole areas in Tiworo district is limited by such environmental conditions as drainage problems, slopes, nutrient deficiencies, and water shortages.
(3) At present, farmers yield, on average, only 25% of the potential yields. Cropping decisions based on this research allow the farmers to produce up to 60 – 80% of the potential yields.
(4) Development of extension services to guarantee an information flow to the farmers is needed.

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A CASE STUDY OF RIT-PILOT PLANT FOR THAI NEEM-BASED EXTRACT PROCESSING: FROM RESEARCH IN BRD TO SMALL-SCALE INDUSTRIAL PRODUCTION IN THAILAND

Unchalee Sanguanpong

Abstract

Neem-based extract processing at Rajamangala Institute of Technology (RIT) in Patumtani province involves a long chain of operations and various equipment. The steps are: seed decorticating, crushing, oil expel, agitation, filtration, evaporation and formulation. As raw material, Thai neem seeds (Azadirachta indica var. siamensis (Valeton)) are used. They are firstly decorticated to obtain the seed kernel, then crushed and finally pressed to separate neem oil by screw expeller. By moving-bed contacting extraction technique, defatted neem cake will be extracted with methanol in an agitated-extraction vessel. After decantation of crude cake in mixing-settling tank, the neem solution is drained out, then filtered and proceeded to the next procedure. The solution will be further evaporated until a specific volume, the so-called-concentrated alcoholic neem-based extract. Before packing in containers, the concentrate will be analyzed for azadirachtin ($C_{36}H_{44}O_{16}$) content by using HPLC. Furthermore, the concentrate is also formulated for specific purpose as different commercial grade. Eventually, the product will be bottled and shipped to the consumer.

The described processing requires a set of special equipment, such as seed decorticator, pulverizer, oil expeller, filter, agitated-extraction vessel and evaporator. However, the actual yield of different neem-based extracts by all equipment and processes was compared with yield of laboratory scale, which was used as standard method or control treatment. The data obtained are discussed in terms of development and improvement for further manufacturing.

Key words: neem-based extract, moving-bed contacting, agitated-extraction vessel, vacuum evaporator, Azadirachta indica var. siamensis

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Introduction

The efficacy of neem-based extracts displays an array of effects on insects; such as, repellent, antifeedant, growth-retardant, molt disrupting, progeny development disrupting and oviposition deterrent. (National Research Council, 1992; Schmutterer, 1995). Although every plant part of the neem tree contains pest control properties, the past research works indicated that active ingredients are mostly concentrated in the seeds. Azadirachtin ($C_{36}H_{44}O_{16}$), tetranortriterpenoid, the most active insecticidal substance in neem seed, causes growth disruption, molting inhibition, egg-sterilization and other effects (Schmutterer, 1995). In Thailand, neem could be of economic significance and practically applied in many rural areas. It shows considerable potential for controlling of various insect pests; such as, *Plutella xylostella, Spodoptera litura, S. exigua, Hellula undalis, Phyllocnistis citrella, Helicoverpa armigera, Ohiomyia phaseloi, Nephotettix virescens* (Sombatsiri *et al.*, 1995) and phytophagous mites (Sanguanpong and Schmutterer, 1992). Besides, the practice of mixing neem materials especially neem oil with store products in a warehouse trial showed an effective protection against certain store insect pests (Sanguanpong *et al.,* 2001a, 2001b, 2002a).

Sadao, the local name of Thai neem, *Azadirachta indica* var. *siamensis* (Valeton), can be found in the North, Central, Northeast and South of Thailand. It is popularly used as farm borders and roadsides-tree and grows well at altitudes below 200 meters. Similar to "Sadao-Thai", the other two varieties, Indian neem tree (*A. indica* A. Juss) and Marrango tree (*A. excelsa* (Jack) Jacobs)*,* are naturally found in western and southern part of Thailand, respectively. According to their natural widespread, Thai neem is considered as the main kind of raw material for a commercial production in Thailand.

A single-step extraction method is commonly used for commercial production of neem-based extract in Thailand. Figure 1 shows the schematic diagram of of Thai neem-based extract processing in small-sized manufactures (Sanguanpong, 2000). Neem seeds are firstly crushed to crude powder and then extracted with methanol. By moving-bed contacting method neem seed will be stirred for 3-4 hours by overhead stirrer in mixing-settling tank. After decantation of crude cake, the neem solution is drained out, then filtered and proceed to the next procedure. The dilute neem solution will be further evaporated until a specific volume-the so called- "concentrated extract". Eventually, the obtained solution can be bottled and shipped to the consumer. Furthermore some of the products are formulated for a specific purpose. However, the formulation technology of neem-based insecticides is commercial secret.

According to the single-step extraction method, the concentrated extract still contains neem oil, which actually causes phytotoxic to the plant, if the oil content exceeds 1.00% W/W (Srivastava and Parmar, 1985). In some cases "latent phytotoxicity" by higher concentration of neem-based extract can result in lower yields than do lower doses (Ermel and Kleeberg, 1995). To separate the oil from neem material, oil expeller was designed and constructed. Besides, in this current experiment various equipment for other operations were also designed and assembled at Faculty of Agricultural Engineering and Technology as prototype for small-scale industrial production, such as seed decorticator, pulverizer, agitated-extraction vessel and evaporator. The actual yield of different neem-based extracts by all equipment and processes was compared with data on productivity under processing in laboratory, which was used as standard method or control treatment. The data obtained are discussed in terms of development and improvement for further manufacturing.

Neem Seed

CRUSHING

Neem Powder

Extraction

Diluted Extract   Marc

Evaporation

Concentrated extract   Recovery solvent
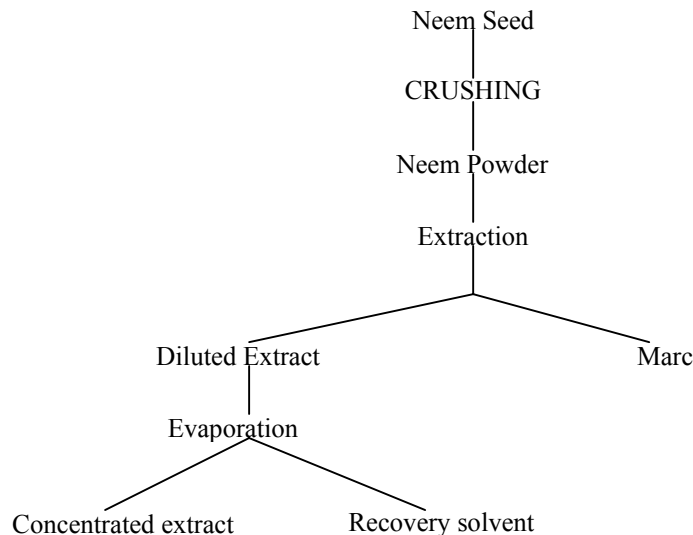
Figure 1. Schematic diagram of of neem-based extract processing in small-sized manufactures in Thailand

Materials and Methods

Processing Technology and Machinery

As raw material for neem-based extract processing, Thai neem seeds (*Azadirachta indica* var. *siamensis*) are used. Figure 2 shows the schematic diagram

of Thai neem-based extract processing at RIT-Pilot Plant resulting with equipment. Thirty kilogram of dried neem seeds at 8-12% (w.b.) moisture content was used in each experiment. They are firstly decorticated to obtain the seed kernel, then crushed and finally pressed to separate neem oil. By moving-bed contacting extraction technique, defatted neem cake will be extracted with methanol (1:3 W/W) in an agitated-extraction vessel. After decantation of crude cake in mixing-settling tank, the neem solution is drained out, then filtered and evaporated until a specific volume, the so-called-concentrated alcoholic neem-based extract. After quality measurement, the concentrate could be formulated for specific purpose as different commercial grade. Eventually, the product will be bottled and shipped to the consumer.
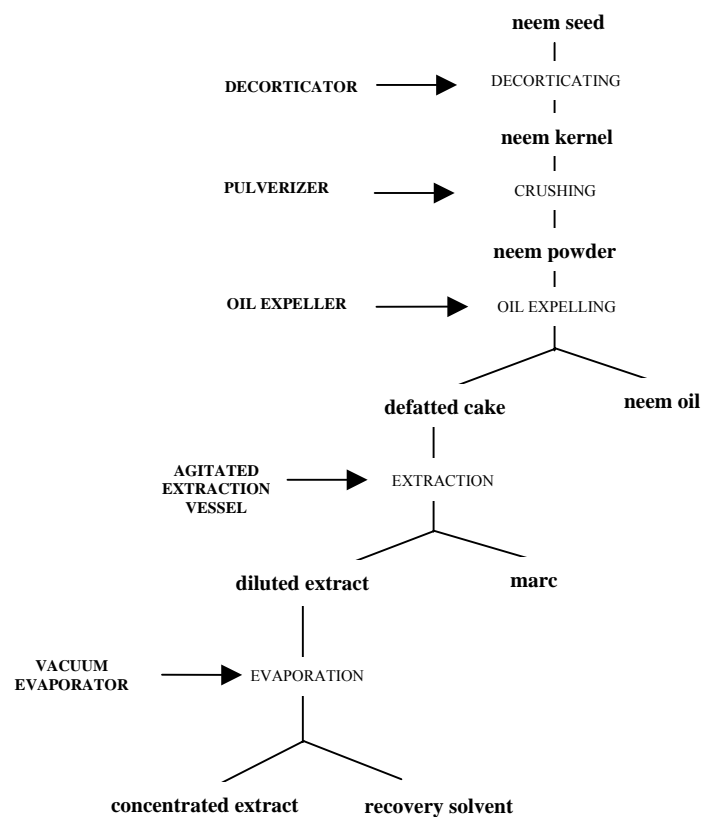
Figure 2. Schematic diagram of neem-based extract processing in RIT-Pilot plant resulting with equipment

Quality Control by Chemical Analysis of Azadirachtin

According to registration of neem-based extract for domestic production and use in Thailand, the requirements at the Toxicity Substance Act B.E. 2510 (1967) and B.E. 2516 (1973) under chemistry are prescribed by not requiring the toxicological data (Wong-Ek *et al*., 1997) The registration guideline set by Department of Agriculture, requires that a neem formulation should contain at least 0.1% azadirachtin (Praneetwattakul *et al.*, 1999). Hence, before packing and labeling, the concentrate will be analyzed for azadirachtin ($C_{36}H_{44}O_{16}$) content. It has been characterized quantitatively mainly by using High Performance Liquid Chromatography (HPLC) as described by Schneider and Ermel (1987).

Process Monitoring

To monitor the performance of two main processes, extraction and evaporation, the experiment under the same procedure as in pilot plant will be carried out in laboratory conditions and used as control process. 30 g of defatted neem cake is extracted with methanol (1:3 W/W) by moving-bed contacting using 8 positions magnetic stirrer. After decantation of crude, the solution is drained out, then filtered and further evaporated by rotary vacuum evaporator. The concentrate neem-based extract is residue after complete removal of methanol.

Characteristics of Physical Properties

Even information on the physical properties such as L*-a*-b* value (Hunter system), total soluble solid (TSS, °Brix) and density of neem-based extract as compared with chemical analysis of azadirachtin is yet not practical. It could be proper for rapid comparative analysis of large number of commercially available products and for optimizing process control. The L-a-b values of the extract were measured by Tristimulas-Colorimeter (Juki JC-801S, Japan), while refractometer was employed to measure total soluble solid (TSS, °Brix). Density was also measured in terms of mass (kg) per volume (liter) in all samples.

<div align="center">Results</div>

Processing Technology and Machinery

Data on preconditioning of neem materials by decorticating, crushing and oil expel was given in Table 1. By decorticating of Thai neem seed, the constitution of 50.17±3.08% hull and 47.75±3.05% kernel were found, while processing loss of 2.08±0.44 was obtained. The same trend on decorticating of Indian neem seed using 2 different disc hullers, i.e. granite disc huller and emery disc huller was reported by Ramakrishna *et al*. (1996). It was noticed that Indian neem seed constituted of 53% hull and 35% kernel, and the emery disc huller

was most efficient in decorticating. However, it was not mentioned on moisture content of seed materials, which influenced on result data (Sivakumar *et al*., 1996). In the next processing, seed kernel was directly fed into pulverizer (hammer mill). Data obtained showed that crushing of seed kernel gave also a good yield. However, processing loss of 6.67±3.33 was observed in crushing. Through oil expeller, only 7.93±1.79% neem oil was obtained, while the oil content was 18.64±2.28% in whole seed. It is suggested that development of oil expeller should be considered for better manufacturing.

Data on productivity of extraction and evaporation of neem-based extract was given in Table 2. It was found that extraction process gave a good yield of solution and a few loss of solvent was also determined. Compare to evaporation process, loss of solvent at 13.72±0.34% was observed. This reflected the low performance of evaporator which could be considered for further improvement. Similar data was reported on vacuum evaporator for village scale (capacity of 30 L/batch), but fewer loss of solvent (8.00±3.60%) was determined (Sanguanpong, 2002b).

Quality Control by Chemical Analysis of Azadirachtin

The result of azadirachtin and oil content was shown in Table 3. Only 0.98±0.06% oil was found in the concentrated extract, whereas the average amount of azadirachtin content of Thai neem-based extract was 3.43±0.64 mg/g seed kernel. Compare to Foerster and Moser (2000), it was reported that azadirachtin content of neem kernel in Thailand was approx. 5.20 mg/g whereas in India only 5.14 mg/g was found. High amount of azadirachtin were observed in Ghana and Kenya about 6.2-6.9 and 6.8-8.8 mg/g respectively. However, many important factors could affect the degradation of azadirachtin in tropical regions, i.e. high temperature, humidity and storage conditions (Ermel *et al*., 1987). Hence, it was difficult to define the ability or quality of process by using omly azadirachtin content in material. These could be confirmed by Sombatsiri *et al.* (1995), who found that samples from different provinces throughout Thailand contained azadirachtin content from inferior quality (1.40 mg/g) to high quality (5.30 mg/g).

Table 1. Preconditioning of neem material (8-12% mc) by decortications, crushing and oil Expelling

Process (Equipment)	Products	Yield (%)
Decorticating (Decorticator)	Hull* Kernel Processing loss	50.17±3.08 47.75±3.05 2.08±0.44
Crushing (Pulverizer)	Kernel powder Processing loss	93.33±3.33 6.67±3.33
Oil expelling (Oil expeller)	Oil** Defatted cake Processing loss	7.93±1.79 88.10±2.69 3.97±0.90

*   Thai neem seed constitutes of 50.07±1.07% hull and 49.93±1.12% kernel
** The oil content is 18.64 ± 2.28% in whole seed.

Table 2. Productivity of neem-based extract under processing in RIT-pilot plant

Process	Solution out[1] (%)	Marc out[2] (%)	Recovery solvent[3] (%)	Loss of solvent[4] (%)
Extraction	63.67±3.79	27.00±4.00	-	9.33±1.53
Evaporation	50.17±1.09	-	36.11±1.17	13.72±0.34

[1]solution out (%) = (weight of extract) x 100   [3]recovery solvent (%) = (weight of recover solvent) x 100
                              Total mass   Total mass
[2]marc out (%) = (weight mace) x 100   [4]loss of solvent (%) = (total mass-solution out-mace out) x 100
                        Total mass   Total mass

Process Monitoring

In Table 4 data obtained on productivity of extraction and evaporation of neem-based extract under laboratory scale are presented. Compare to productivity under processing in RIT-pilot plant in Table 2, the results confirmed that the extraction process in RIT-pilot plant gave a good yield as same as in laboratory but more loss of solvent was determined. Similar to extraction process,

more loss of solvent was observed by evaporation in RIT-pilot plant. Yield and loss (%) of different products under the same process in different scales were also calculated (Table 5). It showed that yields obtained from pilot plant were not different from control process. On the other hand, loss of solvent by extraction and evaporation process in pilot plant were relative higher than in laboratory.

Table 3. Azadirachtin (amount in mg/g and concentration in solution) and oil content (%) in neem-based extract produced from RIT Pilot Plant

Production Scale	Azadirachtin content		Neem oil (%)
	mg/g $\pm$ SE	% in solution	
Pilot Plant	3.43±0.64	0.23±0.02	0.98±0.06

Table 4. Productivity of neem-based extract under processing in laboratory

Process	Solution out[1] (%)	Marc out[2] (%)	Recovery solvent[3] (%)	Loss of solvent[4] (%)
Extraction	68.49±1.33	30.42±1.26	-	1.09±0.16
Evaporation	50.01±0.01	-	46.40±1.25	3.60±1.25

[1]solution out (%) = (weight of extract) x 100   [3]recovery solvent (%) = (weight of recover solvent) x 100
                              Total mass   Total mass
[2]marc out (%) = (weight mace) x 100   [4]loss of solvent (%) = (total mass-solution out-mace out) x 100
                        Total mass   Total mass

Characteristics of Physical Properties

         Characteristic comparison on physical properties of neem-based extract produced from laboratory and RIT-pilot plant were shown in Table 6. Under the same procedure, neem-based extract could be produced more concentrate in RIT-pilot plant than those obtained in laboratory. More total soluble solid (°Brix) and density were observed. L*-value (Lightness value) indicated that the extract from laboratory was brighter than from pilot plant. It was obviously seen from the color of neem-based extract from pilot plant, which was yellow-brown and darker than from laboratory. However, the relevance between physical properties and quality of neem product was not investigated.

Table 5. Yield and loss (%) of different products under processing in laboratory compare to RIT- pilot Plant

Production scale	Neem-based extract [2] (%)	Marc out [2] (%)	Recovery solvent [3] (%)	Loss of solvent [4] (%)	
				Extraction	Evaporation
Laboratory	34.25±0.01	30.42±1.26	31.77±1.25	1.09±0.16	2.47±1.25
Pilot plant	31.57±2.71	27.00±4.00	22.67±0.76	9.33±1.53	8.63±0.71

[1]solution out (%) = (weight of extract) x 100   [3]recovery solvent (%) = (weight of recover solvent) x 100

                         Total mass   Total mass

[2]marc out (%) = (weight mace) x 100   [4]loss of solvent (%) = (total mass-solution out-mace out) x 100

                Total mass   Total mass

Table 6. Physical Properties of neem-based extract produced from RIT-pilot plant compared to rom laboratory

Production Scale	L*-a*-b* value			° Brix	Density (Kg/L)
	L*	a*	b*		
Laboratory	43.57±0.71	-1.89±0.80	29.25±0.35	8.00±0.00	0.82±0.00
Pilot plant	28.86±6.44	1.13±1.42	19.97±4.57	10.33±2.89	0.83±0.01

Conclusions

Small-scale industrial production of neem-based extract in RIT- pilot plant was studied. A set of special equipment; such as, seed decorticator, pulverizer, oil expeller, agitated-extraction vessel and evaporator were assembled. They were employed to produce mainly an alcoholic neem-based extract. The performance of all equipment was evaluated. With 250 days running, the capacity of pilot plant will be approx. 27,000 L/year. However, low capacity of some equipment, in particular, oil expeller and high processing loss of evaporator were found. To apply the finding for improvement of processing quality, it is still necessary to develop a suitable equipment for further manufacturing. On these attributes, data analysis of productivity in laboratory is

recommended for process monitoring and optimizing. However, the ability to optimize or improve the process is dependent upon not only the ability to control the process, but also the access to reliable eventually valid measurements. By the way, requisite research on physical properties of neem-based products and development effort will have to put not only technology practically but also technological challenge.

Due to increasing of consumer health awareness in case of toxic residues in food crops, it can be expected that market potential of neem-based pesticide will be growth. At present, three kinds of neem-based products are availble: RITNEEM (a liquid extract containing 0.10-0.30% aza.), RITNEEM -DC (defatted neem cake for "Tea-bag method") and RITNEEM –O (formulated neem oil). However, the products are not available in the market. They are only produced for distribution to RIT-agricultural campus in different part of Thailand. Through multilateral co-operation with representatives of companies and some institution (i.e. Federal of Thai Industrial), chance for joint-venture are being done.

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POTENTIAL YIELD TEST OF FIVE LILIES GENOTYPES
(*Lilium spp.*)

Syarifah Iis Aisyah[1], Budi Marwoto[2] and Erythrea[1]

Abstract

Sustainable resource management in plant breeding means maintaining the variability of germplasm for the success of creating a new plant variety with novel characters. These characters should be commercially demanded by consumers, such as high productivity with low input, resistance to pest and disease, etc. In the lily breeding program at RIOP (Research Institution of Ornamental Plant) Indonesia, interspecific hybridisation was conducted between local and introduced lines, in order to obtain better characters based on consumer's demand: more adaptive to low land of tropical area, having more attractive performance of its flower and better size of its reproductive organs.

The local line (Lilium longiflorum), namely "Lokal Bandungan (LBD)" was used because of its longevity of vas life and unreduced bulb size of its offspring. The introduced line (L. candidum, L. pumilum) used, based on the most consumer preference of its performance, were cv "Casablanca (CS)","Connecticut King (CK)", "Garden Lily-4 (GL4)", Solemio (SL)", "Avignon (AV)" and "Snow Queen (SQ)". There are five lilies genotypes resulted from these interspecific hybridisation used in this experiment, i.e. genotype 500.8, 500.11, 500.14, 61.2, and 414.1. As a comparison we used number 29.1, since this is an usual adapted genotype cultivated by the farmers.

The objective of this study was to test the potential yield of six genotypes of interspecific-crossed lilies. The experiment was conducted at PT Mekar Alam Asri, a private company located at Cibinong-Bogor, with the elevation around 600 meters above sea level. A randomised complete block design with three replications was applied to the experiment with the different genotypes as treatments.

The results showed that there were no significant differences among genotypes in terms of all characters observed, compared to genotype 29.1. All the evaluated genotypes showed similarity on its yield and have potential for further testing such as multilocation test, before being released as new cultivars.

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Introduction

Agribusiness of ornamental plants, including cut flowers, still have prospective market in Indonesia. As cut flower, lily (*Lilium sp*.) is preferred because of its fragrance, beautiful colour and attractive appearance.

To maintain the sustainability of lilies cultivation, one should provide the availability of the seed/ bulb, which is adaptive to the local area. Regarding to this matter, the breeding program of lily was carried out in Research Institution of Ornamental Plants (RIOP), Indonesia. The hybridisation was conducted between local lilies and introduced one. The local lily (*L. longiflorum* or *L. pumilum*) has a high adaptability to the tropical condition and its bulb doesn't have any dormant period, whereas "Asiatic" or "Oriental" imported lily needs vernalization to break the dormancy of bulb (Wilkins, 1980; Pergola, 1986; Weiler, 1992). The interspecific hybridisation was proved as a good technique to create a new-novel hybrid variety (Van Tuyl, 2002).

In preparation of releasing a new variety, the prospective lines should be tested for their potential yield. The line will be evaluated as a novel variety when it has a high productivity and other characters (Sjamsudin, 1999).

Objective

The objective of this research was to test the yield of six genotypes resulted from interspecific hybridisation of lilies, for the preparation of releasing a new lily variety.

Methodology

The genotypes used in this study were number 500.11, 500.14, 61.2, 414.1 and number 29.1 as a comparison genotype. Number 29.1 has been an usual genotype cultivated by the farmers, and known as an adapted line in tropical area. The study was conducted by a complete randomised design, consisting 6 genotypes as treatment. Each treatment was presented by 15 samples, with three replications.

Plants were propagated by cultivating the bulb in perlite media. Four weeks seedlings was transplanted in the polybag for 2 months, and were planted in the land afterwards, with 20 x 20 cm space in between. Long day period was treated in order to induce the flower initiation. This additional light was given during the night, from 22.00 pm until 02.00 am, using 75 watt inflorescent bulb lamp. Harvesting was conducted when 50% of the plants has produced "ready-to bloom" flower. Insecticide and fungicide were applied once a week or when it was needed.

The parameters observed were plant height (cm), diameter of stem (cm), total leaf number, time of flower initiation, diameter of flower (cm),

diameter of pistil (cm), the length of style (cm), the length of ovary (cm), vase life (day), and the number of flower.

The data were analysed by ANOVA and the significant result will be further analysed by Duncan Multiple Range Test (Gomez and Gomez, 1995).

Results and Discussions

All tested plants grew well in the research field. Day and night temperature was 29^0C and 16^0C, respectively. Temperature is an important factor for the flower initiation of lily. Likewise, the day length is also important for the initiation of lilies' flower and the uniformity of plant growth.
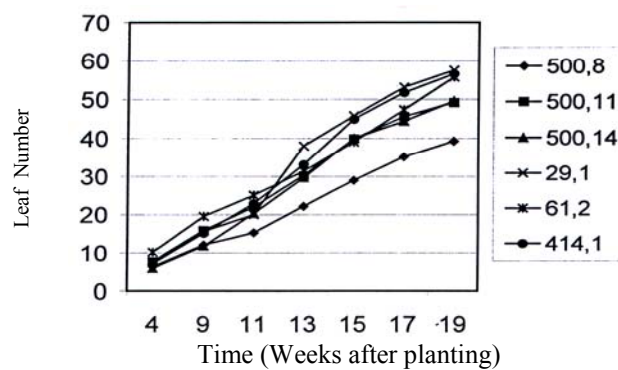
Figure 1. The Growth of Leaf Number of Six Lilies Genotypes

Vegetative Parameter

The growth of some vegetative parameters was measured, i.e. the total leaves number (Figure 1), plant height, and stem diameter. Based on analysis of variant, there are no significant differences among these vegetative parameters.

At 9 weeks after planting date, the total number of leaves were around 11.7-19.5 pieces; Genotype 61.2 had the highest of total leaf number, whereas the least was genotype 500.8. Actually, plant with too many leaves may cause the death of leaves in the below part because of their upper leaf covering (Weiler, 1992). In addition, too many leaves may increase the relative humidity, which eventually will initiate the growth of disease (mould, fungi, etc.). Vice versa, too little amount of the leaves may cause insufficient nutrient for better growth, and finally will inhibit the production of flower.

The treatment of long day period given to the plants was successful to uniform the height of plant for the same genotype population. But among the genotypes, the plant height was also insignificantly different due to statistical

analysis. In fact, there are a lot of factors influence the plant height, i.e. planting method, vernalisation, light intensity, photoperiodism, temperature, plant variety, bulb size, rooting time, fertilizer, and watering (De Hertogh and Wilkins, 1971 *in* Wilkins, 1980).

Although statistically the stem diameter is not significantly different among genotypes, but genotype 29.1 has the largest diameter of stem and the smallest one is genotype 500.14. The plant with too small diameter of stem will be easy to fall down. Therefore, the stem diameter should be big enough in order to be able to support more than one flower per stem.

Generative Parameter

Flower initiation occurs when an apical meristem start to form generative bud (Wilkins, 1980). The analysis of variance of the number of days for flower initiation showed that there was no significant difference among genotypes. However, genotype number 61.2 is the fastest (only need 17.9 days to initiate the flower) and the latest is the compared genotype, 29.1 (need 20.6 days for initiation).

The diameter of flower among observed genotypes did not show any difference statistically. But actually, there were 3 genotypes (no. 500.8, 500.11, and 414.1) known having bigger diameter compared to number 29.1 (Figure 2.). The biggest flower was found in genotype number 500.8 (11.5 cm) and the smallest flower was genotype number 61.2 (10.9 cm).
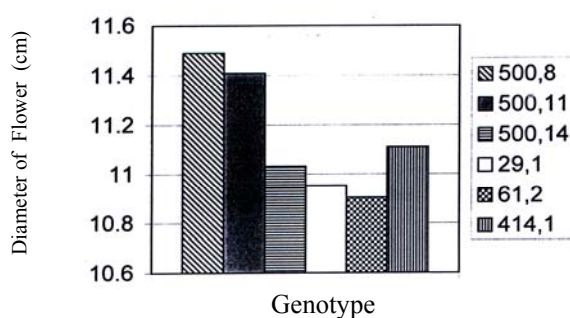
Figure 2. Diameter of Flower of Six Lilies Genotypes

In the market, the most preferred lilies are those with big (diameter of) flower and beautiful colour. All of observed flowers in this study have white colour and outward facing flowers.

All statistical analysis for diameter of pistil, the length of style and the length of ovary indicated no significant differences. The range of pistil diameter is from 0.97 cm (the biggest, number 500.8) to 0.84 cm (the smallest, number

500.14). The longest style is 9.28 cm (number 414.1) and the shortest is 8.57 cm (number 500.11). The longest ovary is found in number 29.1 (7.58 cm) whereas the smallest one is number 61.2 (6.37 cm).

The size of pistil, the length of style and the length of ovary wanted by the consumers are those proportional to the flower size. Too big or too long pistil will be looked mismatch with the performance of flower. But for plant breeder, in term of hybridisation purpose, big diameter of pistil will increase the opportunity to the occurrence of higher fertilisation process.

The character of flower number per stem did not show any differences statistically. But as the comparison genotypes, number 29.1 still indicated the highest of flower number (2.8 buds per stem). The observation from the research field also showed that one sample plant of genotype 61.2 had 6 flowers per stem, the prospective line that should be kept for further breeding program. Genotype 500.14 has the smallest number of flower, 1.8 buds per stem. Nevertheless, this genotype is still better than Local Korean Lily, which only produce 1.5 buds per stem on average (Roh and Choi, 1982).

The number of flower per stem is highly influenced by some vegetative factors, e.g. plant height, stem diameter, and the number of leaf. High production plant usually has high characters of plant height, stem diameter, and the number of leaf, as well.

Vas life test was done indoor, with room temperature 20-27^{0}C. This test was very important to know how long each lily genotypes can survive as cut flower when they were placed indoor. ANOVA for this traits did not show any difference statistically among genotype. However, Number 29.1 as a comparison genotype, still has the longest period for its vase life: 8.5 days; whereas the shortest was number 500.8 which only can survive for not longer than 7.1 days (Table 1).

Table 1. Average and Varian of Generative Characters and vase life of Six Lily Genotypes

Genotype	Flower Initiation (WAP)*	Flower diameter (cm)	Pistil diameter (cm)	Length of style (cm)	Length of ovary (cm)	Flower per stem (buds)	Vase life (days)
500.8	19.8	11.46	0.97	8.93	7.53	1.9	7.10
500.11	19.1	11.41	0.96	8.57	7.22	2.1	7.96
500.14	19.8	11.03	0.84	8.64	7.02	1.8	7.73
61.2	17.9	10.91	0.90	9.21	6.37	2.1	7.13
414.1	20.0	11.11	0.88	9.28	7.24	2.1	8.20
29.1**	20.6	10.95	0.90	8.93	7.58	2.8	8.53
F table	**0.97**	**0.94**	**0.91**	**1.06**	**0.94**	**1.41**	**1.39**

* Weeks after planting date
** Comparison genotype

One important factor for retaining the freshness of cut flower is the ability of its petiole to absorb water from the vas to the flower. Flower wilt is generally caused by the air trapped in the capillary vessel, that blocked water flow from vas to apical flower (Marwoto *et al.,* 1999). It is suggested to change vase water every 2 days and cut 1 cm the basal part of petiole to fluent the water from vas to flower. According to Swart (1981), vase life can be prolonged by immersing the petiole to the preservative solution e.g. Bendien Anjer VB, for 4-36 hour after harvesting time

Conclusion

Generally, all tested genotypes are able to grow well in the tropical area. The characters of total leaf number, plant height, stem diameter, flower initiation, diameter of flower, diameter of pistil, the length of style, the length of ovary, the number of flower per stem and the vase life of each tested genotype have a similar performance and show insignificant differences to the comparison genotype.

Genotype number 29.1 has the highest number of flower per stem and the longest vase life. Genotype number 61.2 has the fastest flower initiation, whereas genotype number 500.8 has the biggest diameter of flower. All lilies tested in this study show statistically insignificant differences of yield amongst genotypes.

Suggestion

The plant from genotype number 61.2 which has 6 buds per stem is suggested to be used as a parental line for further breeding program. All of these lily genotypes are suggested to be develop and include in multi location test.

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ANTIBACTERIAL ACTIVITY OF *ANDROGRAPHIS PANICULATA* LEAF EXTRACTS

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Abstract

A study was conducted at the laboratory of Diagnosis and Research Centre, Department of Livestock Development, Wang Tong District, Phitsanulok Province, Thailand and the study was carried out to determine the antibacterial activity of Androgprahis paniculata (Burm. f.) Nees extract with different solvents. AP leaves powder (andrographolide 7.30%) that was already tested for quality was used in this experiment. It was extracted in a series of three different solvents: distilled water, 70% alcohol and 85% alcohol. The antibacterial activity of each AP leaves solvent was analyzed by using agar disk diffusion method as antibacterial susceptibility test was placed in flasks and added solvent either distilled water, 70% alcohol or 85% alcohol (1:10 w/v). The flasks were placed in a shaking water bath at 50°C for 48 hr after which the solvents were filtered through filter paper (residue was not used). The extract solutions were put in a rotary evaporator and evaporated at 50°C until dry residues were left. These residues were weighed. Disk papers with a 5.8 mm diameter, were sterilized and dried. Then, the dry extract prepared was dissolved again with the same solvent and diluted with distilled water in proportions of 1:10, 1:100, 1:1000 (w/v) to determine which of these concentrations had a inhibitory effect on bacterial growth. 0.03 ml AP extract were added to each paper. After that it was placed in an oven and dried at 50°C overnight. 4 samples of bacteria from the Laboratory of Diagnosis and Research Centre, Department of Livestock Development were used in the experiment 1.1: S. typhimulium, S. spp., E. coli ATCC 25922 (standard), E. coli (from chicken). The bacteria were grown in Petri dishes with Mueller-Hinton Agar (MHA). The inoculum suspensions were compared with McFarland standard No. 0.5. After that the bacteria were spread over the surface of the MHA disks using sterilized swab. The experiment 1.2 was conducted after Experiment 1.1 was evaluated. It used the same method as Experiment 1.1 but the number of samples was changed to 14 samples with 3

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types of bacteria: Salmonellae (sample 1 - 3), E. coli (sample 4 - 10) and P. multocida (sample 11 - 14) and only the concentration 1:10 w/v of the different AP extracts was used. As control Streptomycin 2 mg/ml was used. The Study in experiment 1.1 showed none of the used concentrations 1:10, 1:100 and 1:1000 of AP aqueous extract showed any antibacterial effect on S. typhimrium, S. spp., E. coli ATCC and E. coli (from chicken). Only the concentration 1:10 of 70% and 85% of alcoholic extract of AP showed moderate to intermediate activity to S. typhimurium with inhibition zones of 12 and 10 mm respectively. The minimum inhibitory concentration (MIC) of 70% and 85% alcoholic extract of AP were 1:10 according to this test.

The lower concentrations of 1:100 and 1:1000 did not influence the bacteria growth. Results of experiment 1.2 showed the aqueous extract of AP 1:10 showed no antibacterial activity towards any of the bacteria tested. Also 70% and 85% alcoholic extract of AP 1:10 showed no antibacterial activity towards any of the Salmonellae and E. coli strains of bacteria tested. However, these two extracts of AP showed antibacterial activity towards three of the four tested P. multocida strains. Six of the seven tested E. coli strains, one of the two tested S. spp. and one of the four tested P. multocida showed resistance to the Streptomycin. Thus, AP leaves can be used as antibacterial agents against diarrhea is promising .

Key words: Andrographis paniculata (Burm.F.) Nees., agar disk diffusion, minimum inhibitory concentration (MIC), antibacterial activity

Introduction

Currently, the farmers in Thailand usually raise livestock production by using antibiotic for example chlortetracycline for stimulates growth rate of animal and for the reason to prevent the animal from the disease. However the using of antibiotic has some problems about the toxic in their meat. Therefore, these studies will considered the using of *Andrographis paniculata* (Burm. F.) Nees. (AP), it is a shrub found throughout India and other Asian countries that is sometimes called "India Echinacea." It has been used historically in epidemics, including the Indian flu epidemic in 1919, during which AP was credited with stopping the spread of the disease. It is well known for the active compound the name Andrographolide. Which can be used as medicine for human such as antibacterial agents against diarrhea. On the other hand, AP is long known in traditional Asian medicine as an immune system booster. AP is considered to have beneficial effects on various modify functions and ailments ranging from degenerative diseases to the common cold.

Objective

The study was conducted to determine the antibacterial activity of *Andrographis paniculata* (Burm. f.) Nees extract with different solvents.

Materials and methods

Experiment 1.1

This experiment was carried out in the laboratory of Diagnosis and Research Centre, Department of Livestock Development, Wang Tong District, Phitsanulok Province, Thailand under the supervision of a team of veterinarians.

1.1.1 Preparation of AP leaves powder

AP leaves powder (andrographolide 7.30%) that was already tested for quality in experiment 1 was used in this experiment.

1.1.2 Extraction of AP by maceration method

Based on the standard method for chemical analysis described by Cuilei (1984), AP leaves powder was extracted in a series of three different solvents: distilled water, 70% alcohol and 85% alcohol. The antibacterial activity of each AP leaves solvent was analyzed by using agar disk diffusion method as antibacterial susceptibility test (NCCLS, 1993).

AP leaves powder was placed in flasks and added solvent either distilled water, 70% alcohol or 85% alcohol (1:10 w/v). The flasks were placed in a shaking water bath at 50°C for 48 hr after which the solvents were filtered through filter paper (residue was not used). The extract solutions were put in a rotary evaporator and evaporated at 50°C until dry residues were left. These residues were weighed.

1.1.3 Preparation of disk papers with AP extract

Disk papers with a 5.8 mm diameter, were sterilized and dried. Then, the dry extract prepared was dissolved again with the same solvent and diluted with distilled water in proportions of 1:10, 1:100, 1:1000 (w/v) to determine which of these concentrations had a inhibitory effect on bacterial growth. 0.03 ml AP extract were added to each paper. After that, this was placed in an oven and dried at 50°C overnight.

1.1.4 Preparation of bacteria

4 samples of bacteria from the Laboratory of Diagnosis and Research Centre, Department of Livestock Development, Wang Tong District, Phitsanulok Province, Thailand were used in this experiment: *S. typhimulium*, *S. spp., E. coli* ATCC 25922 (standard), *E. coli* (from chicken). The bacteria were grown in Petri dishes with Mueller-Hinton Agar (MHA). The inoculum suspensions were compared with McFarland standard No. 0.5. After that the bacteria were spread over the surface of the MHA disks using sterilized swab.

1.1.5 Preparation of disk diffusion test with AP extract

    The papers with AP extract in different rations that were prepared under 1.1.3 were placed on the MHA disks on which the bacteria were spread (1.1.4) and the disks incubated at 37°C for 24 hr. After that the diameters of inhibition zones (clear zones) around the papers were measured**.**
Result were measured according to Ruengsakul (1987) for medicinal plants as:

    Resistant: < 6 mm   (-)
    Susceptible: intermediate susceptible: 6 - 10 mm (+)
           moderate susceptible: 11 - 15 mm (++)
           susceptible: 16 - 20 mm   (+++)

Experiment 1.2

    This experiment was conducted after Experiment 1.1 was evaluated. It used the same method as Experiment 1.1 but the number of samples were changed to 14 samples with 3 types of bacteria: *Salmonellae* (sample 1 - 3), *E. coli* (sample 4 - 10) and *P. multocida* (sample 11 - 14) and only the concentration 1:10 w/v of the different AP extracts was used. As controlled, Streptomycin 2 mg/ml was used.

    The results for medical plants were recorded as under experiment 1.1 whereas the results for the antibiotic streptomycin was recorded according to Arunruek (1994) as:

    Resistant: < 11 mm   (-)
    Susceptible: > 11 mm   (+)

Results

    In experiment 1.1 none of the used concentrations 1:10, 1:100 and 1:1000 of AP aqueous extract (Table 1.1) showed any antibacterial effect on *S. typhimrium*, *S. spp.*, *E. coli* ATCC and *E. coli* (from chicken). Only the concentration 1:10 of 70% and 85% of alcoholic extract of AP showed moderate to intermediate activity to *S. typhimurium* with inhibition zones of 12 and 10 mm respectively. The minimum inhibitory concentration (MIC) of 70% and 85% alcoholic extract of AP were 1:10 according to this test. The lower concentrations of 1:100 and 1:1000 did not influence the bacteria growth.

    Results of experiment 1.2 were given in Table 1.2 The aqueous extract of AP 1:10 showed no antibacterial activity towards any of the bacteria tested. Also 70% and 85% alcoholic extract of AP 1:10 showed no antibacterial activity towards any of the *Salmonellae* and *E. coli* strains of bacteria tested. However, these two extracts of AP showed antibacterial activity towards three of the four tested *P. multocida* strains. Six of the seven tested *E. coli* strains, one of the two tested *S. spp.* and one of the four tested *P. multocida* showed resistance to the Streptomycin.

Table 1. Susceptibility results of agar diffusion test with different AP extracts and concentrations for different diarrhea bacteria

Types of bacteria	Aqueous extract of AP			70% alcoholic extract of AP			85% alcoholic extract of AP		
	1:10	1:100	1:1000	1:10	1:100	1:1000	1:10	1:100	1:1000
S. typhimurium	-	-	-	++ 12	-	-	+ 10	-	-
S. spp.	-	-	-	-	-	-	-	-	-
E. coli ATCC (25922)	-	-	-	-	-	-	-	-	-
E. coli (from chicken)	-	-	-	-	-	-	-	-	-

Notes: for medicinal plants: Resistant: - = < 6 mm; Susceptible: + = 6 - 10 mm, ++ = 11 - 15 mm, +++ = 16 - 20 mm

Table 2. Susceptibility results of agar diffusion test with different AP extracts for different diarrhea bacteria

Type of bacteria	Aqueous extract of AP 1:10	70% alcoholic extract of AP 1:10	85% alcoholic extract of AP 1:10	Streptomycin 2 mg/ml
1. *S. spp.* (Lampang province)	-	-	-	+ 20 *
2. *S. typhimurium* (Institute)	-	-	-	+ 18
3. *S. spp.* (Phitsanulok)	-	-	-	- 6
4. *E. coli* 25922	-	-	-	-
5. *E. coli* (chicken)	-	-	-	-
6. *E. coli* (chicken)	-	-	-	-
7. *E. coli* (pig)	-	-	-	-
8. *E. coli* (pig)	-	-	-	-
9. *E. coli* (deer)	-	-	-	+ 20
10. *E. coli* (duck)	-	-	-	- 7
11. *P. multocida* (buffalo tissue)	-	++ 12	+ 10	+15
12. *P. multocida* (buffalo liver)	-	+ 6	+ 6	- 6
13. *P. multocida* (beef tissue)	-	+ 6	+ 7	-
14. *P. multocida* (beef heart)	-	-	-	+ 20

Notes for medicinal plants: Resistant: - = < 6 mm; Susceptible: + = 6 - 10 mm, ++ = 11 - 15 mm, +++ = 16 - 20 mm
*For Streptomycin (control): Resistant: - = < 11 mm; Susceptible: + = > 11 mm

Discussion

In experiment 1.1 and 1.2 the antibacterial activities of AP leaves extracts were determined using the agar diffusion test method. Arunruek (1994) describes in her book about sensitivity tests, that the agar dilution test is quite difficult because the medicine must be diluted several times to treat each sample, so it takes a long time and is more expensive than the agar diffusion test which gives comparable rapid results. Therefore, in this experiment the agar diffusion test was chosen. Agar diffusion is meant to be an excellent method to quickly determine anti-microbial properties (Rovinsky and Cizadlo, 1998). In the disk diffusion susceptibility test, disks containing known amounts of an antimicrobial agent are placed on the surface of an agar plate that has been inoculated confluently with a standardized suspension of a strain of bacteria. The antimicrobial agent diffuses into the medium causing a zone of inhibition of growth of the strain around the disk corresponding to the susceptibility of the strain to that agent. Interpretative zone diameters have been established to permit classifying an isolate as belonging to the susceptible, intermediate resistance or resistant categories of susceptibilities to an antimicrobial agent (CDCD, 2000), but this method has also a few sources of error. Among this method are clerical error in recording data, reader error in measuring zone diameters and contamination or changes in the bacterial strain has been tested. Also agar diffusion may not give an accurate picture of the effectiveness of an antibiotic within a living organism. Microbes may show *in vitro* sensitivity to an antibiotic, with little or no sensitivity to it *in vivo* (Rovinsky and Cizadlo, 1998).

In experiment 1.1, the AP aqueous extract had no activity in any type of diarrhea bacteria. However, the 70% and 85% alcoholic extract in concentration 1:10 showed high activity to *S. typhimurium*. The inhibition zone (clear zone) on *S. typhimurium* in 70% alcoholic extract was 12 mm and 10 mm in 85% alcoholic extract. However, the lower concentrations showed no activity on any bacteria.

In a similar experiment using agar dilution method Pluemjai (1992) studied the antibacterial activity of 70% and 80% alcoholic extracts from AP leaves against diarrhea and respiratory tract bacteria. She found that both alcoholic extracts showed high activity. However, at the same value of the minimum inhibitory concentration (MIC), the 85% alcoholic extract which contained 8.30 mg of andrographolide showed significant antibacterial activity against *E. coli*, *S. kerfeld, S. typhimulium, V. cholerae* 01 and *S. dysenteriae*, whereas the 70% alcoholic extract showed less antibacterial activity.

The result of Pluemjai (1992) are similar to the results of experiment 1.1 However, the experiment 1.2 differs from her results since here neither of the alcoholic extracts 70% and 85% showed any activity to *Salmonellae* and *E. coli*. They only showed high activity in *P. multocida*. The 70% alcoholic

extract showed higher antibacterial activity in *P. multocida* from buffalo tissue than 85% alcoholic extract, but 85% alcoholic extract showed higher antibacterial activity than 70% alcoholic extract in sample from beef tissue. A reason for these different results may be due to the different methods that were used. A possible reason could be the different content of active constituents of AP leaves in the studies. This study used AP leaves with 7.30% of andrographolide, the most effective active constituent of AP plant but Pluemjai used plant material with 6.77% andrographolide in 70% alcoholic extract and 8.30% andrographolide in 85% alcoholic extract. Another reason for the different result are the different sources of bacteria that were used in the experiments. In this experiment all bacteria were from the tissue of different animals that had been sent for disease diagnosis at the Diagnosis Research Center in Phitsanulok Province, Thailand whereas Pluemjai got all bacteria samples from human patients of Siriracha Hospital in Bangkok, Thailand. Some bacteria from the animals may already have been treated by antibiotics. This may have led to resistance in some strains.

Streptomycin used as control in experiment 1.2 showed high activity in *Salmonellae, P. multocida* but was not active in *E. coli* bacteria. 70% and 85% AP alcoholic extract had antibacterial activity on *P. multocida* but not on any other bacteria. *P. multocida* strains tested were from buffalo and this may give different result as when bacteria from poultry were tested. Therfore further studies should be established. If it proves effective in poultry strains, it can possibly be good to give this plant as a feed additive in poultry production to prevent fowl cholera.

However, also if the AP plant has no antibacterial activity killing diarrhea bacteria, it may relieve the diarrhea symptoms. Yin and Guo (1993) found that a dose of 500 mg per day for six day of andrographolide was effective on acute bacterial diarrhea in human patients. Chturvedi *et al.* (1983) found also an overall effectiveness of 91.3% of AP leaves on bacterial dysentery and diarrhea and Thanangkul and Chaichantipyuth (1985) found that AP had effect on curing diarrhea and bacillary dysentery in the group of patients in Ramatipbodee Hospital in Bangkok, Thailand. Dhamma-upakorn *et al.* (1992) and Sawascimongkol *et al.* (1990) found that the AP extract has an effect to reduce the movements of the smooth muscle in stomach and intestinal tract in human.

Conclusions

Though active constituents in AP leaves have the activity to reduce the symptoms of diarrhea and dysentery diseases in human, this effect doesn't seem to be an antibacterial effect. Further test should be made for poultry.

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Livestock Production Systems

A STUDY OF THE BLOOD CHEMISTRY VALUE OF THAI NATIVE CHICKENS IN PHATTHALUNG PROVINCE

Adcharatt Suwanpugdee[1], Aporn Songsang[1] and Hirihattaya Phetmung[2]

Abstract

Data on the blood chemistry of native chickens in the tropical environment is scarce. The blood chemistry value of three types of regional Thai local male chickens were investigated. Twelve of each type of chicken; naked neck male chickens (NNC), fighting cocks (FC) and normally feathered male chickens (NFC), at the age of approximately 5 - 6 months, were collected from the farmers. All animals were kept and provided with the same feeding and housing conditions for 1 month. Blood samples were taken from the wing vein for the analysis of blood chemistry. The average level of uric acid in blood of NNC, FC and NFC was 4.83 ± 1.01, 5.91 ± 1.58 and 5.24 ± 1.22 mg/100ml, respectively. The average level of creatinine content in blood was 1.27 ± 0.15, 1.36 ± 0.17 and 1.33 ± 0.19 mg/100ml for NNC, FC and NFC respectively. Even though there were no significant ($p>0.05$) differences in both uric acid and creatinine across the groups, there was a trend of a higher uric acid and creatinine in the blood of FC compared to those of NNC and NFC. There were no significant ($p>0.05$) differences in cholesterol among groups. They averaged 144.51 ± 25.75, 131.17 ± 24.29 and 136.82 ± 30.98 mg/100ml, respectively. There was a trend of lower cholesterol content in blood of FC compared to the NNC and NFC. For protein content in blood, there were no significant ($p>0.05$) differences in total protein and globulin content in blood of NNC (4.37 ± 0.74, 2.56 ± 0.76 g/100ml), FC (4.69 ± 0.67, 2.76 ± 0.66 g/100ml) and NFC (4.03 ± 0.65, 2.42 ± 0.58 g/100ml). In contrast, there was a higher ($p<0.05$) in blood albumin of FC (1.92 ± 0.35 g/100ml) compared to NFC (1.62 ± 0.20 g/100ml) but there was no significant difference to NNC (1.81 ± 0.29 g/100ml). No significant differences ($p>0.05$) in Ca was observed among groups. They were 8.95 ± 1.54, 9.67 ± 1.05, 9.10 ± 1.77 mg/dl in NNC, FC and NFC, respectively. There was a higher ($p<0.05$) P in blood of NNC (3.48 ± 0.59 mg/dl) compared to FC (2.68 ± 0.41 mg/dl) and NFC (2.49 ± 0.66 mg/dl). These data can be a representative of the normal value of blood chemistry of the regional Thai local male chickens. The value out of the normal range may reflect the problem on nutritional and health status.

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Introduction

Chickens kept by small farmers in backyards, have involved in integrated agricultural system, for a long time. Approximately 70-80% of small farmers in Thailand normally kept 10-12 chickens/family. Indigenous male chickens which are normally kept in southern Thailand, especially in Phatthalung province, are of three types; normally feathered chickens, naked neck chickens and fighting type chicken. The chickens are kept for protein source and eggs, social need, contests and as show animals. Indigenous chicken are well adapted to the climate in Thailand and have high disease resistance. But, their disadvantage is they need a longer time to reach market size compared to the commercial broiler. More than 50% of chicken meat production in Thailand are produced by commercial farms. The chicken kept in intensive production are normally exotic breeds which are not well adapted to the hot climate. Therefore, they are susceptible to disease. The use of drug and manipulation in management are required to provide a condition in which exotic breeds can perform to their genetic potential. A lot of drugs are used during the production and subsequently remains in the product as residue. As consumers concern about the health status and the government wants to decrease the veterinarian drug used in the country, the promotion of native Thai chicken production is a hot issue. Furthermore, some indigenous chicken are reduced with the substitution of intensive production. Therefore, it is an urgent issue to collect and preserve the indigenous breeds in term of conservation and increasing the population of the indigenous breed. However, several data about indigenous breed are still needed.

The aim of this study is to evaluate the normal level of blood chemistry value in male chickens normally kept in Phatthalung province which facilitate to indicate their nutritional, health and stress status.

Materials and methods

Twelve of each type of chicken; naked neck male chickens (NNC), fighting cocks (FC) and normally feathered male chickens (NFC); at the age of approximately 5 - 6 months, were collected from the farmers. All animals were kept together under free range condition and additional feed was provided two times a day. Water was freely available all the time. After one month, blood samples were taken from the wing vein. Serum was analyzed for blood chemistry values. Total protein, albumin, Uric acid, Creatinine, Cholesterol, Calcium, Phosphorus, were determined by colorimetric method, using the standard diagnostic kit provided by BIO-MEDICAL Laboratory. The globulin value was obtained by subtraction of albumin from total protein. The difference across treatment means were tested using the Duncan's Multiple range test.

Results and Discussion

Table 1. The blood chemistry values of necked neck male chickens, Fighting cock, Normally feathered male chickens.

Blood parameters	necked neck male Chickens (NNC)		Fighting cock (FC)		Normally feathered male chickens (NFC)	
	Means±SD	n	Means±SD	n	Means±SD	n
Total protein (g/100ml)	4.37±0.74[a]	12	4.69±0.67[a]	12	4.03±0.65[a]	12
Albumin (g/100ml)	1.81±0.29[abc]	12	1.92±0.35[ab]	12	1.62±0.20[c]	12
Globulin (g/100ml)	2.56±0.76[a]	12	2.76±0.66[a]	12	2.42±0.58[a]	12
Uric acid (mg/100ml)	4.83±1.01[a]	12	5.91±1.58[a]	7	5.24±1.22[a]	7
Cholesterol (mg/100ml)	144.51±25.75[a]	12	131.17±24.29[a]	12	136.82±30.98[a]	12
Creatinine (mg/100ml)	1.27±0.15[a]	11	1.36±0.17[a]	7	1.33±0.19[a]	7
Phosphorus (P; mg/dl)	3.48±0.59[a]	6	2.68±0.41[b]	6	2.49±0.66[b]	6
Calcium (Ca; mg/dl)	8.95±1.54[a]	6	9.67±1.05[a]	6	9.10±1.77[a]	6

Means in the same row with different superscript differ significantly ($p < 0.05$)

The normal blood chemistry value of chicken can be varied depending on several factors; such as, nutrition, breed, age, sex, environment (Harrison and Harrison, 1986). Khoomsab and Tumkiratiwong (2003) had reported that after stress inducement in Silver Pheasant (*Lophura nycthomera*), the level of total protein albumin and globulin were decreased. The reduction of blood total protein, albumin and uric acid were also observed by Deyhim *et al.* (1995) after heat distress. The parasitic infection had been reported to reduce blood cholesterol (Curca *et al.*, 1998). Furthermore, it was noted that chronic aflatoxicosis was diagnosed by determining blood biochemistry alteration before clinical symptoms occured (Kececi *et al.*, 1998). This was confirmed by the reduction of the blood total protein, albumin, inorganic phosphorus, uric acid and cholesterol during aflatoxicosis (Oguz *et al.,* 2000). Blood Ca and P concentration was altered by several factors such as diet (Williams *et al.*, 2000) and age of chicken.

Those above findings were an evidence of the fluctuation of blood chemistry caused by uncomfortable conditions. Therefore, the blood chemistry value obtained from this study represents a normal blood chemistry level of native Thai chicken kept under the same condition in the region, where the alteration of the normal value may indicate or diagnose the nutrition or health status as well as animal welfare.
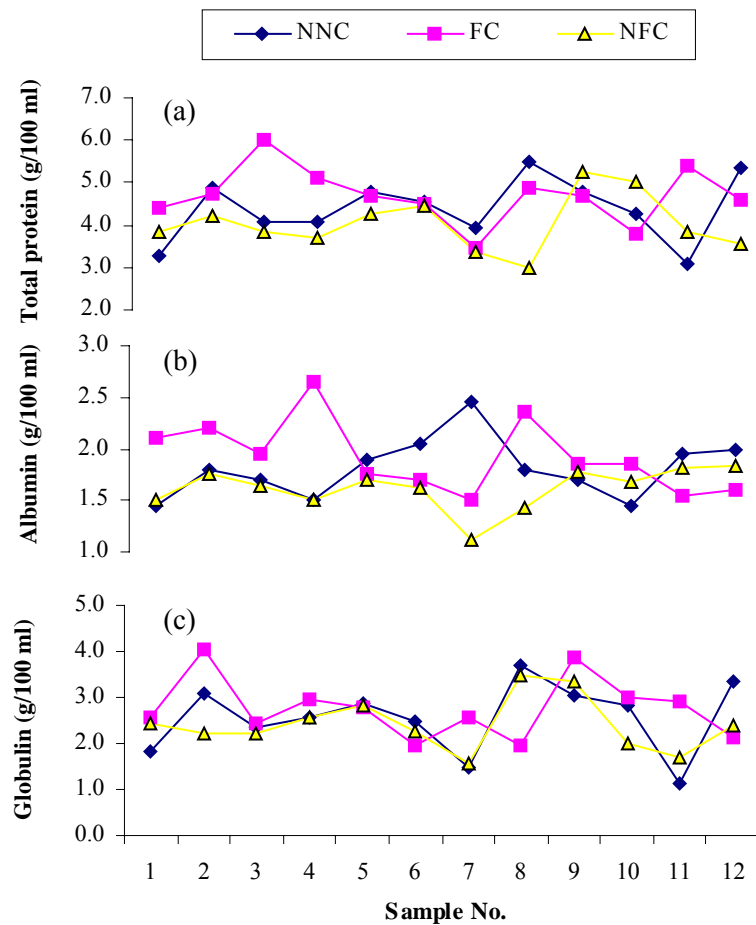
Figure 1. The level of total protein (a), albumin (b), globulin (c) in blood of naked neck male chickens (NNC), fighting cocks (FC) and normally feathered male chickens (NFC)

Conclusion

1. There is no difference in level of total protein, globulin, uric acid, creatinine, cholesterol and calcium in blood of different types of chicken; naked neck male chickens, fighting cocks and normally feathered male chickens.
2. Fighting cocks have higher blood albumin levels compared to naked neck male chickens and normally feathered male chickens.
3. The level of blood chemistry values, which is an indicator for physiological condition, should be further investigated.

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DETERMINATION OF METABOLITE PRODUCTS OF CHLOROCHOLINE CHLORIDE (CCC) IN TISSUES OF LAYING HENS RECEIVING ^{15}N-CCC DIETS

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Abstract

This study was conducted to assess the metabolite products of chlorocholine chloride (CCC; a plant growth regulator) in tissues of laying hens fed ^{15}N-CCC diets. Ten brown laying hens at approximately 280 days of age and 1,991± 175 g average body weight were used. Hens were housed in individual battery cages and were randomly divided into two groups of five each. One group was offered ^{15}N-CCC free diet while the other group received a diet with 100 ppm ^{15}N-CCC for 11 days. Samples of eggs and meat from the laying hens were collected. Egg yolk and albumen were separated. Meat was collected from the breast and thigh. The metabolite products of CCC were measured using thin layer chromatography (TLC) and gas chromatography (GC) techniques. No spot colour and R_f value of samples similar to CCC standard were found on the TLC plate and also no CCC could be detected using the GC method. This study indicates that CCC is metabolized, degraded and converted to other compounds during metabolism and does not appear in tissues and in eggs in its original form.

Key words: *Chlorocholine chloride, ^{15}N-CCC, GC-MS, TLC*

Introduction

Chlorocholine chloride (CCC) is the common name of 2-chloro-N,N,N-trimethylammonium salts and is widely used as a plant growth regulator in several food crops, grass and ornamental plants. As a controller of plant growth, CCC is applied to reduce plant size and improve grain yield. The chlorine ion (Cl$^-$) in CCC stabilizes its structure. However, this ion also prevents CCC alteration during metabolism in plants. As a result, presence of CCC residues in crops is unavoidable.

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Several research studies have been conducted to determine the residue of CCC in plants or plant products using different methods. However, data on monitoring and surveillance of CCC residues in animal products are lacking. The reasons for this may be that, most methods of analysis of residues in animal products are time-consuming and laborious. Higher content of fat, peptides or proteins in animal tissues and products should be taken into account in the extraction and isolation procedures in CCC determination.

Although CCC has been used for a long time, its metabolism in both plants and animals are still unclear. Several workers have reported that no CCC breakdown takes place in plants (Bohring, 1982) and animals (Blinn, 1967). In contrast, other workers have found that CCC breaks down to choline or its derivative fractions in protein fractions, or in other chemical fractions in both plants (Dekhuijzen and Vonk, 1974) and animals (Romanowski, 1972). This study was therefore conducted to determine the form in which the metabolite products of CCC appear in eggs and meat when hens were offered diets with ^{15}N-CCC inclusion.

Materials and Methods

Hens, housing, feeding and sample collection

Ten brown laying hens at approximately 280 days of age and 1,991 ± 175 g average body weight were used. The hens were housed in individual battery cages. Two dietary treatments were composited. Diet 1 was the control consisting of CCC free wheat (57.90%), fishmeal (11.87%), corn (20.00%), vitamin-mineral premix (2.00%) and lime (8.23%). The ration had a crude protein content of 16.37% and metabolisable energy content of 11.48 MJ/kg DM. In diet 2, 100 ppm ^{15}N-CCC was incorporated. A hundred mg of ^{15}N-CCC was first dissolved in 1,000 ml water to get the right amount of 100 ppm CCC content before incorporation into the feed. Feed was offered *ad libitum* for eleven days after which the hens were slaughtered. Eggs were collected daily, weighed and the yolk and albumen were separated. Separation was done in different rooms for each treatment using separate utensils for each group to avoid any cross contamination with ^{15}N. Meat was collected from the breast and femur. All samples were kept frozen until analysis.

Thin layer chromatography

Thin layer chromatography (TLC) was used to determine the CCC residues in yolk, albumen and meat following the procedures of Lautié *et al*. (2000). Samples of yolk and albumen were extracted with methanol whereas breast and femur meat samples were extracted with distilled water. Isolation of samples were done using the wet method. Because of the small concentration of CCC in samples, determination was done in two ways: with and without

addition of standard. The quantity of CCC was calculated by visual comparison of the size and colour intensity of the applied reference quantities with those of the tested samples, considering the applied sample volume and the weighed CCC portion. The chromatograms were evaluated and the R_f values measured. To determine the quantity of CCC residue, spots on the plates were scratched and weighed. The CCC standards were also dissolved in distilled water in concentrations of 5, 50, 100 and 500 ppm and assessed using the TLC plate of silica gel (60 F_{254}, 0.5 mm). The R_f values were measured in order to be able to compare the treatments and standard spots.

Gas chromatography mass spectrometry

Residues of CCC in yolk, albumen and meat were analyzed by gas chromatography mass spectrometry (GC-MS; Mortimer and Weber, 1994). Five ml of standard CCC was bought from SIGMA-ALDRICH Chemie GmbH, Steinheim, Germany consisting of 98% CCC. The CCC and samples were analyzed under heterogeneous and homogenous conditions. The volatility of CCC was increased by adding pentafluorothiophenol (PFTP) from SIGMA-ALDRICH Chemie GmbH, Steinheim, Germany at a concentration of 20 g/L acetone. The following standard solutions were used to set up CCC detection limits: 20, 50, 125, 250 and 375 ng/ml.

Results and Discussion

Thin Layer Chromatography

No CCC spot developed on the TLC plate without addition of the standard from samples of yolk, albumen and meat of hens receiving 100 ppm ^{15}N-CCC diet (Table 1). All spots, which developed, had different R_f values and spot colour compared to the CCC standards. The sample spots were of a larger size and were darker red than the CCC standard spot, which had a red orange or orange colour spot. Addition of a CCC standard did not result in CCC on the TLC plate. The sample spot weights were lower than the estimated spot weights of CCC. CCC standards showed different colours and different R_f values when they were developed in different solvents. CCC colour tended to be orange.

Using the TLC method, the quaternary ammonium compounds could be separated based on different colours and R_f values. However, the differences were not distinct. This could have been due to the activated alumina partly converting the acetone from the eluent to a viscous condensation product that would not evaporate. Besides, the transfer of the syrupy residue that was obtained from the extracted yolk or fat that was obtained from the extracted meat into the alumina column was difficult. The syrup or fat was not thoroughly soluble in small volumes of methanol, dichlormethane and acetone. Different authors have noted that difficulties in determination of residues in biological

sample such as tissues have been due to their complicated multi-component mixtures. Moreover, differences of colours and R_f values indicated that several compounds were present in eggs and meat. However, there were no spot colour and R_f value similar to the CCC standard. This indicated that there was no CCC detectable in eggs and meat samples from hens offered CCC diets. Maybe the CCC content in the samples was too low due to most of CCC having been excreted through the urine and faeces. Landazuri *et al.* (1993) found that only a small amount of CCC remained in the tissues of laying hens. Most of it was excreted through urine (around 90%) in 24 hours after a single oral dose. Ü berschär (1998) has suggested that the reason why no CCC residue was detected in eggs and meat, was most of the CCC were excreted. Lack of detection of CCC in treated samples in this study could therefore be explained through its rapid excretion from the body.

Gas chromatography mass spectrometer

CCC standard was not detected by GC-MS even after derivatisation with potassium pentafluorothiophenol (PFTP) either under heterogenous or homogenous conditions. These results agreed with those of Tafuri *et al.* (1970) who derivatised CCC with sodium benzenethiolate based on an *in vitro* multi-step reaction and Allender (1992) who derivatised CCC with PFTP. These authors found that the derivative products were not really produced from these derivatising agents. In this study, no CCC peak appeared on the chromatogram. Since CCC is involatile, has a high aqueous solubility and highly polar (Baker *et al.,* 1992), it cannot be directly analyzed by GC. Diserens and Oberson (1996) reported that the GC technique can be used to determine compounds which are non-polar or semi-polar. To determine CCC, GC should be performed with high performance capillary columns. Another possibility is that CCC has to be converted to a volatile compound.

Conclusion

No CCC or its metabolite product could be detected in the present study either by TLC or GCMS in egg yolks, albumen and meat of hens receiving 100 ppm ^{15}N-CCC in the diet. CCC might have been degraded during the metabolism process into other compounds.

Acknowledgement

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Table 1. R_f value and colour of CCC and choline standards determined by thin layer chromatography.

Substrate	Solvent	Colour	R_f value
CCC standard	n-butanol - formic acid - distilled water (70 + 20 + 10, v/v/v)	orange	0.33
	n-butanol – ethanol – acetic acid – distilled water (80 + 20 + 10 + 30, v/v/v/v)	light orange	0.23
	n-butanol – acetic acid – distilled water (70 + 20 + 10, v/v/v).	red orange	0.18
Choline standard	n-butanol - formic acid - distilled water (70 + 20 + 10, v/v/v)	purple	0.22
	n-butanol – ethanol – acetic acid – distilled water (80 + 20 + 10 + 30, v/v/v/v)	purple red	0.17
	n-butanol – acetic acid – distilled water (70 + 20 + 10, v/v/v).	brown red	0.13
Yolk	n-butanol – formic acid – distilled water (70 + 20 + 10, v/v/v)	dark purple	0.22
	n-butanol – ethanol – acetic acid – distilled water (80 + 20 + 10 + 30, v/v/v/v)	purple	0.19
	n-butanol – acetic acid – distilled water (70 + 20 + 10, v/v/v).	purple	0.17
Albumen	n-butanol – formic acid – distilled water (70 + 20 + 10, v/v/v)	purple red	0.21
	n-butanol – ethanol – acetic acid – distilled water (80 + 20 + 10 + 30, v/v/v/v)	light red	0.18
	n-butanol – acetic acid – distilled water (70 + 20 + 10, v/v/v).	dark red	0.12
Meat	n-butanol - formic acid - distilled water (70 + 20 + 10, v/v/v)	red	0.23
	n-butanol – ethanol – acetic acid – distilled water (80 + 20 + 10 + 30, v/v/v/v)	dark purple	0.19
	n-butanol – acetic acid – distilled water (70 + 20 + 10, v/v/v).	dark purple	0.14

LIPID METABOLISM IN RABBITS OFFERED DIETS VARYING IN CURCUMA (*Curcuma xanthorrhiza* Roxb.)

Ietje Wientarsih[1] and Udo ter Meulen[2]

Introduction

Fat is believed to be the cause of atherosclerosis and cardiovascular diseases. This diseases which are now also in Indonesia are the most common cause of death and their occurrence is increasing from year to year. In 1972, cardiovascular disease was the 11th most common cause of death in Indonesia, but then rose to third in 1986 and to first in 1992, accounting for 16% of the total deaths (Boediarso, 1989). In 1995, this had increased to 24.5% (Sumantri, 1995).

Hypercholesterolemia has received attention as a risk factor for the development of coronary heart disease (Connor and Connor 1994). It is important to decrease excess levels of cholesterol to amount consistent with the maintenance of normal body functions and decrease a risk for developing atherosclerosis. The concentration of plasma cholesterol can be regulated via manipulation of lipid metabolism, the absorption of dietary cholesterol and the excretion of lipid through faeces. Researchers have developed effective plasma cholesterol-lowering agents with some of the drugs commonly used being lovastatin, pravastatin and simvastatin (Lee *et al.,* 1999).

The composition of the diet is an important determinant of the blood cholesterol concentration (National Research Council, 1989). The reduction in blood cholesterol levels diminishes the risk of coronary heart disease (Gotto *et al.,* 1990). Studies on the plasma cholesterol and incidence of the development of atherosclerosis heart disease have shown that eating foods with saturated fats can cause a risk of coronary heart disease.

Pharmaceutical drugs are seen increasingly as being over-prescribed, expensive and even dangerous (Snider 1991). Herbal remedies are less expensive and less toxic. Many people especially those with chronic illnesses; such as, high cholesterol, atherosclerosis, rheumatism, tumours and hepatitis are turning to herbs as adjuncts to other treatments.

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In Indonesia, women have long used curcuma to guard against becoming fat. It is believed that curcuma has properties that are antilipid deposition (Subba *et al.,* 1972). However, this is based on empirical evidence and there is a dearth of information on how it works. Curcuma is used more as a spice than a drug, but some people use this mixture of herbs as medicine. Curcuma has been found to have anti-inflammatory, anti-infectious and anti-tumour properties (Allen *et al*., 1998).

This study was set up to evaluate the effect of inclusion of curcuma in rabbit diets on lipid metabolism. Rabbits were chosen as a model monogastric animal.

Materials and Methods

Animals and Housing

Forty growing male New Zealand white rabbits of average body weight 2.3±0.216 kg were used. The animals were obtained from the research institute for animal production, Bogor, Indonesia and were individually housed in metabolic wooden cages in a room to adapt to laboratory conditions.

Diets

Four isoenergetic and isoatherogenic diets with different levels of curcuma were prepared. The diets contained 0, 0.2, 0.3 and 0.4 per cent curcuma, representing atherogenic (A), atherogenic low curcuma (ALC), atherogenic medium curcuma (AMC) and atherogenic high curcuma (AHC), respectively.

Experimental Procedure

Experimental design

A completely randomized block design (CRBD) was used in this experiment. Blocking factor was initial cholesterol concentration. The rabbits were randomly distributed within blocks into four experimental groups of ten animals per treatment, giving ten replications per treatment.

Animal Management and Data Collection

The rabbits were offered the respective diets for fourteen days to allow for adaptation before faeces and feed samples were collected for seven days. The samples were stored in a freezer (-25°C) prior to analysis of the proximate constituents.

The animals continued on their respective diets for a total period of four months. Feeding was *ad libitum* throughout the period allowing for 20 per cent more of the previous day's intake. Fresh feed and water were provided

daily. The refusals were collected and weighed for each animal throughout the collection period.

Body weight was measured weekly. Blood samples were taken at the beginning of the study and at 4, 9 and 17 weeks in the study. Animals were fasted overnight and were bled from the vena jugularis of the ear. Blood was collected into heparinised tubes. Plasma was separated by centrifugation at 10,000g in a refrigerated centrifuge (4°C) for 20 minutes.

High and low density lipoproteins cholesterol and total cholesterol

High-density lipoprotein cholesterol (HDL-cholesterol), low-density lipoprotein cholesterol (LDL-cholesterol) and total cholesterol concentrations were determined using the MPR 1 cholesterol kit, CHOD-PAP according to the Boehringer, Mannheim method of the European Atherosclerosis Society (1987).

Triglycerides and Glucose

Triglycerides were analyzed using the method of enzymatic hydrolysis with subsequent determination of liberated glycerol by colorimetry. The procedure is based on that of Fossati and Prencipe (1982).

Glucose was analyzed using the enzymatic colorimetric method described by Boehringer Mannheim GmbH and based on the method of Schmidt (1971).

Statistical Analysis

The randomised complete block design model was used for data analysis:

$Yijk = \mu + Ti + Bj + eijk$, Where $Yijk$ = measured response variable; μ = overall mean; Ti = treatment effect; Bj = blocking effect and $eijk$ = random error. Significance of differences of treatment means were tested using the Duncan's Multiple Range Test (Duncan, 1955).

Results

Blood cholesterol, HDL-C and LDL-c concentrations

Time course changes in blood cholesterol, HDL and LDL concentrations are presented in Figure 1. Plasma cholesterol concentration was influenced from the beginning of the study till the fourth month by curcuma level in the diet. Feeding the atherogenic diet led to high plasma cholesterol concentrations in rabbits. Rabbits on 0.4 per cent curcuma had the lowest plasma cholesterol concentrations. Significant differences (p<0.01) were obtained at 1 and 2 months on diets with 0.2 and 0.4 per cent curcuma. Although there was an increase at four months in plasma cholesterol concentrations on curcuma supplemented diets, the concentrations similarly increased on the atherogenic diet.

There were significant (p<0.01) dietary differences on plasma HDL-c concentrations from the first to the fourth month of the feeding trial. The addition of curcuma to the diets had a significant (p<0.01) lowering effect on HDL-cholesterol in the rabbits blood plasma.

The feeding of atherogenic diets with curcuma significantly (p<0.01) decreased plasma LDL-c levels throughout the study. The atherogenic diet had the highest level of LDL-c concentration and the addition of curcuma to the diets lowered the LDL-c concentration in the rabbits.

Blood triglyceride content

Changes in blood triglyceride concentrations are shown in Figure 2. At the beginning of the first month and at four months, there was no significant (p>0.05) effect of curcuma on triglyceride concentration. However, significant differences (p<0.01) were obtained in the second month. At two months, there was a depression of 20.36, 28.50 and 29.54 per cent in blood triglyceride concentration on 0.2, 0.3 and 0.4 per cent curcuma diets, respectively. The depression at four months was 6.18, 7.6 and 17.97 per cent on 0.2, 0.3 and 0.4 per cent curcuma diets.

Glucose

Glucose data at four months in the study are presented in Table 1. There were significant differences (p<0.01) in blood glucose concentrations across diets only at four months. The depression was 15.18, 18.21 and 21.27 per cent on 0.2, 0.3 and 0.4 per cent curcuma inclusion.

Discussion

Currently, cardiovascular disease prevention is gaining worldwide momentum. This has led to many studies being conducted to evaluate the use of certain short-term tests to gain information on disease preventive agents. Many of the substances are presented in a natural environment of man including diet. These dietary inhibitors of cardiovascular disease mainly of plant origin are being evaluated for their anti-cardiovascular disease properties. Most of these are either anti-hypercholesterolemia or act by stimulating the activity of enzymes, which reduce cholesterol content in the host.

The concentration of plasma cholesterol in the body can be regulated via biosynthesis of cholesterol, the removal of cholesterol from the circulation, the absorption of dietary cholesterol or the excretion of cholesterol via bile and faeces.

Curcumin content was not measured in this study. However, from literature, each 100 g of *curcuma xanthorrhiza* yielded approximately 5 g curcuminoids (*curcumin desmethoxycurcumin*) (Yasni *et al*., 1993). Assuming that the curcuma used in this study contained 5 per cent curcuminoids, this translated

to 4.98, 6.69 and 10.12 mg d^{-1} curcumin intake on 0.2, 0.3 and 0.4 per cent curcuma inclusion diets.

Cholesterol was depressed by curcuma inclusion in diets. This has been noted before (Yasni *et al.,* 1993) who when they gave 0.2 per cent curcuminoids in rats found a depression in liver cholesterol. Beynen *et al.* (1986) found that curcumin increased faecal excretion of bile acids and cholesterol both in normal and hypercholesteremic rats. The biliary drainage is a possible explanation for the reduction of tissue cholesterol through curcuma feeding.

The results on blood HDL-c concentration in this study were the opposite of what has been previously noted. *Curcuma comosa* extract has been found to increase plasma HDL-cholesterol and to decrease both plasma triglyceride and LDL-cholesterol in Hamsters (Piyachaturawat *et al*., 1999). In clinical practice, an increase in HDL-c level is regarded as an indicator of possible anti-atherogenic effect of a therapeutic diet or a dietary supplement (Davis *et al.,* 1988).

The findings of the significant reductions in the concentration of plasma LDL-c are in accordance with the reports of Piyachaturawat *et al.* (1997) who found that administration of 100-400 mg kg^{-1} body weight extract of the rhizome of *curcuma comosa* Roxb. decreased LDL-c concentration in mice. Also the reduction of triglyceride concentration with curcumin as observed in this study has been observed before in mice. Intragastric administration of an ethyl extract of the rhizome of *curcuma comosa* Roxb. of 100 to 400 mg curcumin kg^{-1} body weight significantly decreased plasma lipid levels of both triglyceride and cholesterol in mice.

Cholesterol is involved as a cause of atherosclerosis, cardiovascular heart disease and hypertension (Assman, 1979). The regulation of plasma cholesterol level involves factors that influence both extracellular as well as intracellular cholesterol metabolism.

Conclusion

In conclusion the present study shows that curcuma when included in rabbit diets with 0.2–0.4% has a multiplicity of roles at tissue level metabolism. The active substances in curcuma act by:
   - Decreasing total cholesterol concentration
   - Decreasing LDL concentration
   - Decreasing HDL concentration
   - Decreasing triglyceride
   - Decreasing glucose concentration

Except for changes in HDL concentration, results from this study from the other metabolites confirm that curcuma has a role in minimizing the incidence of coronary heart disease because it has anti-hepatotoxicity and anti diabetic activities.

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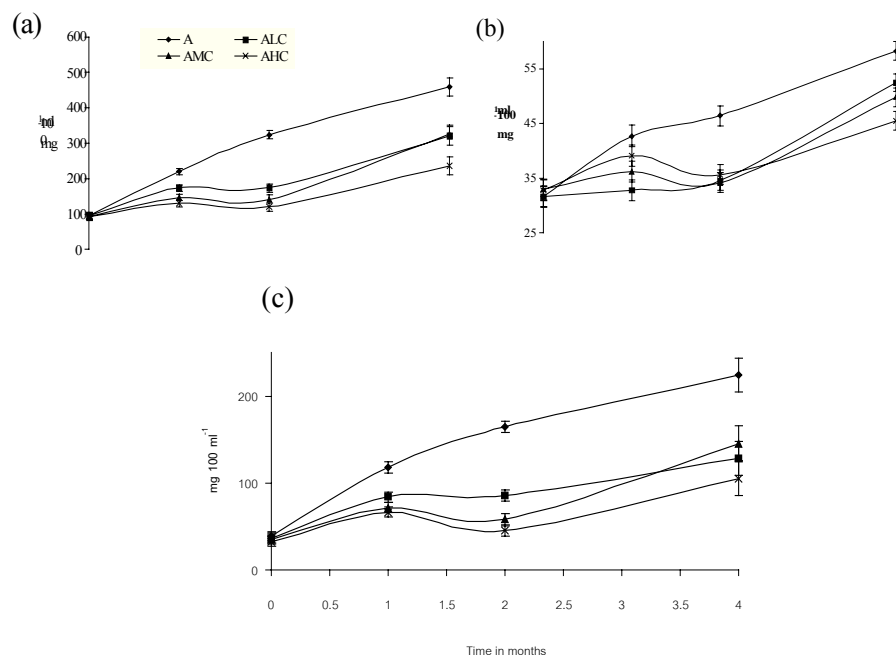
Figure 1. Mean changes (±SE) over time in blood (a) cholesterol, (b) HDL and (c) LDL concentrations in rabbits offered atherogenic diets with varying levels of curcuma
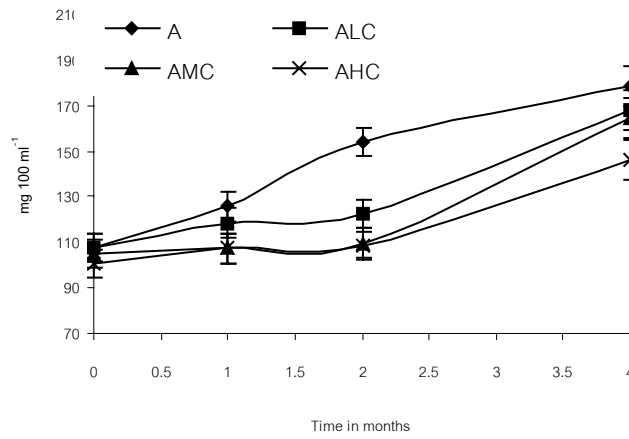
Figure 2. Mean changes (±SE) in blood triglyceride concentration in rabbits
offered atherogenic diets varying in curcuma level

Table 1. The concentrations of glucose activity in rabbits offered atherogenic
diets varying in level of curcuma inclusion after four months

Component	Diet				SED
	A	ALC	AMC	AHC	
Glucose (mg 100 ml^{-1})	85.37[a]	72.41[b]	69.82[b]	67.21[b]	4.13

SED = standard error of difference of means; Means in the same row with no
common superscript are significantly different ($p<0.05$).

SULFAMETHAZINE RESIDUES IN PORK WITH DIFFERENT WITHDRAWAL PERIODS AND PIG TISSUES IN CHIANG MAI MARKET

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Abstract

Sulfamethazine is antimicrobial activity that used world wide in swine industry. In Thailand, sulfamethazine was prohibited in feed formulation, but some small swine holder often mixed in the feed, which would not withdrawn or shortened withdrawn. Thai's Food and Drug Administration accepted maximum residue level was 100 ppb. Surveying on September, 2002 of sulfamethazine residues in Muang Chiang Mai market found that sulfamethazine concentration in kidneys, livers and loins came over maximum residue level 88.89%, 100% and 44.44%, respectively. Hypermarket in Chiang Mai found that concentration of sulfamethazine in kidneys, livers and loins were over maximum residue level 40%, 100% and 50%, respectively. In district around Muang Chiang Mai found that kidneys and livers came over the maximum residue level, but loins were acceptable. For this study, twenty-four 60 kg pigs were divided into 3 groups of sulfamethazine supplement 0, 250 and 500 ppm on corn-soybean basal diet. About 80 kg of each groups were withdrawn as well as weekly different periods within 4 week, slaughtered and collected sera and loins. The results found that serum concentrations of sulfamethazine supplementary 500 ppm were 76.19% and 66.29% significantly greater than 250 and 0 ppm, respectively at 0th week of withdrawal period. The others were not significant difference in treatments and withdrawal periods. The sulfamethazine residue in loins found that 500 ppm sulfamethazine supplementary pigs were 33.50% and 67.50% significantly greater than 250 and 0 ppm, respectively ($p<.05$) at 1st week of withdrawn period, the other periods were not significant different. Productive performance was not significant different. The biochemical criteria such as alkaline phosphatase, blood urea nitrogen and creatinine were not significant different. It was concluded that sulfamethazine in finishing pig diet fed 14-day period before slaughtering that were not altered productive performance and biochemical criteria. 14-Day withdrawal period may acceptable clearance of sulfamethazine residue in flesh.

Key words*: Sulfamethazine, Maximum Residue Level, Loin, Chiang Mai*

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Introduction

Antimicrobial agents were divided into 6 groups such as Penicillins, Aminoglycosides, Chloramphenicols, Macrolides, Quinolones and Sulfonamides (Srivattanakul, 1995). Sulfonamides were used world wide in swine industry as sulfamethazine. Some swine keepers were used as antibiotics especially growing-finishing period. It prevented and cured much pathogens such as *Salmonella spp.* (Gutzmann *et al.*, 1976; Fenwick and Olander, 1987), *Mycoplasma hyosynoviae*, *Bordetella bronchiseptica* (Kobland *et al.*, 1984), *Streptococcus spp.* (Yuan *et al.*, 1997), *Pasteurella multocida, Haemophilus pleuropneumoniae, Streptococcus suis, B. multocida* (Mengelers *et al.*, 1989), *S. typhisuis* (Fenwick and Olander, 1987). Therapeutics level was 400-600 ppm and 14-21-days period, depended on virulent and epidemically (Urairong, 1992). Sulfamethazine has been withdrawn 15-day period before slaughtered (Augsburg, 1989). In Europe and USA, the maximum residue level (MRL) of sulfamethazine was not over 0.1 ppm in any tissue (Shearan and O_Keeffe, 1994). In Australia, MRL was not over 0.2 ppm (Thomas *et al.*, 1997).

Oral bioavailability was $85.8 \pm 5.3\%$ - $88.9 \pm 5.4\%$ (Sweeney *et al.,* 1993; Nouws *et al.*, 1986; Nouws *et al.*, 1989). Half-life of distribution was 0.46 hours. Half-life of elimination was 16.9 hours by kidney (Sweeney *et al.,* 1993). De_Baere, *et al.* (2000) found that sulfadiazine and sulfamethazine were residue in muscular extracted portion. Porter (1994) found that sulfonamides were residue in kidney. Cordle (1988) expected that the residues in liver may 6% of slaughtered swine and 2.5% in meat. Cordle (1989) found that thyroid adenomas were induced in rats and mice by sulfamethazine.

In Thailand, some small swine keepers used normally sulfamethazine as prevention and treatment in any situations. It seems that sulfamethazine was magic drug. High level of sulfamethazine was formulated in growing-finishing feed. The keepers fed without withdrawal period or shortened. However, the residues were not recorded. Thai's FDA and Livestock Department prohibited Sulfamethazine for animal production in Thailand. The objectives of this study were that 1) Survey residue of sulfamethazine in meat, liver and kidney in Chiang Mai markets 2). Detect the residue of sulfamethazine with different withdrawal periods.

Material and Methods

First Experiment

Sulfamethazine residues were surveyed in market of all districts of Chiang Mai such as Mae-ai, Fang, Chaiprakarn, Prao, Chiang Dao, Wiang Hang, Mae Tang, Maerim, Samoeng, Sansai, Doi Saked, Sankampang, Mae-on, Sarapee, Hang Dong, Sanpatong, Jomthong, Hod, Om-koi, Doi-tao and Mae-jam. Loins,

livers and kidneys were collected. In Muang Chiang Mai, the portions were collected at Chiang Mai Gate's Market, Muang Mai's Market, Nong Hoi's Market, Ton Lam Yai's Market, Chang Puak's Market, Sanpakoi's Market, Tanin's Market and 5 hyper-market in Chiang Mai. Tissues were stored in ice during transported and had been stored at -20°C until analyzed. Extracted of each tissue was analyzed by HPLC, briefly, minced 5 g of each loin with 10 ml 0.4 N $HClO_4$, homogenized with homogenizer (Polytron®), centrifuged 12,000 rpm in 2 mins, collected the supernatant for analyzed. Injected the supernatant into analytical HPLC (ConstaMetric® 3200) and detected 250 nm (SpectroMonitro® 3200). ChromSep HPLC column glass was used as reverse-phase HPLC, 10-cm length and 3.0 mm diameter, ChromSep guard column C 18 with 0.45 μ x 13 cm diameter membrane filter. Column was incubated at 35+2°C, 1.0 mm/min as flow rate. 0.1 mM Phosphate buffer (pH 7.0) and methanol were used as mobile phase in 7:3 ratio (Boison and Keng, 1994).

Second Experiment
        Twenty-four 60 kg of equally pigs were divided into 3 groups as control, preventive criteria of sulfamethazine (250 ppm) and treatment criteria of sulfamethazine (500 ppm). Pigs had been reared until 80 kg, each replication in each group were 1-week different withdrawal period (figure 1). When the 4th withdrawn period had been done, the pigs were sent to slaughterhouse. Loins, livers and kidneys had been collected in ice during transported. The tissue has been stored at -20°C until analyzed as same as 1st experiment at Science Center of Rajabhat Chiang Mai Institute.

Third experiment
        Blood were collected every 2 weeks in jugular vein of each pig. Blood were centrifuged at 2000 rpm 3 min. Serum were collected and stored at -18°C. Alkaline phosphatase (Marshell, 1995), Blood Urea Nitrogen (Anderson and Cockayne, 1993) and Creatinine (Bauer, 1982) were analyzed by enzymatic method at Science Center of Rajabhat Chiang Mai Institute.

Statistic analysis
        The data from each study were analyzed as a complete randomized design according to analysis of variance procedures using the GLM procedure of SAS (1990).
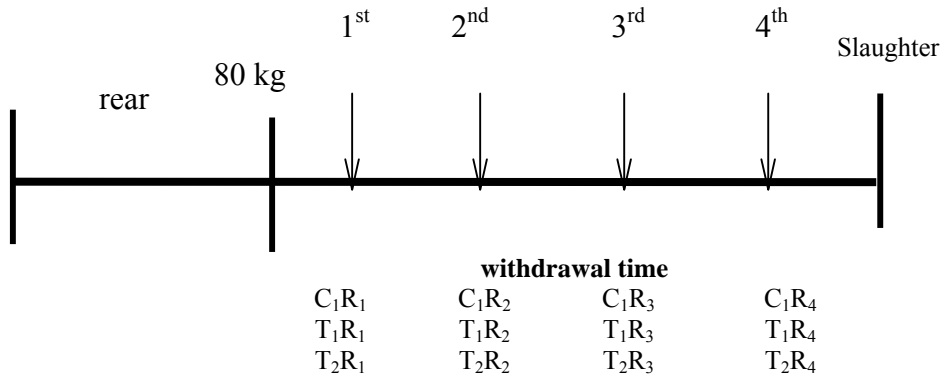
Figure 1. Arrows means each replication of treatment that has been different withdrawn sulfamethazine in feed until slaughtered at 4th week. C_1 means control (0 ppm). T_1 means preventive criteria (250 ppm). T_2 means treatment criteria (500 ppm).

Results and Discussions

First experiment

      Sulfamethazine residues in swine tissue on hypermarket at Chiang Mai were found as follows: that means of kidney, liver and loin were 101.04, 202.98 and 121.66 ng/g flesh respectively (Table 1). Kidney, liver and loin were 40, 100 and 50% over maximum residue level respectively (Table 1).

Table 1. Sulfamethazine residue of any portion of hypermarket in Chiang Mai.

Hypermarket	Sulfamethazine (ng/ 1 g flesh)		
	Kidney	Liver	Loin
1	162.16	No sample	30.00
2	31.57	333.20	93.62
3	31.58	No sample	No sample
4	10.52	122.58	157.89
5	269.39	153.19	205.13
Mean	**101.04**	**202.99**	**121.66**
Maximum Residue Limit	**>**	**>**	**>**
% over MRL	**40**	**100**	**50**

      Market in Muang Chiang Mai, it was found that means of kidney, liver and loin were 208.32, 196.74 and 109.04 ng/g flesh respectively (Table 2).

Kidney, liver and loin were 88.89, 100 and 44.44% over maximum residue level respectively (Table 2).

In market of all districts of Chiang Mai, it was found that means of kidney, liver and loin were 245.32, 204.91 and 90.13 ng/g flesh respectively (Table 3). Kidney, liver and loin were 85, 90 and 90% over maximum residue level respectively (Table 3).

Second experiment

Sulfamethazine was supplemented in finishing pig feed as antibiotics in 3 groups such as control (0 ppm), preventive criteria (250 ppm) and treatment criteria (500 ppm). It was found that blood sulfamethazine concentration of treatment criteria was significant higher than preventive criteria and control respectively. After 2-weeks and 4-weeks withdrew of sulfamethazine were found that blood sulfamethazine concentration of any criteria were not significant different (Figure 2).

Loin sulfamethazine concentration with different withdrawal period was found that at 1st week-withdrawal period, a treatment criterion was significant higher than preventive criteria and control. But, the others were not significant different (Figure 3).

Productive performance of pigs showed that weight gain, feed intake, feed/gain and cost of weight gain were not significant difference between criteria (Table 4). Sulfamethazine toxicity on alkaline phosphatase, blood urea nitrogen and creatinine were not significant different between criteria (Table 5).

Pork in Chiang Mai market has sulfamethazine residue, so that most of swine keepers used normally sulfamethazine or contaminated from feed processing, rearing, slaughtering and cutting (Augsberg, 1989; Norpoth *et al.*, 1989; McCaughey *et al*., 1990; Keitzman *et al.,* 1995).

Table 2. Sulfamethazine residue of any portion of market in Muang Chiang Mai.

Market	Sulfamethazine (ng/ 1 g flesh)		
	Kidney	**Liver**	**Loin**
Sompet	81.075	139.36	92.31
Thanin	178.37	211.09	62.73
Nong-hoi	241.57	225.70	5.13
Tonlamyai	177.00	156.38	112.60
Suthep	246.98	358.14	231.59
Muangmai	238.24	171.51	97.76
Changpuak	160.69	126.23	117.88
Sanpakoi	326.23	240.68	91.25
Pratu-chiangmai	224.71	141.60	170.09
Mean	**208.32**	**196.74**	**109.04**
Maximum Residue Limit	**>**	**>**	**>**
% over MRL	**88.89**	**100**	**44.44**

Table 3. Sulfamethazine residue of any portion in market of all districts of Chiang Mai.

Market	Sulfamethazine (ng/ 1 g flesh)		
	Kidney	**Liver**	**Loin**
Mae-ai	80.10	178.72	92.31
Fang	189.00	205.13	94.74
Chiprakarn	367.57	93.33	10.26
Phrao	235.89	100.00	108.11
Chiangdao	432.43	374.47	400.00
Wianghang	314.89	266.67	21.00
Maetang	231.58	200.00	107.69
Maerim	118.92	122.58	70.97
Sameong	400.24	261.54	142.86
Sansai	112.82	246.15	53.84
Doi-saked	57.14	183.78	18.00
Sankampang	133.33	307.69	128.65
Mae-on	61.54	170.21	110.64
Sarapee	446.15	400.00	32.00
Hangdong	451.06	154.84	156.67
Sanpatong	194.87	174.36	115.78
Jomthong	187.23	61.08	32.26
Hod	187.23	204.25	70.96
Doi-tao	338.51	246.81	123.08
Mae-jam	365.96	128.57	212.77
Mean	**245.32**	**204.91**	**90.13**
Maximum Residue Limit	>	>	>
% over MRL	**85**	**90**	**50**

Figure 2. Serum sulfamethazine concentration (ppb). Difference letters were the significant difference (p<0.05)
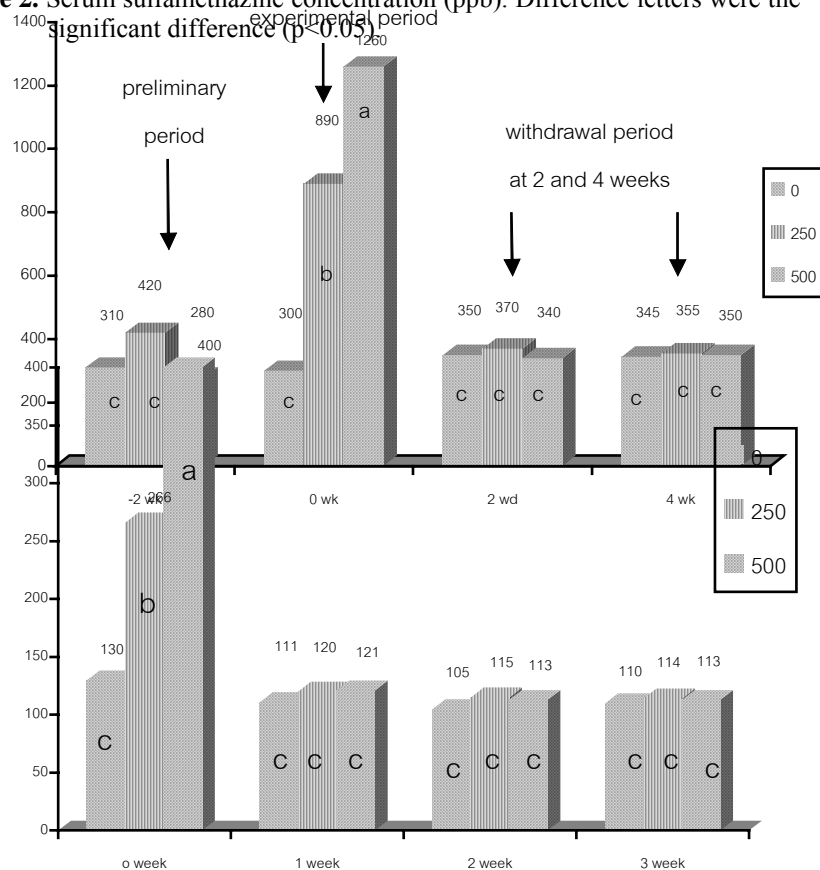
Figure 3. Loin sulfamethazine concentration (ppb). Difference letters were the significant difference (p<0.05).

Blood sulfamethazine concentration of treatment criteria was significant higher than the others (Saschenbrecker and Fish, 1980).

Productive performance of feed that supplements sulfamethazine was not affected on weight gain, average daily gain, daily feed intake, feed/gain and feed cost per weight gain. On the other hand, supplementation of sulfamethazine in starter pig feed was improved weight gain and feed/gain than control (Weber *et al*., 2001)

Toxicity of sulfamethazine on kidney and liver were not altered biochemical parameters such as alkaline phosphatase, creatinine and blood urea nitrogen. supplementation of sulfamethazine in pig feed was not effected to alkaline phosphatase, creatinine and blood urea nitrogen.

The result was concluded that 14-days sulfamethazine supplementation in pig feed was not altered productive performance and biochemical parameters. And 14-days withdrawal period of sulfamethazine in feed was accepted residue in any portion of pork.

Table 4. Productive performance of finishing pig

	Sulfamethazine supplementation (ppm)		
	0	**250**	**500**
Weight gain; kg	55.75	62.65	61.02
Average daily gain; g/d	796.43	895	871.71
Feed intake; kg	156.10	172.29	166.58
Feed conversion ratio	2.80	2.75	2.73
Feed cost/weight gain; baht	1050.56	1181.91	1162.73

Means are not significant different in the same row.

Table 5. Biochemical parameters of finishing pig

	Sulfamethazine supplementation(ppm)		
	0	**250**	**500**
Alkaline phosphatase; units/dL	49.61	44.56	43.43
Blood urea nitrogen; mg/dL	3.21	2.46	2.59
Creatinine; mg/dL	1.11	1.31	1.18

Means are not significant different in the same row.

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RESEARCH ON CHICKEN BREEDING BY USING MIXED SEMEN OF HUBBARD AND LOCAL COCKS WITH ISA-BROWN HENS AND THEIR HYBRIDS GROWTH RATE

Chhum Phith Loan[1] and Heng Sok Chea[2]

Introduction

The population of Cambodia is around 88% working in agriculture. The revenue of family income of the farmer contributed around 50% from poultry production in compare to the farmer who are working only on rice field. Regarding to statistic animal was showed that the poultry populations in Cambodia are available until present time 13,117,000 chicken, that means the number is increased at level of 38.6%. Due to increasing the Cambodian population yearly, the demand of poultry meat is especially very high because local chicken meat is delicious and the Asia people prefer to consume it.

Daghir (1995) mentioned that the local chicken have low performance but the meat quality is higher than exotic and adaptability under hot climate. Therefore, the local race should be improved their performance through crossing with exotic race. Moreover, Harpal (1998) indicated that the using of biotechnology in animal breeding could be reduced the production cost 2 or 5 times in compare to natural mating.

Objective of research
- Produce two hybrids chicken simultaneously
- Improve the hatching rate of baby chicken
- Compare the semen quality between local and exotic
- Adaptability under Cambodia condition
- High demand on free market

Material and Method

a. Material
- The experiment was carried out at the Royal University of Agriculture
- The duration of research was 3 months.
- 100 young hens ISA-brown were bought from CP Cambodia
- 9 cocks from local and 9 cocks from Hubbard were tested for semen quality and then preparing for artificial insemination

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b. Research Methodology

- The semen quality was tested 2 times weekly as below:
- Semen volume
- Semen concentration
- Motility

After selection of best cocks, the artificial insemination was conducted 2 times per week by mixed semen 0.2 ml (Froman and Mclean, 1996). 3 days after artificial mating, the fertility egg were collected for hatching.

The duration of egg hatching for hen is 21 days at Temperature of 37.8^0C and Humidity 60-70% from 1st to 18th day and at 37.5^0C and Humidity 80-90%. Up to 18th days, 320 chickens divided in completely randomized block design.

- 40 chickens consisted per group and each race was divided into 4 replicates.

- Whereas the feed ratio at the 1st phase contained 22% crude protein and ME=3,200 Kcal/Kg and at the 2nd phase the crude protein was 20% and ME=3,000 Kcal/Kg. The composition of feed ingredient was showed in 2 tables as below:

Table 1. Feed ratio for chicken from 1st day to 4th week

Components	Quality (%)	Protein Content (%)	ME (Kcal/Kg)	Ca (%)	P (%)	Lysine (%)	Methionine (%)
Maize	42.5	3.4	1620	0.008	0.04	0.075	0.037
Rice Bran	21	2.11	600	0.018	0.11	0.161	0.057
Dry Fish	17	10.2	467	1.36	0.61	0.612	0.117
Soy Bean	17	6.29	420	0.08	0.02	0.454	0.104
Premix	0.50	-	-	-	-	-	-
Shell	2.00	-	-	0.175	-	-	-
Total	**100**	**22%**	**3,107**	**1.64**	**0.78**	**1.30**	**0.315**

Table 2. Feed ratio for chicken from 5th week to 10th week

Components	Quality (%)	Protein Content (%)	ME (Kcal/Kg)	Ca (%)	P (%)	Lysine (%)	Methionine (%)
Maize	456	3.64	1550	0.01	0.10	0.08	0.04
Rice Bran	22.8	2.28	638	0.01	0.10	0.14	0.05
Dry Fish	14.55	8.70	364	1.06	0.48	0.47	0.1
Soy Bean	14.55	5.38	340	0.01	0.02	0.42	0.1
Premix	0.50	-	-	-	-	-	-
Shell	2.00	-	-	0.17	-	-	-

Total	100	20%	2,892	1.26	0.70	1.11	0.29

The parameter estimation:
- Semen quality and hatching rate
- Live weight weekly
- Feed consumption every day
- Feed conversion ratio until end of period
- Mortality

Result of research and discussion
      Semen quality

a, <u>Volume</u>
Table 3. Compare average semen volume between Hubbard and local cock

Frequency	Hubbard Group			Khmer Group		P = Sig
	N	Mean (g) (cc)	S±	Mean (g) (cc)	S±	
1	9	0.72^*	0.20	0.51	0.17	0.047
2	9	0.60^{ns}	0.25	0.47	0.13	0.191
3	9	0.71^*	0.20	0.47	0.16	0.022
4	9	0.75^{***}	0.15	0.39	0.20	0.001
5	9	0.75^{**}	0.19	0.46	0.12	0.003

Note: * Symbol of significantly difference $p \leq 0.05$
            ** Symbol of significantly difference $p \leq 0.01$
            *** Symbol of significantly difference $p \leq 0.001$

b, <u>Concentration</u>
Table 4. Estimation of semen concentration

Frequency	Hubbard Group			Khmer Group		P = Sig
	N	Mean (g)	S±	Mean (g)	S±	
1	9	7.85^*10^6ns	2.41^*10^6	7.44^*10^6ns	1.94^*10^6	0.71
2	9	6.57^*10^6ns	1.90^*10^6	7.66^*10^6ns	1.73^*10^6	0.25
3	9	7.14^*10^6ns	1.46^*10^6	6.88^*10^6ns	1.93^*10^6	0.78
4	9	7.28^*10^6ns	1.60^*10^6	7.77^*10^6ns	2.53^*10^6	0.66
5	9	6.71^*10^6ns	2.13^*10^6	8.55^*10^6ns	1.58^*10^6	0.06

c, <u>Motility</u>
Table 5. Compare activity of semen Hubbard and local cocks

Frequency	Hubbard Group			Khmer Group		P = Sig
	N	Mean (g) (Ball)	S±	Mean (g) (Ball)	S±	
1	9	75.7^*	11.33	51.1	13.64	0.002
2	9	75.7^{***}	7.86	50.0	11.18	0.001

3	9	68.5*	13.45	51.1	17.63	0.048
4	9	64.2^{ns}	12.72	70.0	12.24	0.378
5	9	64.2^{ns}	12.72	53.3	15.46	0.145

The result of research indicated that the semen quality of Hubbard is significantly higher than local race.

Hatching rate

The result of an experiment showed that: The hatching rate by using mixed semen between local and Hubbard cock is 71.2% and 62% had phenotypic tendency to Hubbard and 38% tendency to local chicken. This result is similar to Wezyk *et al*. (1991) who found out that Hatching rate by using AI is around 76.2%

Growth rate of both race

The growth rate of local and hybrid chicken was indicated in Table 6. This growth rate wasn't quite different from investigation of Gietema (1996) and Widowski *et al.* (2000).

Table 6. Compare the average live weight between local and Hubbard race

Age	Group 1 (Khmer)		Group 2 (Hubbard)		P
	Mean (g)	S±	Mean (g)	S±	
Starting weight	29.77	0.15	32.88**	0.33	0.01
Week 1	53.99	0.47	70.29***	0.42	0.001
Week 2	90.39	0.88	140.83***	1.35	0.001
Week 3	131.81	2.89	241.10***	7.42	0.001
Week 4	207.36	3.06	345.30***	8.29	0.001
Week 5	291.08	2.56	450.41***	9.01	0.001
Week 6	352.78	2.29	599.57***	14.72	0.001
Week 7	435.00	1.15	759.57***	8.63	0.001
Week 8	534.54	8.39	911.89***	3.40	0.001
Week 9	661.84	10.17	1152.05***	15.76	0.001
Week 10	876.52	6.26	1426.06***	4.79	0.001

Note: * Symbol of significantly difference p≤0.05
** Symbol of significantly difference p≤0.01
*** Symbol of significantly difference p≤0.001

The feed consumption and FCR

The feed consumption of local and Hubbard chicken was showed in Table 7

For the feed conversion ratio (FCR) was relatively higher than the result of Ralph (1987) who found out the FCR of chicken Hubbard is around 2.26.

Table 7. Average feed consumption per chicken daily

Group Age	Group 1 (Khmer)		Group 2 (Hubbard)		P
	Mean (g)	S±	Mean (g)	S±	
Week 1	7.7	0.52	8.82[*]	0.55	0.03
Week 2	13.88	0.78	17.79[**]	0.3	0.01
Week 3	16.04	0.11	23.3[***]	0.88	0.001
Week 4	20.72	1.12	30.85[***]	0.46	0.001
Week 5	26.31	1.83	36.78[***]	1.66	0.001
Week 6	35.66	0.42	43.37[***]	1.21	0.001
Week 7	48.66	0.31	62.37[***]	0.67	0.001
Week 8	52.71	1.85	79.69[***]	0.2	0.001
Week 9	57.19	0.65	91.64[***]	1.7	0.001
Week 10	62.46	0.6	101.9[***]	1.89	0.001

Note: [*]   Symbol of significantly difference p≤0.05
[**]   Symbol of significantly difference p≤0.01
[***] Symbol of significantly difference p≤0.001

Mortality

The mortality of hybrid chicken (Hubbard) is 6.25% whereas local chicken about 5%.

Conclusion

The result of research can be concluded as following:
- Semen quality of Hubbard race is significantly better than local race.
- The hatching rate of hybrid Hubbard 62% is significantly higher than local (38%).
- Whereas the live weight, the local race has a significant lower live weight (876.52±2.26) than hybrid Hubbard (1,426.06±4.79) by (p≤ 0.001).
- The FCR of hybrid chicken (2.65) is significantly better than local chicken 3.10 by (p≤0.001).
- The mortality of local chicken is lower than Hybrid.
- Otherwise the demand of free market for local race is higher and the price doppler than exotic race.

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EFFECT OF THE ADDITION OF DIFFERENT ACIDS AND PROPYL GALLATE DIPS ON COLONISATION OF AGED POULTRY WITH *E.Coli, Staphylococcus areus* AND SALMONELLA

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Abstract

Propyl gallate dips of poultry meat are common in order to prevent rancidity or oxidation. According to the purple color of meat that has iron contamination, propyl gallate is always used with acid. However, the antimicrobial effect might be enhanced. Propyl gallate was used always the same amount of 40 g/kg either without acid (control group) or mixed with acids in different levels namely citric acid and phosphoric acid at levels of 0, 10, 20 and 30 g/kg; respectively and sodium phosphatic acid at levels of 0, 1, 2 and 3 g/kg. Poultry thigh was dipped in the solutions for 10 min in 12 replicate per solution. After drying for 2 mins, samples were vacuumed and kept at 4°C for 7, 14 and 21 days to detect the growth of total colony count, E.Coli, Staphylococcus areus and Salmonella. The results of this study indicated that the total colony count of all solution for 7, 14 and 21 days storage were more than 3.0×10^7 colony forming units (cfu)/g except with phosphoric acid at the level of 30 g/kg for 14 and 21 days as well as the results of E.Coli for all groups and storage time were more than 1,100 cfu/g except with phosphoric acid at the level of 30 g/kg for 7 and 14 days. Staphylococcus areus of the control and phosphoric acid groups were less than 1.0 cfu/g for the 3 storage period. The Salmonella was detected for the control, citric acid and sodium phosphatic acid in every level of solution and storage periods as well as phosphoric acid at the level 10 and 20 g/kg; respectively except at the level of 30 g/kg. From this study, it could be concluded that propyl gallate 40 g/kg combined with phosphoric acid 30 g/kg would be the optimized to prolong the shelf life at 4°C for 14 days of poultry thigh.

Key words: Propyl Gallate, Acids, Poultry, Shelf life

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Introduction

At present, livestock industry no longer focuses on production value but emphasizes more on the standard and quality of products for a better response to consumers. Shelf life of poultry meat is one of aspect of quality on which consumers place high value in making their purchase decision. Meat scientists, therefore, have become more interested in researching and identifying ways to prolong shelf life or in order to prevent oxidation (Jaturasitha, 2000).

Propyl gallate is ester of gallic acid or so called propyl ester was used to retard oxidative rancidity of meat (Gray *et al*., 1999; Hamilton, 1994). The efficiency and efficacy depends on the molecular weight and concentration as well as initial microbial contamination (Lin and Chuang, 2001). According to the purple color of meat that has iron contamination, propyl gallate is always used with acid (Siwaves, 2000). Subramanian (1996) had used 0.02% of propyl gallate in Surimi and found that there was no oxidation and could prevent the growth of microorganism.

One way to improve shelf life of poultry meat is generally practiced by mixing solution of propyl gallate and acid. Consequently, the present study has the objectives to identify the optimal level of different acid which can best improve the shelf life in terms of the evaluation of microorganism growth, i.e. total colony count, *E.Coli, Staphylococcus areus* and Salmonella. The results from this study can be useful for poultry industry in deciding on meat quality improvement.

Materials and Methods

After poultry slaughtering, the 120 thighs from both sides were removed to immerge into the solution of propyl gallate combined with acid. The solutions were:
1. Propyl gallate 40 g/kg combined with citric acid at the level 0, 10, 20 and 30 g/kg
2. Propyl gallate 40 g/kg combined with phosphoric acid at the level 0, 10, 20 and 30 g/kg
3. Propyl gallate 40 g/kg combined with sodium phosphatic acid at the level 0, 1, 2 and 3 g/kg

After dipping in the solution for 10 minute, the samples were dry for 2 minute then placed in plastic bag and vacuumed. These samples were kept in the refrigerator at 4°C for 7, 14 and 21 days in order to detect the microorganism in terms of total colony count, *E.Coli, Staphylococcus areus* and Salmonella.

Total colony count was detected by the method of ISO 4833 (1991). *Staphylococcus areus* was found by the recommendation of ISO / DIS 6888 – 1 (1997). *E.Coli* was evaluated by the method of ISO / DIS 11866 – 1.2 (1994). Salmonella was detected according to ISO 6579 (1993E). Means of data were given in the tables.

Results and Discussions

Total colony count

The effect of using propyl gallate 40 g/kg with citric acid at the level 0, 10, 20 and 30 g/kg as well as sodiumphosphatic acid at the level 0, 1, 2 and 3 g/kg for poultry thigh storage for 7, 14 and 21 days found that the microorganism in terms of yeast, mold and bacteria were more than 3.0×10^7 colony forming units (cfu)/g. Our current food law requires that total count plate of fresh meat products should be less than 3.0×10^7 cfu/g. These results were similar to using propyl gallate 40 g/kg with phosphoric acid at the level 0, 10 and 20 g/kg keeping as the same period as mention before but the total colony count on poultry thigh decreased when using propyl gallate 40 g/kg with phosphoric acid at the level of 30 g/kg for 14 and 21 days (7.3×10^6 vs 5.1×10^6 cfu/g). This result was similar to the finding of Lin and Chuang (2001).

Staphylococcus areus

Using propyl gallate 40 g/kg with phosphoric acid at the level of 0, 10, 20 and 30 g/kg found *Staphylococcus areus* on poultry thigh less than 1.0 cfu/g for every storage period but with other acid (citric and sodium phosphatic) found *Staphylococcus areus* on poultry thigh more than 1.0 cfu/g for keeping for 7 days at some level. The law allows *Staphylococcus areus* of fresh meat products should be less than 1.0 cfu/g. This result was confirmed by the findings of Cudjoe (1988) and Lillard *et al*. (1987).

E.Coli

E.Coli on poultry thigh was found more than 1100 cfu/g when using propyl gallate 40 g/kg with citric and sodium phosphatic acid of every level and storage time. In contrast, *E.Coli* on poultry thigh was found less than 1,100 when using propyl gallate 40 g/kg mixed with phosphoric acid at the level 30 g/kg keeping for 7 and 14 days. Our safety regulation recommend that *E.Coli* of fresh meat products should be less than 1100 cfu/g. This result was similar to the finding of Dickens and Whittemore (1997)

Salmonella

Salmonella on poultry thigh was only not detected when using propyl gallate 40 g/kg with phosphoric acid at the level 30 g/kg keeping for 7 and

14 days but the other different level organic acid and storage time could be detected Salmonella on poultry thigh. This result was similar to the finding of Mulder *et al.* (1987).

Conclusion

The dipping of propyl gallate 40 g/kg combined with phosphoric acid 30 g/kg was the optimization to prolong the shelf life at 4°C for 14 days of poultry meat is basically effective by the control of Salmonella growth. However, with this level, the number of total colony count, *E.Coli* and *Staphylococcus areus* are accepted by FDA.

Acknowledgement

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Table 1. Effect of propyl gallate with/without acid and different storage time on total colony count and *Staphylococcus aureus*

Item	Total colony count (x 10^6 cfu / g)[1]			*S. aureus* (cfu / g)		
	7 d	14 d	21 d	7 d	14 d	21 d
Propyl gallate 40 g / kg	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
Propyl gallate + citric acid, g / kg						
40 + 10	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
40 + 20	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
40 + 30	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	2.20	<1.0	<1.0
Propyl gallate + phosphoric acid, g / kg						
40+ 10	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
40+ 20	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
40 + 30	>3.0 x 10^7	7.3 x 10^6	5.1 x 10^6	<1.0	<1.0	<1.0
Propyl gallate + sodium phosphatic acid, g/kg						
40+ 1	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	<1.0	<1.0	<1.0
40+ 2	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	6.60	<1.0	<1.0
40+ 3	>3.0 x 10^7	>3.0 x 10^7	>3.0 x 10^7	4.40	<1.0	<1.0

[1]= Colony form unit / gram

Table 2. Effect of propyl gallate with/without acid and different storage time on *E. Coli* and Salmonella spp.

Item	MPN[2] E. Coli (cfu / g) [1]			Salmonella spp. (25 g)		
	7 d	14 d	21 d	7 d	14 d	21 d
Propyl gallate 40 g / kg	>1100	>1100	>1100	D	D	D
Propyl gallate + citric acid, g/kg						
40 + 10	>1100	>1100	>1100	D	D	D
40 + 20	>1100	>1100	>1100	D	D	D
40 + 30	>1100	>1100	>1100	D	D	D
Propyl gallate + phosphoric acid, g/kg						
40 + 10	>1100	>1100	>1100	D	D	D
40 + 20	>1100	>1100	>1100	D	D	D
40 + 30	125.00	7.40	>1100	ND	ND	D
Propyl gallate + sodium phosphastic acid, g/kg						
40 + 1	>1100	>1100	>1100	D	D	D
40 + 2	>1100	>1100	>1100	D	D	D
40 + 3	>1100	>1100	>1100	D	D	D

[1]= Colony form unit / gram, [2] = Most probable number, D = detected, ND = Non detected

THE POTENTIAL USE OF STYLOSANTHES GUIANENSIS CIAT 184 AS A PROTEIN SOURCE FOR INDIGENOUS PIGS IN THE UPLAND FARMING SYSTEM IN LAOS

Chanphone Keoboualapheth[1] and Choke Mikled [2]

Abstract

An experiment was carried out with two objectives: (a) To determine the optimum amount of Stylo 184 as replacement for rice bran in diets for indigenous pigs, (b) To study the effects of Stylo 184 on intake and growth performance of indigenous pigs. Sixteen indigenous pigs of 12 ± 1.63 kg and 3 months of age from the upland area were used in the experiment. The experimental design was a completely randomized design (CRD) with 4 replications. The dietary treatments were: T1: 50% maize + 50% rice bran + 0% Stylo 184; T2: 50% maize + 40% rice bran + 10% Stylo 184 fed separately; T3: 50% maize + 30% rice bran + 20% Stylo 184 fed separately, T4: 50% maize + 20% rice bran + 30% Stylo 184 fed separately. The results revealed that total DM intakes were 942g, 1224g, 1221g and 1309g for T1, T2, T3 and T4 treatments, respectively, while DM intakes of Stylo 184 in total DM intake were 49.2g (4.1% of diet), 76.5g (6.3% of diet) and 82.7g (6.4% of diet) for T2, T3 and T4 treatments, respectively. The average daily gains (ADG) were 154g, 221g, 245g and 320g for T1, T2, T3 and T4 treatments, respectively. ADG was significantly higher ($p<0.01$) for the T4 treatment than for the other treatments. FCR were 6.25, 5.50, 5.00 and 4.00 kg feed/kg gain for the T1, T2, T3 and T4 treatments, respectively. Based on the results of this research it was concluded that indigenous pigs with live weight 10-40 kg can consume Stylo 184 as unconventional feed at up to 6.4% of the diet DM without any negative effects on health and growth performance and with a higher profit for the farmers.

Key words: Growth performance, Indigenous pig, Stylosanthes guianensis CIAT 184, Rice bran, Maize.

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Introduction

Pig raising plays an important role in smallholder farming systems in Laos as a protein source, as a means of family capital accumulation, and are used in traditional ceremonies, especially for minority ethnic groups, living in mountainous areas. Pigs are normally raised in a free-range system supplemented by rice bran, other household waste products and some wild tubers (Hansen, 1997). In general, pig diets are made up of rice bran, coarsely ground maize and weeds that are available in fallow land. These diets are low in crude protein resulting in poor pig performance. Furthermore, the availability of rice bran fluctuates during the year and amounts depend also on rice production, which is often low in shifting cultivation. This results in slow growth and low performance and productivity of the pigs. The other problems that farmers encounterd are the shortage of rice bran in the middle of the year (June to September).

To overcome these problems, many non-government organizations have introduced a wide range of technologies to farmers. Recently, Forage and Livestock Systems Project (FLSP) has introduced some forages, including *Stylosanthes guianensis CIAT 184 (*Common name *Stylo 184)*. Phengsavanh (1997) reported that the *Stylo 184* grows well and is well-adapted to a wide range of environmental conditions. It was initially widely used mainly for ruminants. However, *Stylosanthes guianensis CIAT 184* is now more commonly fed to the pigs rather than ruminants. Legumes can provide extra protein, as they have much higher levels of protein in their leaves than grasses. Legume leaves also provide essential minerals and vitamins for animal growth (Horne and Sture, 2000). In some areas where there is a shortage of rice bran and it is expensive, *Stylo 184* can be another alternative protein resource for feeding pigs, especially during the rainy season.

The objective of this experiment was to investigate the effects on growth performance of *Stylosanthes guianensis 184* as replacement for rice bran in basal diets for indigenous pigs.

Material and methods

Location and climate of study area

The experiment was conducted on station, at the Livestock Research Center, National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry, Lao PDR during August and November 2002. The center is located at an altitude of 175 m above sea level, 44 km north of Vientiane. The climate of this area is tropical monsoon with an average rainfall of 1600 mm per year. At the time of the experiment the wet season was from

May to October. The mean daily maximum and minimum temperature is 32°C in April and about 15°C in December (MAF, 2002).

Experimental design and treatments

The experiment was a completely randomized design (CRD) with 4 replications. The dietary treatments were as follows:

T1: 50% maize + 50% rice bran
T2: 50% maize + 40% rice bran + 10% chopped *Stylo 184*
T3: 50% maize + 30% rice bran + 20% chopped *Stylo 184*
T4: 50% maize + 20% rice bran + 30% chopped *Stylo 184*

Experimental animals

The pigs were selected and bought from Hmong villages in the northern upland area of Meuang Feuang district, which is 300 km from Vientiane. Sixteen indigenous pigs (8 females and 8 castrated males) with live weights of 11.0-13.4 kg of around 3 months of age were used. The pigs were vaccinated against swine fever and were treated with Ivomectin against external and internal parasites. At the beginning of the experiment, the pigs were weighed and randomly allocated into the four dietary treatments, distributed and housed individually in 1.5m x 1.8m pens following the experimental designs. Before commencement of the experiment all pigs were adapted to the conditions of the experiment for 15 days, especially to the experimental feeds and fresh chopped *Stylo 184* which were prepared for the experimental animals.

Experimental diets

The basal diets for the experimental pigs were based on locally available feed stuffs, including rice bran, ground maize, bone meal and salt. *Stylosanthes guianensis 184* (Common name: *Stylo 184*) replaced rice bran in the basal diets. There were four experimental dietary treatments. The rice bran, ground maize, bone meal and salt were mixed together, according to the formulation of the experimental diets for each experimental treatment and the control feed (Treatment T1). Each morning fresh *Stylo 184* at the age of 45-70 days was cut and carried daily from fields near the pig house. Fresh *Stylo 184* was then chopped into 4-5cm lengths, replacing rice bran in the experimental diets of treatments T2, T3 and T4, at 10%, 20% and 30% of DM respectively.

Animal management

The pigs were fed the basal diets and Fresh *Stylo 184 ad libitum* during the adaptation period (15 days) before starting the experiment. The pigs were fed twice daily *ad libitum* in two equal meals, in the morning at 07:00 h, and in the evening at 17:00 h and also the clean water was supplied *ad libitum* at all times throughout the experiment. At each occasion before feeding, the

offered feeds were recorded and weighed by using a 5 kg capacity portable weighing scale. The basal feed and fresh chopped *Stylo 184* were given separately to the pigs at the same time. The daily allowances were based on the mean of the nutritive requirements of of the pigs at each live weight. The feeding trial lasted 91 days.

Data collection

The initial weight of the experimental pigs was recorded at the beginning of the experiment. Before feeding the pigs in the morning, the feed offered and refused, and refusals of *Stylo 184* were weighed and recorded daily by using a 5 kg capacity portable weigh scale to estimate feed intake and feed conversion ratio. During the experimental period every pig was weighed once every two weeks before feeding in the morning and also the finishing weight of all pigs at the end of the experiment was recorded by using a 50 kg capacity portable scale for calculating live weight gain.

Sample analysis

Samples of fresh *Stylo 184* were collected daily and were placed in a refrigerator immediately and then were pooled and sent for analysis of DM at the end of the week. Every two weeks the dried sub-samples of *Stylo 184* were pooled and mixed together. In total 6 samples of *Stylo 184,* 2 samples of maize and 5 samples of rice bran were collected and analyzed for DM, CP, CF, Ash, Ca and P, by standard methods (AOAC 1988), (Van Soest, 1994).

Statistical analysis

The various data were subjected to the analyses of variance (ANOVA) procedure for completely randomized design experiment using the general linear models (GLM) in MINITAB 12.21 program (1998) and treatment means were compared using Duncan's New Multiple Range Test.

Results and Discussion

Feed and nutrient intakes

The results of the effects of *Stylo184* in the diets on feed and nutrient intakes are presented in Table 2. In the first month of the experiment, DM intake was not affected clearly when the proportion of rice bran decreased in the mixture of maize and rice bran, as there were no significant differences between T1, T2 and T3 ($p > 0.05$). However, DM intake was significantly higher for T4 ($p < 0.01$). In the last two months and overall DM intake was lowest for T1 and increased for T2, T3 and T4 (942, 1224, 1221 and 1309g DM/day for treatment T1, T2, T3 and T4, respectively). All of the differences of DM intake between treatment T1 and the other treatments were highly significant ($p < 0.01$), while

there were no significant differences among the *Stylo 184* treatments. However, the pigs in all *Stylo 184* treatments could not consume the planned amount of *Stylo 184* (10, 20 and 30% in the diets) when replacing rice bran (Table 3). The *Stylo 184* DM intake was very low, only 4.1% of the diet for T2 and increased to 6.3 and 6.4% in diets T3 and T4, respectively. The overall crude protein intakes were lowest for T1 ($p<0.01$) and increased for T2 and T3, but were non-significantly different between T2 and T3, and highest for T4 ($p<0.01$) (99, 133, 135 and 146 g overall CPI/day for T1, T2, T3 and T4, respectively) (Table 2). The overall crude fibre intake of T2 was significantly higher ($p<0.01$) than T3, T4 and T1, whereas T4 and T1 were not significantly different from each other. The *stylo 184* intake was lower than was expected following the replacement of rice bran by different levels of *Stylo 184* because of high fibre content of *Stylo 184* (30%) compared to maize and rice bran. Nevertheless, it could encouraged the pigs to consume more feed, because of stylo is a good, high protein (19.3%) feed supplement for animals and earlier study was shown to increase feed intake (Sture and Horne, 2000).

Pig performance

The results for initial weight, final weight, daily weight gain (ADG) and feed conversion ratio (FCR) are shown in Table 4. Treatment T1 had the lowest final weight and ADG, with the difference being significant compared to all other treatments in the 2 last months and overall ($p<0.01$). The final weight and ADG increased when the ratio of rice bran and maize meal decreased in the diets from T2 to T4 during the 3 months of the experiment. However, the differences of ADG between T2 and T3 were not significant ($p>0.05$) while FCR of T1 was significantly higher than T2 and T3 overall ($p<0.01$) and decreased in T2, T3 (5.50 and 5.00 kg DM/kg gain, respectively, $p>0.05$) and was lowest in T4 (4.00 kg DM/kg gain) ($p<0.05$).

The ADG of the indigenous pigs in this experiment was somewhat lower than in other experiments carried out in the region (Borin *et al.,* 1995; Borin *et al*., 2000) where ADG was in the range of 325 to 476 g/day for crossbreed pigs but protein intake was similar. Loc *et al.* (1997) showed that ADG were 453g/day and 465g/day for crossbreed pigs in central Vietnam fed cassava root silage with "A" molasses and cassava root meal diets with "A" molasses. Hang, (1998) also reported that ADG was 435g/day and FCR was 4.99 kg for crossbreed pigs fed ensiled cassava leaves, rice bran, and ensiled cassava root replacing the sweet potato vines, and ADG was 552g/day and FCR was 3.66 kg for crossbreed pigs fed sweet potato vines, rice bran, ensiled cassava root, brewer's grains and cassava root meal with fresh duckweed replacing the sweet potato vines. The differences might be because the protein sources were different and also the pig breeds were different. In contrast to this experiment in a study on highland pigs in Thailand (Falvey *et al*., 1981) ADG

was 198g/day and FCR was 5.3 kg for growing pigs fed pigeon pea at 3% of live weight on a rice bran and banana stalk basal diet; ADG was 258.5g/day and FCR was 6.2 kg for highland pigs fed pigeon pea at 3% of live weight on a sweet potato basal diet. ADG of the indigenous pigs fed *Stylo 184* with basal diets of maize and rice bran in our experiment varied among treatments in the range of 154 to 320 g/day, values which were slightly higher than the ADG in the range of 180-200 g/day reported for weaned Mong Cai pigs in Vietnam fed ensiled cassava root, rice bran and fresh duckweed (Lai, 1998).

Economical analysis

Feed costs and economic analysis for the experimental treatments are shown in Table 5 and 6. *Stylo 184* had a much lower cost compared to maize and rice bran (897 Kip/kg DM compared to 1,701 and 1,327 Kip/kg DM, respectively) and when the rice bran was replaced by *Stylo 184* in treatments T2, T3 and T4 the feed cost/kg of these treatments were lower than the feed cost/kg of treatment T1 without *Stylo 184* in the diet. The feed cost/kg of treatments T2, T3 and T4 were 8,365, 7,566 and 6,344 Kip or 90.23, 81.61 and 68.43% respectively, lower than that of treatment T1 (9,271 Kip).

Conclusion

Based on the results of this research it was concluded that:
1. Preparation of chopped *Stylo 184* in pig diets is a simple technique, and the product is cheap and suited to the conditions of smallholder farmers in the upland areas.
2. The indigenous pig increased feed intake with increasing levels of inclusion *Stylo 184* in the diet.
3. Indigenous pigs with live weights of 10-40 kg can consume up to 6.4% of diet DM of *Stylo 184* without any negative effects on health and growth performance and with a higher profit for the farmers.

Recommendation

Digestibility and feeding trials on the use of *Stylo 184* in indigenous pig diets should be carried out to estimate the optimum level of *Stylo 184* in diets for finishing pigs.

Acknowledgement

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Table 1. Analyzed chemical composition of feed stuffs (% in DM)

Item	Maize	Rice bran	*Stylo 184*
DM	88.2	90.4	22.3
CP	10.7	10.2	19.3
CF	2.6	27.9	30.0
Ash	0.2	10.8	5.1
Ca	0.2	0.4	0.2
P	0.5	0.7	0.4

DM: dry matter, CP: crude protein, CF: crude fibre, Ca: calcium, P: phosphorus

Table 2. Effect of level of *Stylo 184* on dry matter intake (DMI), crude protein intake (CPI) and crude fibre intake (CFI) of indigenous pigs

Item	Dietary treatment					
	T1	T2	T3	T4	SE	P
Period 1, days	35	35	35	35		
DMI, g/day	884[a]	963[a]	991[a]	1163[b]	38.03	0.004
CPI, g/day	93[a]	104[a]	110[a]	129[b]	4.10	0.001
CFI, g/day	135	138	132	128	5.09	0.531
Period 2, days	28	28	28	28		
DMI, g/day	922[a]	1339[b]	1216[b]	1328[b]	46.52	0.000
CPI, g/day	96[a]	145[b]	135[b]	148[b]	5.06	0.000
CFI, g/day	140[a]	194[b]	160[a]	147[a]	6.15	0.001
Period 3, days	28	28	28	28		
DMI, g/day	1035[a]	1435[b]	1514[b]	1472[b]	57.95	0.001
CPI, g/day	108[a]	156[b]	167[b]	164[b]	6.14	0.000
CFI, g/day	158[a]	209[c]	195[bc]	165[ab]	7.60	0.002
Overall						
DMI, g/day	942[a]	1224[b]	1221[b]	1309[b]	22.72	0.000
CPI, g/day	99[a]	133[b]	135[b]	146[c]	2.44	0.000
CFI, g/day	144[a]	177[c]	161[b]	145[a]	3.07	0.000

[a, b, c], mean values within rows with different superscript letters are significantly different ($p < 0.05$)

DMI: dry matter intake, CPI: crude protein intake, CFI: crude fibre intake

Table 3. Effect of level of *Stylo 184* on dry matter intake (g DM/day) from different feed stuff sources in the diets of indigenous pigs

Item	Treatment						SE	P
	T2		T3		T4			
	gDM/ d	%	gDM/d	%	gDM/d	%		
Period 1, days	**35**		**35**		**35**			
Maize intake	517 [a]	53.7	579 [a]	58.4	782 [b]	67.2	25.40	0.001
Rice bran intake	414 [a]	43.0	347 [b]	35.0	313 [b]	26.9	16.08	0.011
Stylo intake	31.3 [a]	3.3	65.3 [b]	6.6	68.8 [b]	5.9	2.99	0.000
Total DMI	963	100	991	100	1163	100		
Period 2, days	**28**		**28**		**28**			
Maize intake	714 [a]	53.4	712 [a]	58.6	891 [b]	67.1	33.81	0.015
Rice bran intake	571 [a]	42.6	427 [b]	35.1	356 [b]	26.8	20.45	0.001
Stylo intake	53.8 [a]	4.0	76.3 [b]	6.3	81.5 [b]	6.1	2.98	0.001
Total DMI	1,339	100	1,216	100	1,328	100		
Period 3, days	**28**		**28**		**28**			
Maize intake	760 [ab]	53.0	890 [bc]	58.8	979 [c]	66.5	36.79	0.016
Rice bran intake	608 [a]	42.4	534 [a]	35.2	392 [b]	26.6	22.10	0.001
Stylo intake	67 [a]	4.6	91 [b]	6.0	102 [b]	6.9	2.61	0.000
Total DMI	1,435	100	1,514	100	1,472 [b]	100		
Overall								
Maize intake	653 [a]	53.3	715 [a]	58.6	876 [b]	66.9	15.49	0.000
Rice bran intake	522 [a]	42.6	429 [b]	35.1	350 [c]	26.7	8.59	0.000
Stylo intake	49.2 [a]	4.1	76.5 [b]	6.3	82.7 [b]	6.4	1.82	0.000
Total DMI	1,224	100	1,221	100	1,309	100		

[a, b, c,] mean values within rows with different superscript letters are significantly different (p<0.05), DMI: dry matter intake

Table 4. Effect of level of *Stylo 184* on growth performance, feed conversion ratio of indigenous pigs

Item	Dietary treatment					
	T1	T2	T3	T4	SE	P
Period 1						
Initial weight, kg	11.9	11.8	12.6	12.6	0.331	0.244
Final weight, kg	17.1 [a]	18.4 [ab]	19.9 [ab]	22.0 [b]	0.488	0.000
Days	35	35	35	35		
ADG, g	149 [a]	187 [ab]	210 [bc]	270 [c]	10.44	0.000
FCR, kg DM/kg WG	5.99 [a]	5.18 [b]	4.72 [bc]	4.31 [c]	0.165	0.000
Period 2						
Final weight, kg	21.0 [a]	24.9 [b]	27.6 [c]	31.6 [d]	0.394	0.000
Days	28	28	28	28		
ADG, g	139 [a]	233 [b]	275 [bc]	340 [c]	9.48	0.000
FCR, kg DM/kg WG	6.67 [a]	5.75 [b]	4.42 [c]	3.90 [d]	0.106	0.000
Period 3						
Final weight, kg	25.9 [a]	31.9 [b]	34.9 [c]	41.7 [d]	0.525	0.000
Days	28	28	28	28		
ADG, g	177 [a]	252 [b]	260 [b]	361 [c]	14.34	0.000
FCR, kg DM/kg WG	5.92 [a]	5.76 [a]	5.83 [a]	4.09 [b]	0.304	0.006
Overall						
ADG, g	154 [a]	221 [b]	245 [b]	320 [c]	6.28	0.000
FCR, kg DM/kg WG	6.25 [a]	5.50 [b]	5.00 [b]	4.00 [c]	0.171	0.000

[a, b, c], mean values within rows with different superscript letters are significantly different (p<0.05)

Table 5. Feed ingredient cost

Item	Kip/kg as fed	Kip/kg DM
Stylo	200	897
Maize	1,500	1,701
Rice bran	1,200	1,327

Kip: Lao currency, Exchange rate: 10,500 Kip/1USD

Table 6. Economic analysis of experimental treatments

Item	Treatment			
	T1	**T2**	**T3**	**T4**
Total feed cost/pig (Kip)	129,788	168,131	168,720	184,600
Weight gain, kg (overall)	14	20.1	22.3	29.1
Feed cost/kg weight gain (Kip)	9,271	8,365	7,566	6,344
% of control diet	100	90.2	81.6	68.4

Kip: Lao currency, Exchange rate: 10,500 Kip/1USD
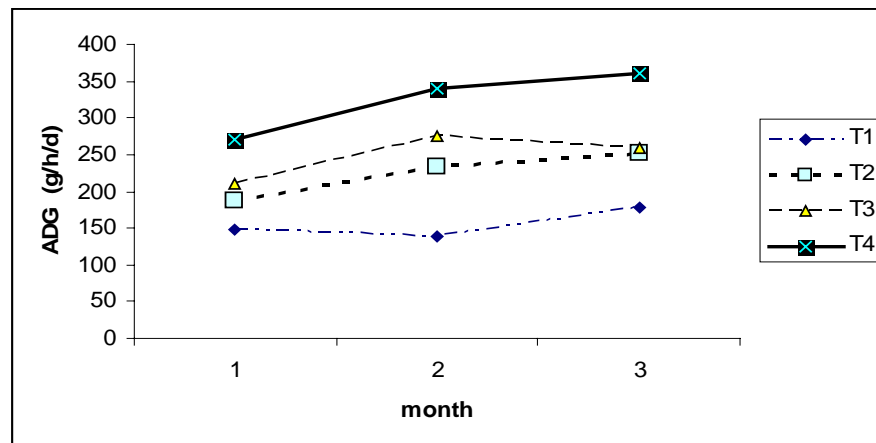
Figure1. Average daily gain of indigenous pigs fed different levels of *Stylo 184* in the diets

EFFECTS OF COOKING METHODS OF THAI SPICE SAUSAGE ON CHEMICAL COMPOSITION AND SENSORY EVALUATION

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Abstract

     Thai Spice Sausage is fresh sausage and originates from the northern of Thailand. The preparation is: minced pork consisting of trimmed-pork: fat (1:1 w/w) is mixed thoroughly with chili paste which consists of dry chili, lemon grass, shallot, garlic, curcumin, salty shrimp-like paste, coriander root, lime-like leaf and galanga. The ratio of minced pork and chili paste was 1:0.25 w/w and cased in the rehydrated natural casing by hand. The raw Thai Spice Sausage was stored at 4°C for 24 hours before cooking. The raw Thai Spice Sausage was further processed with three different cooking methods, namely; roasting, frying and grilling. It was found that dry matter of 3 cooking methods were 42.28%, 44.29% and 47.76%, respectively (p<0.05). Crude protein of frying method was significantly higher than roasting and grilling method (22.20% and 20.88%), respectively. Cooking loss of frying method was lower than roasting and grilling method (37.82% and 24.84%; p<0.05); respectively. Water activity of frying method had no difference from roasting method but was significantly lower 3.45% than grilling method. There were no significant differences in ether extract and shear value. According to the sensory evaluation of Thai Spice Sausage for ideal ratio score in terms of diameter and tenderness, overall acceptance of frying method was significantly higher than the other two cooking methods. It was concluded that frying method of Thai Spice Sausage could prolong shelf life and yield more benefit.

Key words*: Thai Spice Sausage, Cooking Lost, Water Activity, Sensory Evaluation, Ideal Ratio Score*

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Introduction

Thai Spice Sausages are local meat products in the north of Thailand. Thai people preferred to consume. Thai Spice Sausage could make by mixing the minced meat with the chili paste and cased in the rehydrated natural casing then Thai Spice Sausage are cooked by different method such as frying, roasting and grilling. Shelf life of Thai Spice Sausage did not too long at room temperature. Normally, Thai Spice Sausage are produced and suddenly sold. If Thai Spice Sausage were stored too long, they were changed to worse in chemical quality, eating quality and biological quality and the sausage finally decomposed.

The recent manufacturing occurred the problems in term of the different quality of Thai Spice Sausages which came from the different cooking method. The experiment was studied the effect of cooking method on chemical composition and sensory evaluation included with suitable cooking method which could help prolong shelf-life and least lost.

Material and method

Making Thai Spice Sausage

The ingredients of chili paste were crushed together and mixed thoroughly with trimmed-meat and visceral fat (Table 1). The ratio of minced pork and chili paste was 1:0.25 w/w and cased in the rehydrated natural casing by hand. The raw Thai Spice Sausage was storage at 4°C for 24 hours before cooking.

Table 1. Ingredients of Thai Spice Sausage

Ingredients	%
- Trimmed-meat and visceral fat (1 : 1)	100
- Chili paste (based on meat)	
1. Salt	2.5
2. ground dry chili	10.0
3. lemon grass	6.5
4. shallot	50.0
5. garlic	4.0
6. curcumin	3.0
7. shrimp-like paste,salt	5.0
8. coriander root	10.0
9. lime-like,leaf	10.0
10. galanga	3.5

The experiment

The raw Thai Spice Sausage has been stored at 4°C for 24 hours before cooked by different method that were frying, roasting and grilling. The chemical composition such as dry matter, protein and ether-extract were determined (AOAC, 1995). Dry matter was determined by drying at 100°C for 24 hours. Ether Extract was determined with the Soxhlet-extraction method. Crude protein was determined by the Kjeldhal method. Cooking lost was calculated from the different weight before and after cooking. Shear forces were determined on Texture Analyzer (Model TA.XT plus, UK) with Warner-Bratzler-V-blade. Water activities were determined with Testo 650 (Testo GmbH & Co).

The sensory evaluation used Ideal ratio profile. Panels were tested for color, diameter, particle size, toughness, firmness, juiciness, tenderness, herb aroma, meat aroma, hot chili, salty and overall acceptable (Jaturasitha *et al.*, 2003 and Viriyajari, 1992).

The data were analyzed by analysis of variance and compared among means were carried out by Duncan's New Multiple Range test with SAS (SAS, 1990).

Result and Discussion

Chemical composition

Dry matter of Roasting, Frying and Grilling methods were 42.28%, 44.29% and 47.79% respectively (Table 1). Crude protein of Frying method was significantly than roasting and grilling method. Water activity of frying method had no difference from roasting but it was significantly lower than grilling method. Cooking lost of frying method was significantly lower than roasting and grilling method. Ether extract and Shear force did not significantly different between groups.

Discussion

Cooking method of the goat meat by pan-frying, broiling, or baking were investigated that pan-frying method produced the highest cooking yields and shear values but the lowest fat content and instrumental lightness color values compared to the other cooking methods (James *et al.*, 1997). Grilling method resulted in the highest ratings for overall like, tenderness, flavor desirability and flavor intensity except juiciness. Pan-frying produced the highest juice rating, probably because fat was retained and liquid was added during pan-frying, whereas fat was lost during grilling and broiling (Savell *et al.,* 1990.)

Table 2. Chemical and Panel test of Thai Spice Sausage

	Roasting	Frying	Grilling
Chemical composition			
- Dry matter, %	42.28[a]	44.29[b]	47.76[c]
- Ether extract, %	31.12	31.12	34.16
- Crude protein, %	19.41[a]	24.95[b]	19.74[a]
- Water activity, %	0.83[a]	0.84[a]	0.87[b]
- Shear force, N	30.81	38.35	32.81
- Cooking lost, %	39.21[a]	24.38[b]	32.44[a]
Sensory evaluation			
- Color	0.98	1.03	0.90
- Diameter of sausage	0.80[a]	1.30[c]	1.06[b]
- Particle size	1.19[a]	1.57[b]	1.39[ab]
- Toughness	1.25	1.15	1.19
- Firmness	0.99	1.07	1.07
- Juiciness	0.87[a]	1.11[b]	1.12[b]
- Tenderness	0.70[a]	0.90[b]	0.76[a]
- Herb aroma	0.99	0.99	1.04
- Meat aroma	0.90	0.92	0.90
- Hot chili	1.07	1.02	1.00
- Salty	1.19	1.16	1.12
- **Overall acceptable**	**0.75[b]**	**0.92[a]**	**0.78[b]**

[a, b, c] means with the same row with different superscripts are the difference ($p \leq 0.05$).
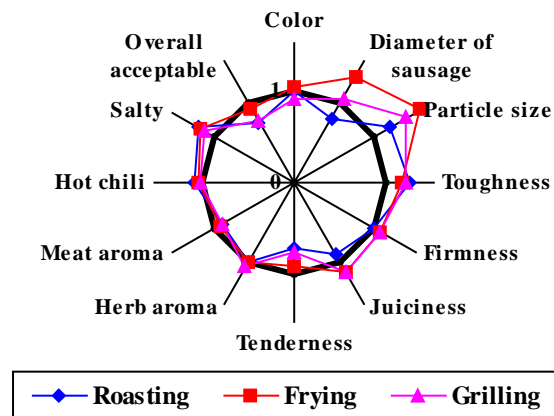
Figure 1. Ideal ratio profile of Thai Spice Sausage made from roasting, frying and grilling

Another experiment tested for the beef customer satisfaction with the top round steak dependent on cooking method (Neely *et al.,* 1999) was reported stir-frying, braising and simmering and stewing consistently produced higher customer attribute ratings in term of overall like, tenderness, juiciness, flavor desirability and flavor intensity.

Conclusion

The result of chemical composition and sensory evaluation of Thai Spice Sausage from frying method were best. It was found that suitable cooking method of Thai Spice Sausage was frying method, furthermore, frying method could prolong shelf life and more benefit.

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Organization and Management of the Rural Economy

STRENGTHENING THE EFFECTIVE IMPLEMENTATION OF RESEARCH AND DEVELOPMENT IN LA UNION, PHILIPPINES

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Abstract

Research and development is considered on of the engines of growth and development in a market economy. The technology index ratio and technology achievement indicators in the Philippines are low due to low investment, lack of R&D system's integration and accountability and weak research and extension linkage.

The result presents a general framework of strengthening the effective implementation of R&D in a multi-sectoral approach, and organized R&D system's integration of the technology development process as a way of supporting food security and sustainable resource management.

The descriptive method was used through the aid of a questionnaire floated to 40 respondents for the four R&D institutions in La Union for 1992 – 2002.

On the status of the 103 R&D studies implemented, the respondents made use of the single (84.47%) and combined (15.53%) and only 0.97% followed the technology development process within the R&D continuum. The adoption rate is 11.65%.

All the respondents were involved in research with a mean of 14 years while only 20% in the development activities for 13 years. The R & D studies were implemented with a mean of 3 years and some had a duration of 1–10 years.

Results reveal that the bulk of R&D studies were conducted from 1993 to 1998. The trend from 1993 to present is declining due to low appropriations from the GDP.

The bulk of R&D commodity is on agriculture (40.78%), and the others are on fishery, forestry, environment, and economics.

Key words: Research, Development, R&D Continuum, Extension System

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Rationale

President Gloria Macapagal-Arroyo envisions a transformed Philippine Agriculture, from a resource-based to a technology-based venture and declared that technology as an output of research and development (R&D), shall serve as the foundation of future economic development in accordance with the pertinent provisions of the Agriculture and Fisheries Modernization Act of 1997 or RA 8435 (BAR Chronicle, 2001).

Research is considered the lifeblood of advanced countries in propelling the economy, while the development or extension component is the catalyst of change considered as accelerators of agricultural development, and social change. R and D is viewed as a process to combat poverty, which still remains a nagging problem in our country.

Hence, this study would like to find out the true picture of the R&D activities in La Union.

Objectives
1. To assess the present status of research and development/extension studies of R&D institutions in La Union.
2. To determine the extent of implementation of the research and development continuum in accordance with its technology classification characteristics;
3. To identify the development/extension strategies utilized by the respondents;
4. To identify the R&D commodities of La Union; and
5. To find out the classification of recipients/clients.

Methodology

The study made use of descriptive method using a questionnaire, conducted in La Union. There were 40 researchers as the respondents from the different government agencies, namely: Department of Agriculture (DA), Department of Environment and Natural Resources (DENR), Bureau of Fisheries and Aquatic Resources (BFAR), Fiber Industry and Development Authority (FIDA), and the Don Mariano Marcos Memorial State University (DMMMSU). Frequency count, mean and percentage were used in analyzing the data.

Discussion of Results

Status of R&D Studies. The R&D studies was be assessed in terms of its status of implementation using the R&D Continuum which covered: TG; TA; TV; ID; TD; TU; and TC based on the DARCOP Model.

The research was classified according to its status in the R&D continuum. The status of the R&D studies was categorized as single and combined used of the continuum. Results reveal that 84.47% of the research

studies was classified to belong to single process of implementation as a status while only 15.53% was using a combination of various processes in the R&D continuum. There were 33.01% studies classified as TG, 9.71% as TA, 5.83% as TV, 8.74% as ID, 20.39% as TD, 4.85% as TU and 1.94% as TC.

On the other hand, only 0.97% of the research studies followed the technology development process of the R&D continuum from TG – TV and TA – TV, 1.94% each from TG – TD, TG – TU, TA – TU and TD – TC. In like manner, researches that started from TD – TU is 5.83%.

R&D Involvement. All the respondents were involved in research ranging from 1-35 years while only 20% of them were engaged in development activities from either 1-25 years. More than one-third (37.50%) of the respondents had been conducting research studies for 11-15 years, 25% for 6-10 years, 22.50% for 21-25 years, and a few from 1-5, 16-20 and 31-35 years. The mean year of research involvement is 14 years.

Along with the development side, there were five percent of the researchers who were involved for 21-25 years, 7.50% for 6-10 years and 2.50% each for 1-5, 11-15 and 16-20 years. The 80% of the respondents were not involved in development activities. The mean number of involvement in development activities is 13 years.

R&D Duration. Research duration reveals that almost one-half of the researches were conducted within the time frame of 1-2 years, 17.48% were for 3-4 years, 14.56% for 5-6 years, only 2.91% lasted for 7-8 years, while 3.88% ended after 10 years. Researchers also claim that 12.62% are considered continuing projects. The mean duration of R&D studies is three years

Year of Implementation. The R&D was implemented as early as 1989 and up to 2002. The various R&D institutions have been conducting R&D for the past 13 years or even more. In 1989-1990, 8.74% of the R&D studies were conducted, 11.65% in 1991-1992, 20.39% in 1993-1994, 18.45% in 1995-1996, 16.50% in 1997-1998, 14.56% in 1999-2000 and 9.71% for 2001-2002.

Technology Classification Characteristics

Technology Generation. Data below reveals that researchers are using various R&D activities in the implementation of their study. On TG, the researcher either uses single or combined classifications. On the single basis, there are seven activities conducted while on the combined basis, it varies from the combination of 2 to 6 activities. There are 64.86% of the research conducted under TG using single activity and 35.14% researchers used a combination of activities.

Technology Adaption. Researchers also utilized the single and combined classification of activities. There are 53.33% who utilized the single method of which there are 46.63% who made use of combined activities which varies from two to five processes (Table 6). The researchers have conducted this component research to evaluate the validity, reliability and replicability of the performance of new technology particularly set for a corresponding ecological condition and farming system.

Technology Verification. Technologies were verified through the use of single or combined means. There were 81.81% who utilized the single process and 18.18% for the combined process. The combined means made use of two activities. The single and combined means are implemented by the researchers in order to integrate the link between research and extension.

Technology Dissemination. This process has the most number of single and combined means of disseminating information. The researcher at this stage performs the role of extensionists in promoting appropriate technologies.
There were only 34% technologies disseminated to the clientele out of the 103 researches implemented since 1989. This figure reveals that only 1/3 of the technologies created awareness to some extent to the clientele using a variety of information dissemination strategy. There were
68.57% who made use of the single process and 31.43% used the combined process utilizing two to five processes.

Technology Utilization. The ultimate goal of the entire R&D activities is measured in terms of its utilization. There were 78.95% adoptors who were engaged in a small scale business; 15.78% were classified as medium scale and only 5.26% were classified as commercial scale. The adoption rate of 18.45% was considered as the performance indicator for R&D activities of government institutions in La Union which is rated to be very low. This implies that at least ¼ of the technologies in La Union were utilized and commercialized at various scales.

R&D Commodity/Sector
The research commodity conducted by the research institutions was classified as to agriculture, fishery, forestry, environmental, economics and others. As an agricultural area, 40.78% of the R&D studies deal with agriculture, 25.24% for fishery, 18.45% for forestry, environmental with 4.89%, economics 3.9% and others 6.79%.

Classification of Technology Recipients/Clientele

Technology recipients are those who availed of the research output through various R&D activities. The recipients were classified according to individual and group categories. There were 30.89% for fishermen, 58.19% farmers, and 10.92% youth. The group categories were classified as NGOs and GOs. For the NGOs, there were 21.42% cooperatives and 64.29% associations while there were 14.29% GOs.

Development/Extension Strategies Utilized

The most strategic approach being utilized the development/extension workers under Individual Approach was the "farm and home visits", (12.26%). The second approach being utilized was the "result demonstrations", (8.50%); third was "office calls", (6.60%). Both were 5.66% for telephone calls and personal letters.

Using the group approach, the most utilized strategy was the training, (14.10%). Other strategies in descending order were: method demonstration, general meeting and tours and field trips.

For the mass approach, the most utilized strategy was publication, (8.49%). Other strategies in descending order were: posters, radio, educational exhibits, bulletin boards and the least used were press, flip chart and billboards. The mass approach not utilized were the slides and filmstrips, motion pictures, flannel graph and wall newspaper.

Recommendations

1. A well-organized R&D system's integration in the Technology Development Process of the R&D continuum is hereby recommended to improve the R&D status in La Union, to wit:

   1.1 The respondents should follow the technology development process of the R&D continuum from technology generation to technology utilization/commercialization. Technology generated as much as possible should be subjected to the process of adaption, further verified, properly disseminated to the clientele and utilized to complete the whole process in order to attain a higher adoption rate.

   1.2 For a strong research and development linkage and accountability, the following strategies are proposed:

      1.2.1 The researchers or the technology generators should also perform the functions of an extensionist as technology promoters. This will lead to more effective research management and improve research and extension linkage which will help minimize the technology utilization lag and ensure that technologies generated are disseminated and

utilized. The process will ensure a complete feedback mechanism as another subject of research.

1.2.2   In cases where the researcher cannot perform both the research and extension functions, this scheme is hereby proposed known as the R&D interface. That is, the researchers are still involved in the R&D Continuum from TG to TC while the development component is taken care of by the extensionists.

1.3 The research using the R&D continuum should have a duration of three to five years in order to serve existing ecological condition and its appropriateness.

1.4 The government should provide a higher budget for S&T if we really want to see R&D as a foundation for economics growth.

1.5 The research institutions should institutionalize the conduct of R&D development activities from the research proposal preparation stage in order to ensure that all the processes of the R&D continuum are integrated to the whole project proposal.

2. To improve the extent of implementation of the R&D continuum in accordance with the technology classification characteristics, the following are recommended:

2.1 A combination of the different technology classification characteristics should be carried within the technology development process from TG, TA, TV and TD, namely.

2.2 For a higher level of technology adoption, the client system should be involved throughout the technology development process of the R&D continuum. This will help facilitate the diffusion process since the clients are the ultimate adoptors and they must be involved in the planning, implementation of R&D projects or a strategy of bottoms-up approach. The R&D system should be treated by the client as an educational facility to improve research and extension interface.

3. In the identified R&D commodities, balanced commodity landscape should be undertaken to ensure that thrusts of the R&D agenda are uniformly addressed and resources of the ecosystem are maximized.

4. To strengthen partnership and sustain the technology development process, the following modalities are recommended:

4.1 The recipients/clientele under the individual category should not be treated as technology beneficiaries only. They must be involved from technology generation to utilization, in the planning, implementation and evaluation of R&D projects.

4.2 Under the group category recipients, a wider partnership among NGOs, GOs should be strengthened in order to sustain research-extension linkage. Modalities of networking on the conduct of R&D activities should be institutionalized between and among the technology

generators and recipients throughout the R&D continuum. This process would provide a greater degree of involvement that will lead to a higher level of technology adoption and ensure greater accountability.

5. To speed up technology transfer and utilization process, the following are hereby suggested:

5.1 The development/extension strategy should not be implemented individually, rather as a combination of more development/extension strategies and should be maximized in disseminating technology. The individual approach must be complemented by the group and mass approaches. The interrelationship should be given emphasis as the common goal of technology transfer, since the more senses involved in technology transfer, the higher would be the chance of having our technologies understood and adapted.

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SPURRING RURAL ECONOMY AND PRODUCTIVITY THROUGH COOPERATIVES IN THE FACE OF GLOBALIZATION AND TECHNOLOGY REVOLUTION

Antonio O. Ogbinar

Abstract

Experiences in many developing and developed nations have proven that one of the most effective strategies to attain economic growth and equitable distribution of income and wealth is through cooperatives. In the Philippines, cooperatives play a crucial role in the wake of the current socio-economic trends. The Asian crisis devastated Philippine economy. The current recession in Japan and the US have stunted the country's recovery. The aftermath of the Iraq war, SARS epidemic, and the recent aborted Philippine coup d'etat added instability. Hence, cooperatives as an alternative economic system in the Philippines becomes more relevant today.

This paper underscores the following:

- Imperatives of cooperatives as a catalyst for local entrepreneurial growth and as a locally-based answer to globalization;
- Current status, growth and development, including weaknesses and prospects of Philippine cooperatives; and
- Economic significance of cooperatives (in terms of market shares) among selected Asian and European countries.

Data from the Cooperative Development Authority (Philippines), World Council of Credit Unions, and Committee for the Promotion and Advancement of Cooperatives (of the United Nations) were analyzed and studied using descriptive statistics. The study made use of time-series data to evaluate the growth and development of Philippine cooperatives.

As of December 2002, the Philippines had a total of 64,000 cooperatives. They may not all be successful but they have taken on various businesses – from dairy cooperatives producing fresh cow's milk, to cow fattening co-ops, to banking, weaving, health service, airlines, coffin-making; rice, corn and vegetable farming and retailing; banana, rubber and pineapple planting; media co-ops publishing local newspapers, meat processing, laundry services, overseas contract workers' co-ops, among others.

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In 1997, the contribution of cooperatives to the country's Gross Domestic Product was 19%. In the same year in Japan, the consumer cooperative movement provided 58,281 full-time and 95,374 part-time jobs. In Europe, cooperatives provided employment to over 5 million individuals in 1996. Germany, in particular, employed 502,700 persons in 1996, up from 487,300 in 1994. These are just some examples of the contribution of cooperatives to employment promotion.

Despite external challenges in the political and economic environment (e.g., impact of economic liberalization, democratization, globalization, new trade groupings, etc.), the cooperative movement is convinced that there is a growing potential for cooperative development, and for cooperative renewal, in light of the limitations of the free market like social responsibility and equity, the advantages of decentralization of power, the importance of stakeholder and community involvement in economic and social life, and the growing role of the civil society.

Introduction

The Committee for the Promotion and Advancement of Cooperatives (COPAC) defines cooperative as an autonomous association of persons united voluntarily to meet their economic, social and cultural needs and aspirations through a jointly owned and democratically controlled enterprise. Cooperatives are people-centre business enterprises which operate in all areas of economic activity and in almost all areas of the world.

Common to all cooperatives are the values of self-help, self-responsibility, democracy, equality, equity and solidarity. Cooperatives also believe in social responsibility and include as one of their principles the concern for the community in which they operate.

An important contribution of the cooperative movement continues to be its capacity for promoting and supporting entrepreneurial development in forms compatible with the principles and objectives of the World Summit for Social Development, held at Copenhagen, Denmark from March 6-12, 1995.

Imperatives of Cooperatives as a Catalyst for Local Entrepreneurial Growth

Philippine President Gloria Macapagal-Arroyo stressed that "Cooperatives are schools for democratic participation and pro-active citizenship. They provide a locally-based answer to globalization. They demonstrate the true meaning of freedom, equity, security and human dignity." She added that "cooperatives are more relevant today than they have ever been. Their ability to combine an entrepreneurship approach with the values and accountability of the private sector and the civil society make them an essential part of the Philippine economy."

The *Cooperative Code of the Philippines* cited that the primary objective of every cooperative is to produce goods and services to its members and thus enable them to attain increased income and savings, investments, productivity, and purchasing power and promote among them equitable distribution of net surplus through maximum utilization of economies of scale, cost-sharing and risk-sharing.

Philippine Cooperatives: Then and Now

The history of the cooperative movement in the Philippines can be divided into three stages.

First Stage (1895-1941). This stage is characterized by the aborted germination of coops by some revolutionary *illustrados* (or the pre-formation period), the introduction and endogenization of the Raiffeisen-type agri-based coops by American missionaries and teachers and western-educated Filipinos which featured the principles of self-help and self-reliance (or the formation period) and the introduction of state-initiated farmer coops by the American colonial administrators.

Second Stage (1941-1986). This stage can be subdivided into 4 phases. The first phase is the period of Japanese occupation which featured a rapid increase in cooperatives as a result of food shortages. The second phase is the period of rehabilitation period after the 2nd World War. The third phase is the resurgence of the state-initiated coops while the fourth phase is the introduction and rise of the non-agricultural coops. The fourth and final phase is the martial law period and the politization of the coop movement.

Third Stage (1986 to present). This stage shows the emergence of the coop movement as a potential political force as it allies with the Non-Government Organizations (NGOs) and trade union movements in pursuing the goals of people empowerment and the strengthening of the country's civil society sector. The growth of Philippine cooperatives from 1939-1985 is shown in Table 1.

Table 1. Philippine Cooperatives, 1939-1985

Year	1939	1967	1977	1980	1985
Number	570	1,530	1,897	2,941	3,350
Membership (in thousands)	105	555	460	223.7	337
Assets (in millions)	3.4	30.5	129.1	280.1	1,053.8
Capital (in millions)	n.a	n.a	129	193.9	627.1

Source: Gray Wine Think Tank

The comparison on the privately-initiated coops (Raiffeisen) with state-initiated coops, according to two studies cited in Ibon, is as follows table 2

Table 2. Privately-initiated coops Vs. State-initiated Coops

Study Conducted by:	Privately-Initiated	State-Initiated
Cooperative Foundation Of the Philippines (CFPI)	- Poor technology and management - Fragmented	- Too much government intervention - National federations are paper organizations and overlapping functions and membership base
Local Initiatives in Science And Technology (LIST)	- Poor in monitoring, evaluation, and audit - Poor promotions - Ineffective or non-existent tie-ups (or networking)	- Obsessed with top-down systems

From 1969-1977, coop membership lost about 95,000 members or a 17% decline, Table 3.

As shown in Table 4, the increase in the number of confirmed and successful coops (from 1985 to 1993) were in multi-purpose coops at 8,107%, credit coops at 750% service at 514.2%, marketing at 183.9%, and producers at 181.5%. Coops that declined in number were in consumers at –4.9% and area marketing at –5.8%.

According to Cosio and Kanda, early cooperatives in the Philippines (with the exception of the first country's cooperative organized by national hero Rizal) were the product of a series of government interventions through legislative measures. Since 1915, more than 20 laws, plus a number of executive and administrative orders, have given more than 15 government agencies the mandate of developing the cooperatives in the country. Since 1991, the number of cooperatives has more than quadrupled to 56,557 organizations (as of September 30, 2000) with more than 7 million members, P54.7 billion (US$1.2 billion) worth of product volume sales, P5.8 billion (US$130.98 million) in savings, P5.9 billion (US$133.3 million) capital build-up and P3.3 billion (US$74 million) paid-up share capital.

Table 3. Development Trends of Philippine Cooperatives

Period	1939-1969	1969-1977	1977-1980
Number of Years	30	8	3
Number of Coops	+960 (168%)	+367 (+24%)	+1,047 (+55%)
Membership (in thousands)	+450 (+428%)	95 (-17%)	+151 (+117%)
Capital (in millions)			+64.8% (+50%)

Source: Gray Wine Think Tank

According to the Cooperative Development Agency (CDA), among the 64,000 cooperatives in the country as of 2002, only 37,000 are viable.

Philippine experience tells us that the main reason for coop failures is still the lack of education and training. This was revealed in more than 80 studies, which assessed the growth and development of coops which included the studies of Emmanuel Velasco, the Cooperative Foundation of the Philippines, Inc. and Leandro Rola, that lack of education and training correlates with the following causes of coop failures: (1) lack of capital, (2) inadequate volume of business, (3) lack of loyal membership support, (4) vested interest and graft and corruption among coop leaders, (5) weak leadership and mismanagement, and (6) lack of government support.

Under the administration of former President Joseph Estrada, the major problems of the cooperative movement include the following:

- A large number of cooperatives remain unviable as shown in the statistics that only 4,494 or 17.8% of the 25,125 registered coops in 1993 have been confirmed by the CDA.
- Globalization and liberalization have resulted to more competitive business environments. Several small, medium and big coops like those in the

electric, producers (or manufacturing), multi-purpose, coop banking, consumers and trading industries are exposed to strong competition.

- Unionization and threats of in unionization in some medium and big size coops continue despite the Supreme Court ruling that employee-coop members are not allowed to join trade unions.
- Agri-based cooperatives, particularly those in agrarian reform communities and in plantations are not showing improvement in productivity and some are encountering mismanagement and failures.
- The mentality of relying too much on protectionism, parochialism and close-doorism are still prevalent among many cooperatives. They feel that coops should be continuously protected and subsidized by the government.

Table 4. Statistical Information on All Types of Cooperatives (1985-1993)

	1985 (BCOD)	1993 (CDA)	%Increase (Decrease)
Total Registered	3,350	21,125	750
Samahang Nayon (SN)	4,496	-	-
No. of Reporting/Confirmed Coops	1,142	4,494	393.5
1. Credit coops	592	1,095	184.9
2. Consumer	305	290	(4.9)
3. Producer	65	118	181.5
4. Marketing	87	160	183.9
5. Multi-Purpose (Agri)	27	2,189	8,107.4
6. Multi-Purpose (Non-Agri)	-	334	-
7. Area marketing	17	16	(5.8)
8. Coop bank	29	29	-
9. Coop federation	-	40	-
10. Coop union	-	43	-

Economic Significance of Cooperatives

The United Nations estimated in 1994 that the livelihoods of nearly 3 billion people, or half of the world's population, were made secure by cooperative enterprises. Nearly 800 million individuals are members of cooperatives. They provide an estimated 100 million jobs. They are economically significant in a large number of

countries providing foodstuffs, financial services as well as the provision of services to consumers.

Examples of the economic significance of cooperatives can be seen by the market shares they hold.

- In 1998, 33% of the United States agricultural market was comprised of cooperatives, and rural electric cooperatives operated more than half of the of the electrical lines in US, providing power to more than 25 million people in 46 states.
- In the Philippines in 1997, the contribution of cooperatives to Gross Domestic Product (GDP) was 16%. It was estimated that the contribution of the cooperative sector to the national workforce was 5.01 million or 16.24 % of the total job market in 1997.
- During the same year in Denmark, cooperatives were responsible for 94% of milk processing, 69% of farm supply and 66% of cattle slaughtering.
- In 1997 in Canada, 62% of the country's dairy products were marketed through cooperatives and in Finland, cooperatives were responsible for 79% of agricultural and 31% of forestry production.
- In Korea, 40% of local agriculture in 1998was marketed and 50% of the group life and accident insurance.
- In Latin America, it was estimated that 15,000 jobs were generated by consumer cooperatives.
- Cooperatives have created over 13.8 million jobs in India in 1998, with 92% of the jobs created through self-employment through worker cooperatives.
- In Japan, the consumer cooperative movement provided 58,281 full-time and 95,374 part-time jobs in 1997.
- In Europe, cooperatives provided employment to over 5 million individuals in 1996.
- In 1996, the German cooperative movement employed 502,700 persons, up from 487,300 in 1994.
- In Russia, the consumer cooperative movement reported 511,300 employees, of which 70% were women.
- In Spain, the Mondragon workers' cooperative movement increased its capacity to provide employment. In 1996, it employed 31,963 persons, increasing its workforce by 7.6% in 1997 to 34,397 and again in 1998 to 42,129 persons.

Conclusion

Cooperativism has a long history of over a century in the Philippines. The general impression, however, is that the cooperative movement has yet to take off from its development stage. Thus, the strengthening of this movement

should be a continuing goal of governments so that the cooperative sector can truly live up to its role as an effective partner in proving people's welfare and national development. After all, cooperatives are an important and indispensable institutional form at the grassroots level by virtue of their numbers and their proven capability to help raise the quality of life of the poor.

The Philippine government, therefore, should sustain its supportive role of providing technical guidance, financial assistance, market linkage, and other direct development services, (such as continued educational efforts to build trust, leadership, accountability, transparency, efficiency, and productivity) to the cooperatives. This is important in order for the cooperative movement to meet the competitive challenges of increasing global market liberalization.

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VILLAGE CHICKEN PRODUCTION SYSTEM IN VIETNAM, WHAT DOES THE FUTURE HOLD

Tran Thi Mai Phuong[1] and Hoang Van Tieu[2]

Background

There has been growing global concern over the worsening problems of poverty, hunger and malnutrition in developing country, also in Vietnam. Evaluation reports from a number of integrated development projects in Vietnam indicated that village chicken play a significant role in poverty alleviation and food security and enhancing gender equity among the disadvantaged communities.

Chicken form a common resources for the different gender groups in the rural population to which the landless and those who do not possess cattle, pig or goats attach high socio-economic value. With the new thrust on sustainable food and nutrition security, which aims at creating physical, economic and social environmental access to a balanced diet, village chicken in Vietnam should be placed in food security programmers.

Scavenging chicken have existed in villages from time immemorial. They form a part of the whole farming system. The type of chicken kept and their management are highly influenced by various biological, cultural, social and economic factors prevailing in the villages. Village chicken are scavenged within the village boundaries. Their nourishment depends on the feed available in the village and their health on the local disease situation. Because of the role they play in village life, scavenging chicken are best described as village chicken.

Based on the survey's results, since 1996 the Vietnamese Government has a long term project to improve the village chicken breeds for the farmers in the rural population.

Characteristics of the village chicken production systems in Vietnam before 1992

Most village chicken production systems in Vietnam are based on the indigenous or native domestic fowl without selection and are characterized by a low level of input and output. The main input is the feed from household refuse as well as that scavenged around the village. Provision of other input such as housing, additional feed and health care vary greatly between and within

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countries, depending on the farmer's or household's socio-economic circumstances. With such low input, the village chicken are capable of generating cheap and readily harvestable meat and eggs for immediate home consumption and sale for income generation, while at the same time performing a useful social hygiene function. In some communities small livestock, particularly village chicken are important in breaking the vicious cycle of poverty, malnutrition and disease (Robert, 1992)

It is easily to see that, the village chicken have low productivity compared with the commercial poultry production system (table 1)

Table 1. Productivity of the scavenging chicken (Dongtao chicken) and commercial chicken

Parameter	Scavenging village chicken	Commercial chicken
Age at slaughter weight (weeks)	> 16 weeks	< 8 weeks
Egg production (eggs/hen/year)	67.71	> 250
Egg weight (g)	32-45	> 60
Mature weight (g)	>1,700	>2,000
Mortality rate (%)	>50	<10

Ownership and management of village chicken before 1992

Ownership of village chicken in most communities is a function of social and cultural aspects. Although village chicken move freely about the whole village, they are all attached to a specific household. The relationship between the chicken and the owner household is unique and has led some researchers to describe the village chicken as part of the household, often sharing the same shelter.

The attachment of the village chicken to the household and the variations in intrahousehold relationship within the villages result in different village chicken production systems. In some villages, the mixing of flocks between households is limited to scavenging periods only. In some other villages there is a greater association of flocks from different household, which can extend to share shelter and housing.

The management of village chicken is complicated by the presence of multi-age groups in the same flock. High chick losses have been attributed to poor feeding, housing and health control practices. With no preferential treatment of the chicks, some starve to death because of high competition for available scavenging feed resources. Where supplementary feeding and water

are provided, the containers used are too deep for the chicks to reach the contents. Predation is also a major cause of high chick losses because the young stock are more vulnerable. These management problems also lead to the failure or poor performance of health control programmes.

A long term project to improvement of the village chicken breeds – goals and results

The population of poultry in Vietnam are increasing rapidly: from 160.55 million birds in 1997 to 215.8 millions birds in the year 2001 and the growth rate is 6.04% in 1997 in comparison with 10.0% in 2001. Chicken is about 80% among them, and the village chicken population is also about 80% of the total number of the chicken population (statistical year book – 2002)

Based on the survey's results, since 1996 the Vietnamese Government has a long term project to improve the village chicken breeds for the farmers in the rural areas.

The goal of this project are:
- To improve the breed quality by selection ,
- Introduction of suitable crossbreds and good management;
- Build the breeding system and disease control programmes.

The results of this projects:

Under the frame of this project, some indigenous chicken breeds and imported breeds are kept by intensive system in order to have the data on their performance and then selection for pure bred and making the crossbred between them depends on the demand of the market.

The crossbreds between the native chicken and imported chicken are produced. 14 suitable crossbreds were produced from this projects such as:
1. Male Kabir x female Ri (KR)
2. Male Mia x female Ri (MR)
3. Male Mia x female Kabir (MK)
4. Male Rhoderi x female Jiangcun (RRJ)
5. Male Kabir x female Rhoderi Jiangcun (KRJ)
6. Male Jiangcun x female Kabir (JK)
7. Male Kabir x female Jiangcun (KJ)
8. Male Yellow chicken x female Rhoderi (YRR)
9. Male Dongtao x female Jiangcun (DJ)
10. Male Rhoderi x female Jiangcun (RJ)
11. Male Ho x female Yellow chicken (HY)
12. Male Mia x female Yellow chicken (MY)
13. Male Yellow x female Kabie (YK)
14. Male Ri x female Yellow chicken (RY)

These crossbred have some good characteristics (their feather is the same with the village)

Table 2. The performance of some native chicken breeds by intensive system

Parameter		Ri	Mia	Dongtao	Ac
Live weight at 12 weeks of age (g)		997.75	1,223.5	1,428.8	445.77
Feed conversion/kg of weight gain (kg)		3.55	3.59	3.14	3.1
Age at the first egg (days)		135	133-165	157-165	122
Egg production (eggs/hen/year)		110	75.6	67.71	95.30
Egg weight (g)		32-35	45-47	33-45	29-33
Fertility rate (%)		93	89.90	89.54	94.59
Hatch ability rate (%)		84.59	73.0	77.27	66.65
Feed conversion/10 eggs		3,6	3,4	4,14	2.26
Mortality rate (%)	Chick	5-10	20-22	5	5-7
	Adult	3-5	4-7	10-11	2-5

Based on these data, by selection, their performance will be improved (Mia and DongTao chicken for meat, Ri chicken for egg, Ac chicken for dual purpose).

Table 3. The performance of some imported chicken breed (from China and Israel)

Chicken breeds / Parameter	Yellow chicken	Jiangcun chicken	LP chicken	Kabir chicken	Mahoang chicken
Live weight at 12 weeks of age (g)	1,404-1,520	1,560-1,802	1,197-1,490	1,440	1,239-1,442
Feed conversion/kg of weight gain (kg)	3.09-3.19	3.15-3.29	2.32	2.31	2.62-3.00
Age at the first egg (days)	138-140	132-135	134-143	168	158
Egg production (eggs/hen/year)	141-143	156-159	166-171	135	157.4
Egg weight (g)	42-50	38-44	41-45	-	46-53
Fertility rate (%)	94.7	96.03	96.2	-	-
Hatch ability rate (%)	79.06	80.45	91	-	-
Feed conversion/10 eggs	3.27	2.92	2.71	-	2.32
Mortality rate (%)	2-5	2-5	2-3	5-10	5-8

LP chicken: Luongphuong chicken

Chicken can adapted well in various areas, their performance are also better than the native chicken and their products are accepted by the market.

The research results on nutrition and development of farm –level skills and entre-preneuship

The first result on using local feed resource (earth worm, cassava leaf) for the village chicken bring some benefit for the farmer.

- Investigating the effect of energy, lysine level in diets and type of rations on growth and some parameter of carcass quality of Yellow and Kabir chicken.

- Investigating the suitable level of Energy and crude protein in diet of some village chicken breeds in the center of Vietnam

- Investigating the suitable diets for Ri, Mia chicken in semi- intensive system.

The Project had developed of 11 pilots for raising village chicken in various areas and a lot of people were trained

And now, we can produce 1.6 millions chickens with high quality every year for the farmers throughout the country, special in the remote areas. With these results, the Project has contributed a significant role in poverty alleviation and food security in Vietnam.

Suggested approach for future development programmes

In view of lessons from the past rural poultry improvement programmes, a new approach should aim at increasing flock productivity instead of individual animal productivity. The potential of the village chicken as a provider of food and income should be exploited. A combined approach is suggested, which must be accompanied by improved extension services and farmers training on good husbandry practices, namely housing, hygiene, feeding and health control. Improvement techniques should be based on indigenous technologies and available local resources. Improvement indicators should be measured by,

- Reduce mortality rates
- Increasing chick growth rates through preferential treatment of chicks
- Increasing egg production per hen and
- Increasing chicken turnover.

It will be interesting to undertake studies at farm level to establish the input-output relationship of a healthy, productive flock. Models developed from farm data can be used advise on production alternatives on the basis of farmer objectives and resource endowment. This is a major challenge to scientists working on poultry development in Vietnam.

Branckaert (1996) made a very profound statement "Village chicken is the backbone for a sustainable well - adapted semi - commercial subsector". Those households that appreciate the economic importance of the village chicken and are willing to invest more, will easily adopt intensive poultry keeping when resources allow.

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THE ROLE OF CO-OPERATIVE ENTREPRENEURS
IN DEVELOPING MILK AGRIBUSINESS SYSTEM IN INDONESIA

Lukman M. Baga

Introduction

Milk agribusiness in Indonesia nowadays faced critical problems as it had faced before 1978. Although in 1980s there was a drastically improvement in this agribusiness, the growth become weaker since beginning 1990s. As the economic crisis struck, milk agribusiness should be well developed because the price of domestic milk becomes more competitive than price of imported milk. However, the economic recovery program caused that most of supporting policy must be deleted and let milk cow breeder faced directly the strong power of milk processing industries (MPIs).

There is a tendency that milk agribusiness will be left behind by breeders due to low output price compared to the higher input price. The agribusiness is no more attractive for breeder, which might bring the agribusiness back to its condition before 1978. The paper figures out the dynamic development of milk agribusiness in Indonesia since 1960s, in order to identify influencing factors which can be used in finding the way of solutions for the faced problem.

Agribusiness System and Role of Co-operative Entrepreneurs

Agribusiness is defined as "sum total of all operations involved in the manufacture and distribution of farm supplies; production operation on the farm; and the storage, processing and distribution of farm commodities and items made from them." (Davis and Goldberg, 1957). With regard to this definition, the agribusiness system consisted of; (1) downstream agribusiness sub-system, which connects to the supply of input factors, (2) on-farm agribusiness sub-system, which produces agribusiness products; (3) upstream agribusiness sub-system, included of processing and marketing the agribusiness products; and (4) supporting service sub-system (Saragih, 1998). Accordingly, the development of agribusiness system is the development of all these subsystems simultaneously and consistently.

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In developing countries, however, the role of supporting service subsystem (SSS) is very important, due to the weaknesses of other sub-systems. In Indonesia, the government role is very dominant in conducting SSS for agribusiness development. Unfortunately, this support is partitioned into several institutions (Baga *et al.,* 1999), which causes a weak coordination and even causes a cannibalization among sub-systems. With such condition, the government has become a source of problem, not the solver (Saragih, 1998). Therefore, the farmers themselves should do the SSS by cooperation among them. By forming co-operative, farmer can improve their bargaining position as a countervailing power in terms of developing more profitable input and output markets, improving production and market efficiencies, getting better of risk handling, and also insuring to business continuity as well as increasing farmers income (van Bekkum and van Dijk, 1997).

Establishing co-operative needs person who plays the role of co-operative entrepreneur (CE), who is able to find the co-operative opportunities and make use of those opportunities in terms of benefiting the member. Relating to developing agribusiness system, the co-operative opportunities should be found out by CE within all of its sub-systems, including within the SSS.

**The Dynamic Development of Milk Agribusiness in Indonesia.**

Introduced by the Dutch in 17th century, milk is actually an exotic commodity for Indonesians, both in production as well as consumption. So, the development of milk agribusiness was very slow until independence from Dutch colonial in 1945, even until the end of 1970s. This was due to many factors, such as: (1) tropical climate which was not suitable for producing milk; (2) small scale breeders, that mostly own only 2-4 milk cows/breeder; (3) the low level of milk cow health as well as low genetic quality; (4) lack of managerial skill in conducting milk cow business, due to low quality of breeder human resources; (5) the difficulty for having high quality of feed, while grass land for milk cow's became less sufficient in Java island; (6) the lack of experts to help the smallholder breeder; (7) the milk quality was still low; (8) lack of infrastructure; and (9) problems on marketing of milk, while milk consumption of Indonesians was still low and also high competition with imported milk. However, since 1978 there was a very significant growth (Figure 1). The milk cow population as well as milk production increased drastically. Even in 1980s era, there was a significant increasing of productivity of milk cow, which indicated by a higher growth of milk production than growth of milk cow population. Milk cooperatives had played a very important role in these changes. The buildings of milk co-operatives in Indonesia were not apart from the role of

veterinarian (drh). The first milk co-operative in Indonesia was GAPPSIP, which was built in 1949 by drh Soejono and drh Hutabarat in Pangalengan-Bandung. Unfortunately, in 1963 it was closed due to bad economic condition at that time. In 1962 there was Co-operative of SAE Pujon-Malang, which was established by drh Memed Adinata, and in 1969 KPBS-Bandung by drh Daman Danuwidjaja. Besides, there were several other milk co-operatives that emerged in those two suitable areas. However, milk agribusiness was still growing very slow due to problem in marketing. In 1970s there was a promotion of milk drinking for health life and then followed by emerging 7 private milk-processing industries (MPIs) in Java. Since that milk consumption by Indonesian was increased. However, the milk marketing problem of farmer's production was still existed because MPI preferred to use imported milk, which was cheaper and had better quality. Thus, there was a labile situation of Indonesian milk farmers. MPIs were totally dominant in determining not only the milk price, but also the purchasing volume and time. On holidays, for examples, MPIs were unwilling to buy farmers' milk, which caused so much milk had to thrown away.

Figure 1. Trend of Cattle Population and Milk Production (1969-1999)
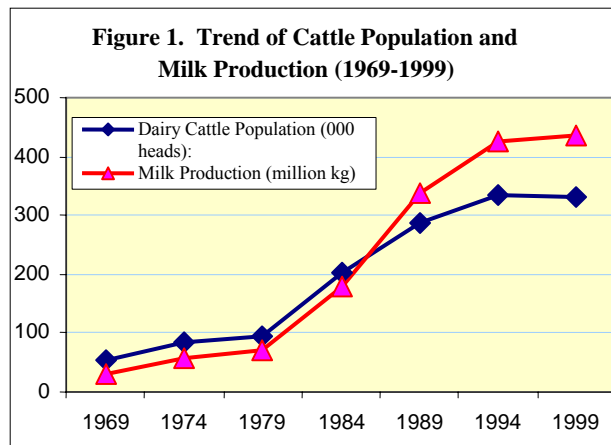
The turning point of milk agribusiness development in Indonesia has begun in 1978. The leaders of several milk co-operatives that led by Chairman of KPBS, drh Daman Danuwidjaja, which made properly use of the moment of Co-operative Department formation in that year. Institutional approach had been done and the communication between government and co-operative movements had become better. Furthermore, Daman initiated the first workshop among milk co-operatives in July 1978, which was fully supported by government. The workshop recommended for forming a BKKSI (Coordination Board of Indonesian Milk Co-operatives) and also encouraged more active role from government in developing national milk agribusiness system. Critical problems

of milk co-operative had been gradually solved through government policy and rules; such as, controlling of milk-imported quota as well as milk price, providing raw material for high quality feed and also importing qualified milk-cows (Djohan, 1996, 139-140). The milk price in farmer level increased from Rp 60-105 per liter into Rp. 165-185 per liter according to farmer's cost of living at that time.

Figure 2: Trend of Absorbed Labor by Milk Agribusiness
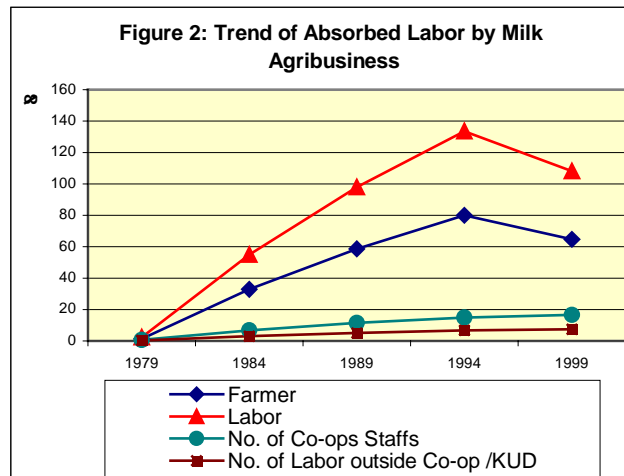
On the second workshop in 1979, BKKSI was changed into GKSI (Indonesian Milk Co-operative Union), which was as a secondary-national level of milk co-operative, and appointed drh Daman Danuwidjaja as the chairman. Daman with GKSI had made many innovations in improving milk agribusiness system through co-operative movement. As seen in Figure 1, the growth of milk cows and its production had increased about 40 times. This increasing happened due to more farmers, who were interested in milk cow business, and also absorbed more manpower in the agribusiness system (Figure 2). It means that milk agribusiness promises a better welfare to the actors. With this achievement, Daman was further promoted as the Director General of Livestock at the Ministry of Agriculture in 1982-1988 (Syarief, 1997).

Due to his effort, in 1992 there was an Agreement Letter of 3 Ministers (Minister of Agriculture, Minister of Industry and Minister of Co-operative), which then was strengthened by Presidential Decree No.2/1985 aimed to seven departments to co-operate in a team that called TKPN (Coordination Team for National Milk Development). TKPN duty was to control the development progress of milk agribusiness system, in both production and consumption aspects. The Director General of Livestock was ex-

officially appointed as the chairman of the team. This position possible Daman to create inter-sector innovation in terms of milk agribusiness development based on smallholder breeder through co-operative institution. Compared to the time of GKSI formation, the number of milk co-operative had increased from 27 into 198 in 1989. The Indonesian milk agribusiness became so attractive not only for farmers, but also large private companies.

Figure 3. Milk Agribusiness 1994-1999
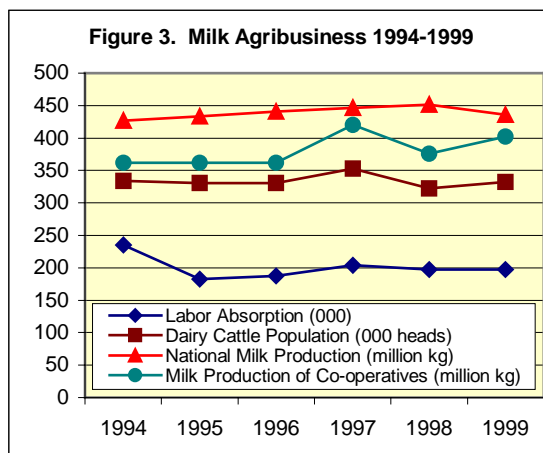
Nevertheless, as seen at Figure 1 and 2, in 1994, there was another turning point of decreasing milk agribusiness that was marked by the decreasing of milk population-growth as well as milk production, also the decreasing number of farmers and employment in this agribusiness system. It might happen due to the decreasing role of TKPN after Daman no more involved in the institution.

Milk Agribusiness in the Crisis Time
        As the economic crisis struck, there were a little improvement of absorbed labor, number of milk cows as well as milk production (Figure 3). The role of milk co-operative became more important as seen that the production share of milk co-operatives was closer to total national milk production. On the other hand, as shown at Figure 4, there was a decreasing of productivity per lactation cow. It might occurred because: (1) the breeder used less concentrate feed due to higher price of the feed, and (2) the age of milk cows were getting older, while breeder found difficulty in cow replacement. Study result of 30 milk co-operatives in Java indicated both of the two reasons. Such problems became more difficult to be solved over the time, because breeders had less capital to run the milk cow business.

Figure 4. Trend of Cows Ratio and Milk Production Per Lactation
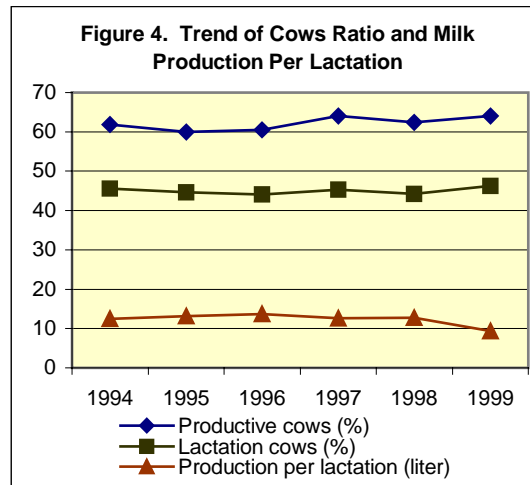
Due to economic reformation, most of supporting policy for the milk agribusiness was deleted by the Presidential Decree No.4/1998. Since then, the relation between milk co-operatives and MPIs has become a normal relationship of buying fresh milk, which based on mutual benefit. However, based on the standard of milk quality, the milk price is more determined by MPIs. As the Rupiah is depreciated, the domestic milk price increased significantly. However, breeders got only little amount.

Figure 5. shows the growth of milk price. Between 1994-1997 the price increased so little from year to year, particularly for industry and farm-gate prices. Since 1998, the milk price was getting much better. Nevertheless, compared to consumer price, the farm-gate price that received by breeder was very low. Milk cow breeders together within milk co-operatives could not get a better output price, at least to compensate the higher of input price. Study result of 30 milk co-operatives in Java indicated the impact of economic crises on milk co-operatives was differed one to another. There were milk co-operatives that improved well, on the other hand, there were also that became worse. That means, besides the influencing factors in macro aspects that describes above, there was also influencing factors in micro aspects. By using Principle Component Analysis, all of 30 milk co-operatives were classified into 4 typologies, which based on their relative performance in business as well as organizational aspects. Business performance was measured by considering the actual condition in the last year (2000) and the growth during the crises time (1996-2000). Interestingly, that not all of large milk co-operatives were categorized as the best typology (Quadrant-I), but were distributed into all quadrants. Likewise, Quadrant-I was not dominated by only large and popular

co-operatives, but also small co-operatives, which had grown well during the crisis time.

Figure 5. Trend of Milk Price (in Rupiah)
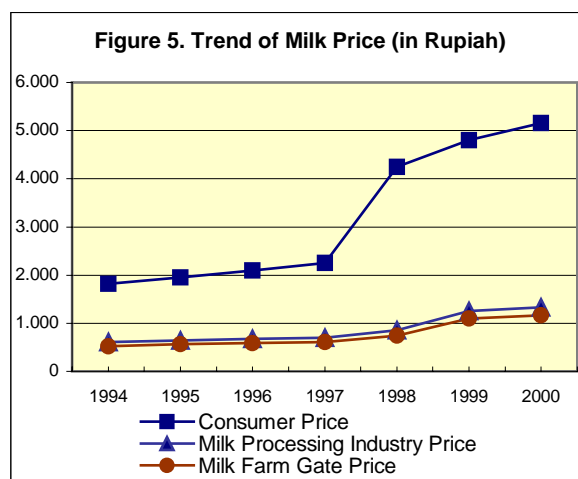
The Ned of Co-operative Entrepreneur

    The experience of milk agribusiness in 1980s indicated that there was an important role of CE in developing agribusiness as a whole system, which included the effort to optimize the government's function on developing SSS. In this case, Daman Danuwidjaja has played a great role of CE. Figure 6 describes the interconection between CE and milk agribusiiness development, in which Daman played an important role, namely: (1) Developing of successful primary milk co-operative, namely KPBS, which was led by Daman for 25 years. Under his leadership KPBS has been a good example of succeed milk co-operative; (2) Developing of secondary milk co-operative, namely GKSI, which was led by Daman almost 14 years; (3) Developing of government's role by establishing TKPN. The agency is one of an innovative breakthrough in developing commitment

    Unfortunately, primary milk co-operatives as well as GKSI were not able to supply more human resources with a good quality of CE as Daman Danuwiidjaja. Hence, the achievement could not be maintained, even decreased. The SSS of milk agribusiness became worse, in fact, was not happend since the economic crisis struck, but since the begining of 1990s, namely since TKPN was no more working well. This occured due to the weakening ability of CE among existing co-operative leaders in terms of finding innovative breakthrough of developing agribusiness as a whole system.

Figure 6. The Role of Co-operative Entrepreneur in Developing Milk Agribusiness System
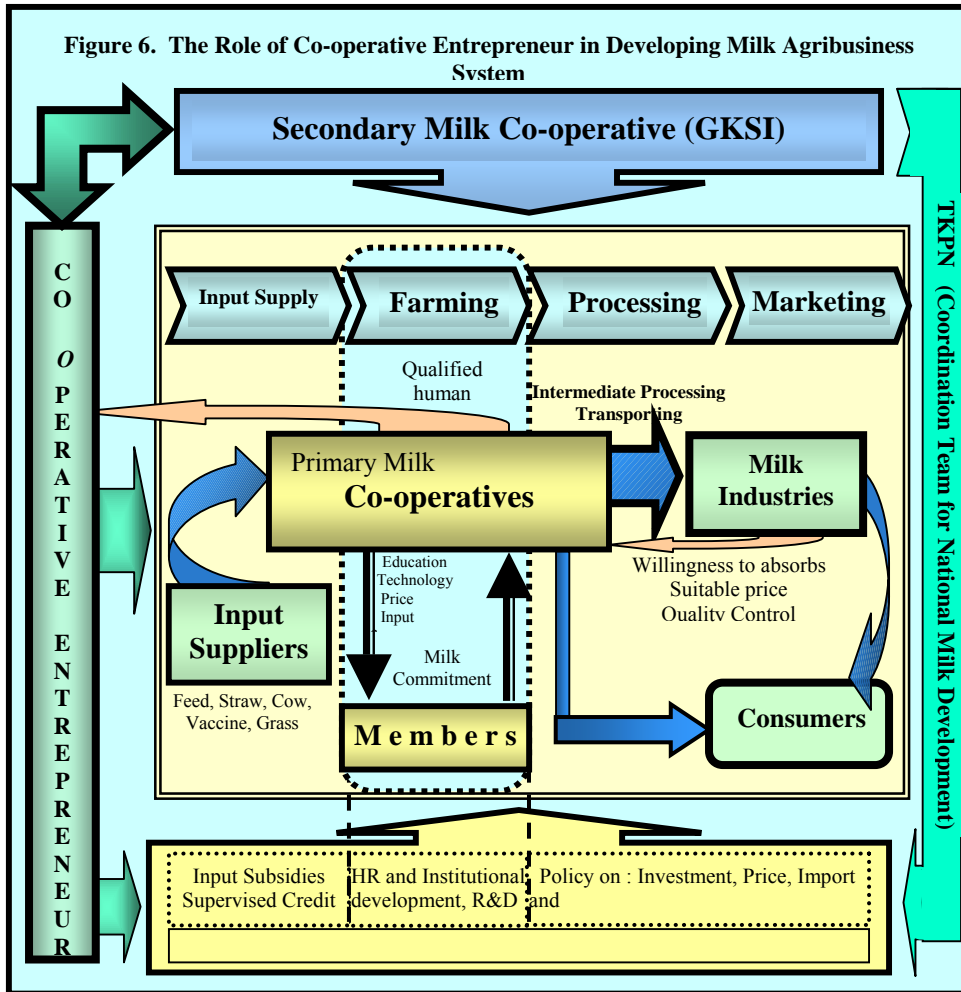
Source: Author's own depiction, 2003

        Study result of 30 milk co-operatives indicated that there were many
enough co-operative human resources who have a qualification of CE,
particularly in Quadrant-I typology. However, these CEs were still not aware
about the important role of SSS in order to developing milk agribusiness as a
whole system, and were trapped by old paradigm of agriculture, which pays
attention to developing on-farm sub-system only.

Concluding Remark

Agribusiness development in Indonesia without a solid SSS may cause cannibalization among the sub-systems. Therefore, farmer organization such as co-operatives should do the SSS, or at least encourage government or other parties to do it well. Establishing agribusiness co-operatives need the role of CE as well as to make it work. The experience of milk agribusiness shows that the golden era of milk development could be achieved due to the role of CE, which played not only in primary-rural level but also in secondary-national level. At national level, CE made a good approach to policy makers in terms of conditioning more suitable environment for growing up agribusiness as a whole system.

Today, the milk agribusiness in Indonesia faces many problems, so the needs of CE become higher. If in 1980s, the very bad condition of milk agribusiness could be reduced due to the role of CE, it is also hoped that the same way would be happened in order to rescuing smallholder breeders today. Therefore, the existing milk co-operative leaders, particularly, in co-operative Quadrant-I need to be encouraged to play the role of CE as good as possible.

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ECONOMIC INEFFICIENCIES OF RICE FARMS IN THAILAND
Wirat Krasachat

Introduction

Only a few decades ago, rice was not only the most important crop in Thai agriculture but was also the backbone of the Thai economy. At present, despite considerable diversification into upland crops, rice continues to be the most important commodity in Thai agriculture. In 1999, about 50 per cent of farm land was planted to rice (Ministry of Agriculture and Cooperatives 2002). This is because rice is not only the staple food of Thai people but also a cash crop for the majority of Thai farmers.

In 1999, 10.51 million hectares were planted to rice, 24.17 million tonnes were produced and 6.84 million tonnes were exported. Thailand has four regions. Based on 2001/02 crop year data, the main output was contributed by the Northeastern Region followed by the Central Region. The highest yields stemmed from the Central Region (Ministry of Agriculture and Cooperatives 2002).

There are at least three causes for worry concerning the future development of rice farms in Thailand. First, the relatively high growth rate of rice production in Thailand has been achieved mainly through the expansion of cultivated areas (Ministry of Agriculture and Cooperatives 2002). Second, although, the growth rate of rice production has been recognized, its yield in Thailand has generally been rather low. Compared with some selected Asian rice-growing countries, the yield of rice in Thailand was the lowest in 2001 (Ministry of Agriculture and Cooperatives 2002). Finally, the Thai government has significantly influenced Thai agriculture through a variety of policies over the past three decades. The most important policies in the agricultural economy were export taxes on agricultural products, especially rice, quotas and tariffs on machinery and fertilizer imports. They could cause imperfect competition in those inputs and in output markets. Because of the above factors, economists and policy makers have raised the question of the economic efficiency of rice production in Thailand, especially at farm level.

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The main purpose of this study is to measure and investigate factors affecting economic efficiency (decomposed into technical and allocative components) of rice farms in Thailand. To estimate efficiency scores, the DEA method is applied to farm-level cross-sectional survey data of rice farms in three provinces of the Northeastern Region in Thailand. Previous studies have investigated economic efficiency and its components at both the farm and aggregate levels in Thai agriculture (e.g., Krasachat, 2001; 2002). However, this study, to my knowledge, has been the first application of DEA in order to measure and explain economic efficiency and its components of rice farms in Thailand. This enables more detailed understanding of the nature of economic efficiency in rice production in Thailand.

This paper is organized into five sections. Following this introduction, the analytical framework is described. Next, data and their sources are described. The last two sections cover the empirical findings of this study, conclusions and policy implications.

Analytical Framework

According to Coelli, Rao and Battese (1998), the constant returns to scale (CRS) DEA model is only appropriate when the farm is operating at an optimal scale. Some factors such as imperfect competition, constraints on finance, etc. may cause the firm to be not operating at an optimal level in practice. To allow for this possibility, Banker, Charnes and Cooper (1984) introduced the variable returns to scale (VRS) DEA model. Due to the consequence of the heavy intervention by the government in both output and input markets in Thai agriculture as mentioned earlier, farmers perhaps have been prevented from operating at the optimal level in farm production. Therefore, technical efficiency in this study is calculated using the input-oriented variable returns to scale (VRS) DEA model. Following Fare, Grosskopf and Lovell (1985), Coelli, Rao and Battese (1998) and Sharma, Leung and Zaleski (1999), the VRS model is discussed below.

Let us assume there is data available on K inputs and M outputs in each of the N decision units (i.e., farms). Input and output vectors are represented by the vectors x_i and y_i, respectively for the i-th farm. The data for all farms may be denoted by the $K \times N$ input matrix (X) and $M \times N$ output matrix (Y). The envelopment form of the input-oriented VRS DEA model is specified as:

$$\min_{\theta,\lambda} \theta,$$
$$\text{st} \quad -y_i + Y\lambda \geq 0,$$
$$\theta x_i - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0, \qquad\qquad\qquad (1)$$

where θ is the input technical efficiency (TE) score having a value $0 \leq \theta \leq 1$. If the θ value is equal to one, indicating the farm is on the frontier, the vector λ is an $N \times 1$ vector of weights which defines the linear combination of the peers of the i-th farm. Thus, the linear programming problem needs to be solved N times and a value of θ is provided for each farm in the sample.

In order to investigate the economic efficiency or cost efficiency, the cost minimization DEA is specified as:

$$\min_{\lambda,x_i^*} w_i' x_i^*,$$
$$\text{st} \quad -y_i + Y\lambda \geq 0,$$
$$x_i^* - X\lambda \geq 0,$$
$$N1'\lambda = 1$$
$$\lambda \geq 0, \qquad\qquad\qquad (2)$$

where w_i is a vector of input prices for the i-th farm and x_i^* is the cost-minimizing vector of input quantities for the i-th farm. The total cost efficiency or economic efficiency can be calculated as:

$$\text{EE} = w_i' x_i^* / w_i' x_i . \qquad\qquad\qquad (3)$$

Allocative efficiency can be specified and calculated as:

$$\text{AE} = \text{EE/TE}. \qquad\qquad\qquad (4)$$

Note that this procedure will include any slacks into the allocative efficiency measure, reflecting an inappropriate input mix (Ferrier and Lovell 1990). Efficiency scores in this study are estimated using the computer program, DEAP Version 2.1 described in Coelli (1996).

In order to examine the effect of farm-specific factors on farm efficiency, a regression model is estimated where the level of inefficiency from DEA is expressed as a function of these factors. However, as indicated in Dhungana, Nuthall and Nartea (2000), the inefficiency scores from DEA are limited to values between 0 and 1. That is, farmers who achieved Pareto efficiency always have an inefficiency score of 0. Thus, the dependent variable in the regression equation cannot be expected to have a normal distribution. This suggests that the ordinary least squares regression is not appropriate. Because of this, Tobit estimation, as mentioned in Long (1997), is used in this study.

Data

The data used in this study is based on a direct interview survey of 74 randomly selected rice farm households in three provinces of the Northeastern Region of Thailand. The selected provinces were Si Sa Ket, Surin and Buri Ram, Where they are predominantly rice producing. The data were for the 1999 crop year (May-October). The selected farms were owner operated and had faced a similar economic and marketing environment for inputs and outputs.

One output and five inputs are used in the empirical application of this study. The five inputs groups are fertilizer, labour, capital, land and "other inputs". Because the variable of other inputs is measured in value terms, the calculation of the unit price for this input is far from satisfactory. Following Ferrier and Lovell (1990), the unit price of this input equals baht 1 for all farms. Land has been one of the most important factors of Thai rice production. Because of lack of data on the price of land, the expenditure of land rent is used in this study.

Several farm-specific factors are analyzed to assess their influence on productive efficiency. The planted area variable is intended to examine the impact of farm size on the economic inefficiency and its components of the rice farms in Thailand while a dummy variable introduced as proxy for irrigated area is employed to investigate the effect of irrigation infrastructure on the inefficiencies of rice farms.

Possible provincial differences in climate, natural resources, etc., are accounted for through the inclusion of provincial dummy variables in each estimating equation. This permits the intercepts in each of the estimating equations to differ in the different provinces.

The input and output variables are defined in Table 1 whilst the variables selected for investigating inefficiency effects are in Table 2.

Empirical Results

Technical, allocative and economic efficiency scores of Thai rice farms were calculated using equations (2)-(4) at the sample. Table 3 shows that the mean values of technical, allocative and economic efficiency of all farms are

0.74, 0.65 and 0.48, respectively. The values of technical efficiency range from 1.00 to 0.27. The values of allocative efficiency range from 1.00 to 0.17, while those of economic efficiency range from 1.00 to 0.28. These empirical results suggest four important findings. First, there are significant possibilities to increase efficiency levels in the Thai rice farms. Second, the average cost of all farms could be reduced by 52 per cent. Third, the results also indicate that allocative inefficiency makes a greater contribution to economic inefficiency among farms. Finally, the results indicate the substantial diversity of the scores of efficiency among farms. This suggests that the considerable variability of farms in farm-specific factors, natural resources, etc., can have different impacts on efficiency in Thai rice production in different farms.

The measurement of allocative efficiencies indicates that some inputs are being used in incorrect proportions. To examine which inputs are being over- or under-used, following Singh and Coelli (1999), the ratios of the technically efficient input quantities to their corresponding cost efficient input quantities are calculated in this study.

The analytical results indicate that the Thai rice farms over-utilized fertilizer, labour, capital, land and other inputs. However, it is not surprising to see the farmers overusing fertilizer and labour more than land and other inputs because Thailand has experienced cheap labour and limited land for many years, as mentioned in Krasachat (2001).

Tobit regression models are estimated to investigate the impacts of the farm-specific factors on economic inefficiency and its components. Inefficiency measures are first obtained by subtracting the level of efficiency calculated in the first stage from 100. Then, each inefficiency measure is regressed on the planted area, irrigation and provincial dummy variables.

Due to there being no statistical significance for all estimates, except those of constant parameters, of the technical inefficiency and economic inefficiency equations, only the estimates of allocative inefficiency equation are reported in Table 4. These empirical results suggest two important findings. First, there is no confirmation that farm size has influenced allocative inefficiency of rice farms in Thailand. Second, there is an evidence that irrigation and the possible provincial differences appear to have affected on allocative inefficiency of rice farms.

The results also show a positive relationship between irrigation and allocative inefficiency. This implies that the farmers who have cultivated in the irrigated area achieve lower levels of efficiency. This may possibly be due to their overuses of factor inputs.

Conclusions and Policy Implications

An input-oriented variable returns to scale (VRS) DEA model and a cost minimization DEA model were used for estimating technical, allocative and economic efficiencies in Thai rice farms.

The results indicate that efficiency scores of some farms were considerably low. This implies that there is significant scope to increase efficiency levels in Thai rice farms. In addition, they also indicate that allocative inefficiency makes a greater contribution to economic inefficiency among farms.

The results also indicate that the Thai rice farms over-utilized fertilizer, labour, capital, land and other inputs. In addition, the inefficiencies are explained by irrigation and the possible provincial differences. This may suggest some policy implications such that the dissemination of the best farming practices to reduce the allocative inefficiency should be strategically focused to farmers who have cultivated in the irrigated area.

Table 1. Variable definitions and measurement

Variables	Units	Definitions
Rice output (y)	Metric tones	Quantity of rice produced per farm
Fertilizer (x_1)	Sacks	Quantity of chemical fertilizer used per farm (1 sack = 50 kilograms)
Labor (x_2)	Man days	Amount of total labor use from family and hired labor per farm
Capital (x_3)	Days	Amount of machinery used per farm
Land (x_4)	Rais	Land area planted per farm (1 rai = 0.16 hectare)
Other inputs (x_5)	Baht	Total costs incurred for using pesticide, herbicides, rice varieties and all variable expenses per farm, except the above inputs (43 Baht = US$ 1)

Table 2. Variable definitions for inefficiency effects

Variables	Definitions
LAND	Land area planted per farm
IRRI	Dummy variable with a value of one if producer has cultivated in the irrigated area and zero otherwise
PROV1	Dummy variable with a value of one if farm has cultivated in Si Sa Ket Province and zero otherwise
PROV2	Dummy variable with a value of one if farm has cultivated in Surin Province and zero otherwise

Table 3. Economic efficiency scores of rice farms in Thailand

	Technical efficiency	Allocative efficiency	Economic efficiency
Average	0.74	0.65	0.48
Std. deviation	0.22	0.16	0.21
Minimum	0.27	0.17	0.28
No. of efficient farms	22	5	5

Table 4. Estimation results

	Allocative inefficiency
Constant	2.50
	(0.42)
Planted area	-0.01
	(0.02)
Dummy variable proxied for farms cultivated in the irrigated area	0.60
	(0.27)
Dummy variable proxied for farms cultivated in Si Sa Ket Province	-0.45
	(0.36)
Dummy variable proxied for farms cultivated in Surin Province	-0.61
	(0.30)
Log likelihood function	-296.16

Note: Standard errors of estimates are in parentheses.

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LAND DISPUTE IN A RED RIVER DELTA'S PROVINCE SINCE RENOVATION

Pham Quang Minh

Introduction

Since 1981, over 20 year's implementation of renovation policies in land, fields and agriculture has produced steady and substantive moves forwards, contributing to the national development, stabilization of socio-political situation and improvement of Vietnam's status in the world arena. What are the causes of the successes in agriculture? How have changes in Vietnam agriculture taken place in the last two decades? Thanks to the natural advantages, agriculture has become a key economy in Vietnam throughout its history. However, agricultural development is not only subjected to natural endowments, but also under the influence of the Government's development policies. This paper will help clarify these questions.

For such a major nation in South East Asia with 76% of the population living in rural areas as Vietnam, agricultural and rural development are one of the most fundamental requirements in the country's socio-economic development strategy.

In agricultural economy, land is the basic, crucial means of production, which is decisive to development. The land reserve in Vietnam is distributed across the 7 agricultural regions (also the 7 large-scale economic regions) as follows table 1:

As the table shows, at present, the total land reserve in Vietnam is 32.92 million hectares, in which 9.34 million ha is agricultural land, accounting for nearly one third of the total land area, which includes various high-value types of soil. The alluvial plains account for over 6 million ha (half of which is in the Mekong Delta), where food crops and short-term industrial crops can grow abundantly.

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Table 1. Land Distribution in Vietnam in 2000 (*million hectares*)

	Types of Land	Country's Total	Northern Mountain-ous and Midland Region	Red River Delta	North Central Coastal Region	South Central Coastal Region	Central High-land	Eastern South	The Me-kong Delta
1	Natural land	32.92	10.09	1.47	5.15	4.42	5.44	2.35	3.97
2	Agricultural land	9.34	1.30	0.85	0.72	0.80	1.23	1.44	2.97
3	Forest land	11.58	3.74	0.11	2.22	1.70	2.99	0.46	0.33
4	Land for special uses	1.53	0.26	0.22	0.23	0.24	0.13	0.20	0.22
5	Land for housing	0.44	0.07	0.09	0.05	0.04	0.03	0.04	0.10
6	Unused land	10.02	4.70	0.19	1.91	1.62	1.05	0.19	0.33

Source: Ministry of Agriculture and Rural Development (MARD), Institute for Agricultural Planning and Design. Vietnam Agriculture – 61 Provinces and Cities. Agriculture Publisher, Hanoi 2001, p. 647.

The situation of land before and after renovation (doi moi)

It is possible to say that prior to *Doi moi*, Vietnam agricultural economy did not receive due attention. Land, though being the foremost, crucial means of agricultural production, was not owned by the farmers – the actors of agricultural production processes. Land and fields were collectivized and under the management of agricultural cooperatives which were formulated as a result of the implementation of the Government's agricultural collectivization policies since 1958.

However, the centrally-planned, subsidy-based bureaucratic management increasingly revealed its weaknesses; the cooperative model failed to bring about expected economic benefits. The outdated management mechanism tied up production strengths, eliminated the driving forces for the development of the whole economy, especially agricultural economy. The point-based returns distribution system made the farmers only pay attention to the number of points they could earn for a working day without any regard to the effectiveness and quality of their work. Therefore, during this period, agriculture seriously stagnated; both agricultural productivity and production showed apparent declines. By the late 1970s, Vietnam agriculture fell into serious crisis.

Aware of that crisis, renovation of economic management mechanism in general, and agriculture in particular, were an imperative requirement to be satisfied immediately. To respond to that requirement, the Secretariat of the Vietnam Communist Party's Central Committee issued the *Directive 100 CT-TW* (called *Khoan 100* for short) on January 13, 1981, officially launching the implementation of the mechanism whereby each individual or group of laborers was assigned specific amount of work and/or products to be finished.

Subsequent to the *Directive 100 CT-TW* were a series of documents and guidance from the Party to address the newly emerged issues, such as *Resolution No 10* dated April 5, 1988 of the Politburo (the 6th term) and then *Land Law* (July 1993), the *Law on Cooperatives* (January 1, 1997), etc.

Following these enactments, the period between 1988 and the present have witnessed fundamental and synchronous renovation of agricultural management mechanism at both micro and macro levels.

1. The change in ownership: The most important change is a move from *collective ownership* regime to the one that allows *private use of public owned land* or *limited private ownership* which provided the farmers with real mastery of their land. *Farmer households* became autonomous economic units that played the key role in rural economy.

2. The change in cooperatives: The change in land ownership entailed substantial modifications of the roles, models of organization and management of cooperatives. *Agricultural cooperatives* underwent modifications in functions, activities and operational modes, and started to provide services to households.

3. The change in mechanism: The implementation of market-driven price policies, free commodity flows, etc., gradually eliminated the centrally-planned, subsidy-based mechanism, which facilitated the move toward "the market mechanism under the Government's management in the socialist orientation." (Vietnam Communist Party, 1996)

4. The changes in percentage of agricultural land area: under the impacts of new policies since the late 1980s are illustrated in the following table 2:
        As can be seen, before and after *Khoan 10*, the area of natural land in the whole country showed almost no increase. Nevertheless, thanks to successful implementation of agricultural renovation policies, particularly the relatively satisfactory solution of the relationship between land use and ownership, the percentage of agricultural land area in the land structure considerably increased. At present, agricultural land reserve accounts for nearly 28.4% of total natural land area, showing an increase of 7.6% compared to pre-1988 period.

5. The changes in production and productivity: Within only four years implementing *Khoan 10* (1989 – 1992), the total rice-equivalent food production in the whole country recorded an increase of 4.6 million tons (26.1%) compared to the 1981 – 1988 period. In the same period, rice productivity increased by 450 kg/ha, i.e. 29.6%; the average food per capita increased by 35 kg (12.2%) compared to 1981 – 1988 (Nguyen Sinh Cuc, 1995). The impacts of new policies on land and economy have generated encouraging changes in agricultural production, and rapidly increased rice productivity and production in the last two decades.

6. The change in export: Under the impacts of the new mechanism, Vietnam agriculture has made rigorous move from self-reliant, self-supply to market-driven commodity production. No longer being a hungry nation with huge amounts of food imports, Vietnam has produced (since 1989) not only sufficient food for domestic demands but also surplus for export. Currently, Vietnam is the second largest rice exporter in the world after only Thailand.

Table 2. Land Use Before and After *Khoan 10* (1988)

#	Types of Land	1987 (hectares)	Percentage (%)	1990 (hectares)	Percentage (%)	2000 (hectares)	Percentage (%)
1	Natural land	34,082,204	100.0	34,187,812	100.0	32,924,060	100.0
2	Agricultural land	7,087,699	20.8	7,260,030	21.2	9,345,345	28.4
3	Forest land	9,768,846	28.7	9,395,194	27.5	11,580,755	35.2
4	Land for special uses	1,659,084	4.9	1,789,942	5.2	1,532,843	4.7
5	Land for housing	871,796	2.5	817,752	2.4	443,178	1.3
6	Unused land	14,694,779	43.1	14,924,894	43.7	10,021.939	30.4

Source: General Statistics Office Agriculture Department. Land Use Situation in 1987, 1990, 2000.

7. The change of the percentage of agricultural product values: The biggest result of this process was the elimination of rice monoculture, the transformation of rural economic structure and initial establishment of an agricultural economy which developed to be relatively more balanced and diverse. That also helped gradually change the economic structure and diversify different types of crafts and services. That result is evident in the changes of the percentage of agricultural product values in the whole national economy.

Land dispute and its solution

The land allocation to households on the one hand brought to an end the indifference of peasants towards the land as it was during the collectivization, caused however on the other hand land dispute among them. (Kerkvliet, 1993; Grossheim, 1997 and Kleinen, 1999) The main reason for outbreak of conflicts in the countryside was the heritage of the collectivization time and the contradiction between fast population growth and the decline in land areas.

With implementation of the Resolution No. 10 in 1988 the peasants began to demand back the land of their villages that they have delivered to the neighbor villages during the collectivization. The dispute on the land contained in many cases at the same time the requirement to dissolve the agricultural cooperatives. During the time of collectivization the land within a cooperative was divided equally among production brigades. The situation became more complicated as the cooperatives reached the frame of some villages whereby the rice fields of a village had been assigned to a neighbor village. Very often the

peasants of a village had to cultivate the rice fields of their production brigade in the other village. At the time of cooperatives, the peasants did not interest much in the rice fields, but only in so called working points that determined their income because the rice fields did not belong them.

The implementation of Resolution No.10 in 1988 and then the land law in 1993 were a decisive step towards guarantee of peasants rights. According to these documents now peasants have five basic rights on exchange, delivery, leasing, inheritance and pledging of land use rights (Luat dat dai, 1993a). The time for land use varies between 20 and 50 years (Luat dat dai, 1993b). However land law 1993 premises each household only to cultivate maximum of three hectare of rice field. This limitation is a contradictory decision and does not meet reality, because many households, first of all in the Mekong delta, have more than determined maximum. Due to equal land allocation and collectivization campaign by the end of 1970s and beginning of 1980s the situation of landed property was very critical. One difference between North and South Vietnam was that in North there were most land dispute between villages while peasants in South Vietnam fighted for their own landownership. There was no southern province that did not have land dispute (Thanh tra tinh Vinh Long, Bao cao Tong ket hoat dong thanh tra nam, 1995).

In Red river Delta where the average landed property per person was very small the land dispute increased since implementation of Resolution No. 10 especially. It was not only at land alone, but also at the fight against corruption and arbitrariness of local cadres and demand to dissolve the agrarian cooperatives.

The situation in Hai Duong province where I conducted my research in 2001 and 2002 was typical example for North Vietnam. Like the other provinces, the average land property per person in Hai Duong was about 500 m2. Due to limitation of land conflict intensified in the whole province. Between 1988 and 1990, the years when most farm land was redistributed to households, Hai Duong province had 26 extreme disputes characterized as "hot points" (*diem nong*) over land. Often they involved a "resistance group" acting in the name of local people who demanded that certain lands be returned to them. (UBNDNG, 1998a). The organizers in several cases were former city and local government cadres. In some instances their discontent was so intense that they tried to take over local government. Some disputes lingered far into the 1990s. Outwards the resistant groups presented itself as organizers of entire movement, but inwards they represented in fact the interests of different families in village. Therefore, it was very often that they fighted against each others for their own position and power as they realized the end of movement.

Out of 26 "hot points" in Hai Duong province there were 16 cases (61, 5%) in which they were at the conflicts between villages. In the other 10 "hot point's it was at complain against corruption, sectional pride of local

administration and demand to dissolve the agrarian cooperatives. The implementation of Resolution No. 10 and renovation policy of central government called forth changes not only in policy in the central level but also in socio-economical sphere of local level.

An example is a 1998 dispute in Dong Xuyen commune, which has two villages, Xuyen Hu and Dong Cao, in Ninh Giang district. Xuyen Hu required its neighbor Dong Cao to return 85 *mau* (30.6 hectares) of rice fields that Xuyen Hu had brought into the shared cooperative in 1975. After the cooperative was dissolved, however, Dong Cao retained the land. In protest, Xuyen Hu villagers sent petitions to the district offices. Among the signatures was the Xuyen Hu village head. Tired of waiting for authorities to resolve the problem, thousands of people from both villages tried to do it with force. The result was a bloody fight without a clear outcome. (TTLTTUHD, 1990)

On 23 October 1998, a group of officials from the Hai Duong province and Ninh Giang district went to Dong Xuyen commune. They announced that the chair of the Hai Duong People's Committee had ruled that the 85 *mau* belonged to Dong Cao village. Immediately 200 Xuyen Hu villagers met in the village kindergarten and decided to reject the decision of the province, contribute 1,000 VND each in order to deliver their complaint to the authorities in Hanoi, refuse to receive delegations from district and provincial offices, and continue to fight for the 85 *mau* of fields. (UBNDNG, 1998b)

Meanwhile, Dong Xuyen commune's government was in a shambles. Cadres favoring Xuyen Hu village's position were so numerous and outspoken that they were able to remove the chair of the Dong Xuyen People's Committee. Even the commune's party secretary was removed. Xuyen Hu supporters also took over the commune's radio station and formed a "blitz group" (*doi cuc nhanh*) to act as security to protect the village from outside forces. (UBNDNG, 1998c)

The police chief of Hai Duong province eventually intervened. On 15 December 1998, police forces moved against the "ringleaders" (dau so) and the extremists who, the chief said, had broken the law during the land dispute in Dong Xuyen village. (Cong an Huyen Ninh Giang, 1998). Also, the Central Mass Agitation Commission (Ban dan van trung uong) sent a representative to the village from Hanoi.

Only with these stepped-up, forceful measures was order restored to Dong Xuyen village. Ultimately the police disciplined 19 people, including the commune's party secretary and people's committee chair, and arrested and sentenced to prison six "ringleaders" of Xuyen Hu. The conflict, however, continue to smolder even after the People's Committee of Hai Duong province awarded the 85 mau to Dong Cao village.

Despite essential achievements in production, as has been indicated, the top issue that must be dealt with in Vietnam agricultural development at

present is the serious contradiction between the fast population growth and the decline in land areas. It has let to situation that the average rate of land per capita continues to decline. This situation increasingly worsens in the Red River Delta. After Khoan 10 (1988), agricultural land area in this region hardly increases while the population continues to grow rapidly (the Red River Delta is the most densely populated region of the country). At present, 96% of the Red River Delta population can use merely less than 0.5 hectare of farming land (Nguyen Van Khanh, 2001). This is a very low rate, which makes it difficult for farmers to turn into commodity production. The same difficult problem exists in rural areas with a large population and little farming land.

Table 6. Average Farming Land per capita in Localities (2000 figure) Unit: m^2 per capita

	Regions	Average Farming Land
1	Nationally	1,224
2	Northern mountainous and midland regions	1,184
3	Red River Delta	507
4	North Central coastal region	724
5	South Central coastal region	1,236
6	Central Highland	3,038
7	Eastern South	1,235
8	Mekong Delta	1,841

Sources: - MARD. Vietnam Agriculture - 61 Provinces and Cities. Agriculture Publisher, Hanoi 2001, p.647
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Compared to the average in other localities and the national one, the figure in the Red River Delta is the lowest (41.4% against the overall average). This is a worrying fact to the second largest rice basket of the country. While farming land in the whole country increases, it remains almost unchanged in this region; farming land accounts for only 9.5% of that in the whole country whereas the *per capita* average declines over the years. On the whole, the average land ratio in the country remains very low. Presently, it is only 0.9 ha/farming household, or 0.25 ha/farmer.

Conclusion

To sum up, after two decades implementing new land and agricultural policies, farming land areas have increased rapidly. Most land and fields have changed hands from collectively owned by cooperatives to privately owned in a limited manner by farmer households. As a result, agricultural production gradually develops, rice productivity and yield rapidly increase. That is a miraculous result of enormous efforts of Vietnam's Party, Government and people in the last two decades.

However, the situation of land, fields and agricultural economy in Vietnam have generated a good number of complicated issues which will negatively affect the country's socio-economic and political life if left unsatisfactorily settled. In this context, it is imperative that the Government find more practical, more effective directions and solutions for better management and exploitation of the soil potentials. Bolder measures should be taken to support agricultural product sales. At the same time, agriculture needs to be modernized rapidly in the direction of specialization and expansion of non-agricultural economies; the construction of district or communal towns and town lets should be facilitated in the rural areas on the basis of modernizing infrastructure, improving facilities and supplies to the farmers. Only by so doing can Vietnam agricultural economy and rural society develop more strongly and steadily, which contributes to satisfying increasing demands of the country's industrialization and modernization in the 21st century.

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ORGANIZATION AND MANAGEMENT OF RURAL ECONOMY (ESPECIALLY IN AGRICULTURE) IN A MARKET ECONOMY IN VIETNAM

Bui Nguyen Huan

Rationale

Rural economy is an essential component of any national economy all over the world. Rural economy include agriculture, forestry, aquiculture and processing industries with small and medium enterprise, but agriculture is some the most important of any national economy in the world. However, the industry in developed countries play the leading role according to Human report of development 2002 of UNDP Sector I, includes: agriculture, forestry and aquiculture making up 5.88% Sector II, includes: Industry and Construction and in agricultural countries this rat is 36%. The role of sector I (include agriculture) is lower than sector II, but the role of agriculture can not replace. It is vital for Human and supply the raw materials for processing industry and other industries and the people with their families of sector I are big consumers in each country and other countries (especially in process of trade liberalization in the globalization era). The development of sector I in general and agriculture in particular are topics of universal interest this has proved at meeting WTO in Sept. 2003 in Cancun – Mexico.

In Vietnam the rural economy in general and agriculture in particular have important role because 74.9% of habitants live in rural area (year 2002), the sector I is 23% GDP, people work in sector I are 67.1% making up labour forces over the country (2001); Now, The relationship between economy and family, city and rural, when very many people from rural area go to work in industrial area, many new towns are built. The People from rural are main source to supply labour for defence, construction and different economies. The result of organization and management of rural economy Vietnam relate to fast or slow develop, rural economy which stable or unstable affects cities and oppositely for the present and the future of economy. The problem liquidation and poverty reduce are important goal in socioeconomic program develop of Vietnam 2001- 2010 and the plan 5 years 2001- 2005, in Vietnam Development Goals -VDGs according to the Millennium Development Goals – MDGs.

Institute of Information Technology (IOIT)

Vietnam has been assessed generally about development of rural economy in general and agriculture in particular recording great achievements and limit at time and has concreted the resolution to promote the development of on rural economy including organization and management of rural economy in a market economy, in the stage of national industrialization and modernization in the time to come. In achieving ambitious targets of rapid and stable development of rural economy, there must be an appropriate model of organization and management of rural economy based on a harmonious combination of four stakeholders namely the State, farmers, scientists and businesses subject to the market rules, the laws and Socialist orientations of the entire economy. Each of the stakeholders will be analyzed from the perspective of its tasks, significance, and linkage with other stakeholders and problems that may arise from such a link and solutions thereto.

In Vietnam at Sapa meeting in July 2003 (Vietnam Government conference with International Sponsors) discuss much about this new resolution and just apply this method is still at the experimental stage. My report topic: "**Organization and Management of Rural Economy (Especially in Agriculture) in a Market Economy at Vietnam**".

Objectives

1. The recorded great achievements of Vietnam economy about in 20 years of the end the 20th century and two years beginning the 21st century

1.1 The economy of Vietnam grows at high speed, ran out of hyperinflation and economy crisis, because 3 sectors (sector I, sector II and sector III-service) grow together:

Table 1. The level grow up average GDP in year - %

Periods	GDP	Sectors		
		Sector I	Sector II	Sector III
Period 1991-2000	7.56	4.20	11.30	7.20
2001 comp. w 2000	6.89	2.98	10.39	6.10
2002 comp. w 2001	7.04	4.06	9.44	6.54

Through *Consumer price index – CPI* we know that, how Vietnam brings out of the hyperinflation and crisis economy:

CPI:

CPI Dec. of 1986 = 8.74 CPI of Dec. 1985, CPI of 1987 = 3.23 CPI of 1986 and CPI of later years numerical decrement from 3 to 2, 1996 only 1 numerical, but 1999 and 2000 the CPI is at very low level, Dec. 1999 =

100.1% Dec. 1998, 2000 - 100, 1%, 2001- 100, 8%, but 2002 the CPI is 4% (104%) more improvement than 2001, the CPI affect positively to economy activities.

1.2 Economic structure is step by step moved upwards to national industrialization and modernization:

	Total	Sector I	Sector II	Sector III
1985	100.0	40.1	27.4	32.5
2002	100.0	23.0	38.5	38.5

Sector I: Agriculture, Forestry, Aquiculture
Sector II: Industry, construction
Sector III: Service

The structure of economy changes to specializing farming zones, industrial and processing areas, the economy includes many parts among state-run economy is leader in the socialism orientation.

Structure of GDP by ownership -%

	1995	2000	2002
GDP	100.0	100.0	100.0
State	40.2	38.5	38.3
Collective	10.1	8.6	8.0
Private	3.1	3.4	3.9
Household	36.0	32.3	31.9
Foreign inv. sector	6.3	4.6	13.4

1.3 Vietnam has succeed in opening the door and international integration. Vietnam has been the member of UNO, APEC, ASEAN and will be having WTO member in the year to come, having signed trade agreement with about 70 countries in which US, having the trade relation whit 170 countries, FDI from 1988-2002:Number of projects licensed: 4,447 total registered capital: 43,194.5 Mill USD, ...; Value of export 2002 = 6.9 times value of export 1990 and value of import 2002 = 7.2 times value of import 1990, export 1995/import 1995 = 66.8% and export 2002/import 2002 = 84.7%; visitors to Viet Nam 2002: 2,628.2thous. Visits = 199.8% foreign visitors to Viet Nam 1995.

1.4 Living, education, public health, cultural and social standards gradually improve. Poverty households reduce:

	1999	2001	2002
All the country		**13.33%**	**9.96%**
Urban		4.81	3.61
Rural		15.96	11.99

1.5 Beginning with, 1986 process of moving structure from planned economy to market economy with state-run leader and socialism orientation to orient socialism, the plan is basically fulfilled with deeply developed.

2. The position of agriculture in Vietnam and results

2.1 Agriculture stands first position (on 2002: 78.2% GDP, about 90% labour, 55% value export) in sector I and 18% GDP.

2.2 Agriculture achieved:
         The gross output in 1995 equals 1.33 of 1990, on 2002 = 1.47 of 1995. The added value in 1990 is 37,000 billion VND, 2002: about 58,000 billion VND (as price 1994), after 12 years growth is 32% and in 10 years having the highest speed to grow in ASEAN countries.

Table 2. Agricultural Production Index (Indices year refer to 1989-1991= 100)

	Index of Food		Index of Cereals		Index of All Commodities	
	1996	**1999**	**1996**	**1999**	**1996**	**1999**
Cambodia	128.4	137.9	133.7	149.2	128.5	137.6
Indonesia	122.5	117.3	116.8	113.3	122.2	117.2
Lao PDR	115.6	155.9	103.8	153.4	110.7	150.9
Myanmar	138.8	144.7	130.5	125.2	138.9	145.9
Thailand	114.5	114.1	115.2	119.7	116.3	115.9
Viet Nam	134.1	156.2	138.8	164.8	136.8	161.6

Source: The ASEAN Secretariat, ASEAN Statistical Yearbook 2001 Jakarta 2002.

2.3 The most typical problem in agriculture of Vietnam in the past is food production, from a country lack of food: the years 1977-1978, 1.2 million tones of rice and flour were imported in each year the years 1985-1988, imported over 470,000 tones of rice and flour; from mid-1990s of the 20th century up to now,

Vietnam has become a rice exporting country in the group of three countries with most rice in the world (in 1999 exporting 4.5 million tones of rice, 2000: 3.5 million tones, 2001:3.7 million tones; 2002: 3.2 million tones of rice), whereas rice importing quantity is very little. Indeed gross output of cereals increases quickly and stably, increasing fast than population growing rate: 2002 at 36,378,000 tones = nearly twice 1990, cereals per capita from 295 kg in 1990 up to 456 kg in 2002, the food security in Vietnam has been confirmed. Only production of Paddy per capita in Vietnam belongs to the first leading group in region.

Table 3. Production of Paddy

	1985	2001	
	x 000 tones	x 000 tones	per capita, kg
Cambodia	1,812.0	4,099.0	305.0
Indonesia	39,032.9	50,096.0	233.2
Lao PDR	1,396.2	2,201.7	407.5
Myanmar	14,317.0	20,600.0	425.9
Thailand	20,263.9	25,200.0	396.3
Viet Nam	15,859.0	31,970.2	406.3

Source: Website Databases - FAO

2.4 Agriculture structure is changed. Cattle-breeding is developed faster than crop growing and structure for crop growing. Husbandry is also changed with high productivity, exporting many high valued goods product and increasing incomes for farmers. ....Paddy growing structure is also changes; some zones in Cuu Long river Delta reduce paddy growing area, transfer that area to raise aquaculture (shrimps…..), to fruit tree growing, while some paddy growing area will grow paddy with high value export. Products of industrial crop and fruit tree are exported with great quantity.

Livestock only equals 27.7% of cultivation (2002) but has increased continuously with higher rate than cultivation:

Index of Gross output - %

	2002/1990	2002/1995
Agriculture	195.7	147.0
Cultivation	195.3	146.4
Livestock	211.0	155.6

2.5 Agriculture production of Vietnam changes from the self – supply state to goods production. That is why agriculture products increase quickly to meet the

needs of domestic and foreign markets, first step linking agriculture production with market. It is positive factor for "hunger liquidation and poverty reduction" in Vietnam, improving people's life in general especially for people in the countryside. According to investigation of family living standard made by General Statistics Office of Vietnam in 2002, the average income per capita a month 2001-2002 compared with 1999, urban inhabitants increase 21.1%, rural inhabitants – 22.3%, the income distance of urban and rural inhabitants are shorter than before: 1995: average income per capita of urban inhabitants is as 2.62 times as rural inhabitants, but in 2001-2002 this gap is only 2.3 times.

2.6 Perfecting mechanism of new organization and management in agriculture are the direction of linking profit of working people with their investment (labour, capital, technique…..), linking production with market with the assistant of Government ….. It is noticeable that the renovation of policies in agriculture and agricultural tax, in the right to use land and in consuming and exporting agriculture products are manage.

3. Limitation of Vietnam economy in general, agriculture in particular

3.1 Potential of economy is still weak: Although Vietnam economy grows greatly, due to low starting point, so economy scale is still small (2002, by exchange rate, GDP per capita: 400 USD; Total Gross capital formation: 14.4 USD; Value of export per capita: nearly 210 USD; and by PPP, 2001, GDP per capita: 2,070 USD, standing the 130th in 175 countries and land areas only equal 32.3% Thailand, 23.7% Malaysia, 9.1% Singapore)

- The effects of business production and social labour productivity are low, reducing the use of capital: the rate ICOR increased from 3.0 in 1995 to 3.5 in1996 and now over 4.
- Goods quality, low unstable service and high cost bring about the competition shortage even in home market not mentioning export. Capacity for low competition will make more difficult in the process of implementing AFTA, Vietnam-USA trade agreement…. As for World Economic Forum the national competition power of Vietnam were arranged in 1998 the 39 / 53 nations, in 2000: 53/ 59, in 2001: 60/75, 2002: 65/80….
- Some vital social problems are slowly overcome (even some problems are higher) as: solving the jobs for workers, hunger elimination and poverty reduction. The difference or not equality and division between the rich and the poor in income between inhabitant groups are raising through coefficient GINI or standard 40% (put forward by World Bank)have a growing tendency, coefficient GINI in 1999: is 0.39, in2001-2002: 42%.

- Man power source is rather great, but quality is low, training man power is still weak, many problems must be discussed.
- System environment (law, investment finance money environment, business and business assistance medium, regime and policy of international trade…..) still have some weaknesses, not yet adequate and synchronic, lack of concreteness and unity, not yet close to practice, so it is difficult to fulfil, not yet creating development power whereas people's idea to observe laws is not quite agreeable.

3.2 The own agriculture also comprises general limitations of economy as mentioned about (3.1) beside there are as:
- The effect of industrialization and modernization on agriculture are still limited. The stages of turning up land, looking after plants, harvesting, post harvest (processing agricultural products) still use many handicraft tools and manual work having great influence on product quality, rice field and labour productivity and economic result in agriculture…..
- Farming rice field is not only few but also scattered, not suitable for requirement of producing goods focally, labour is redundant …..
- The consume market (quantity, kind and price) is unstable.

4. The strategy for Vietnam economic-social development in 10 years (2001-2010)
- Bringing Vietnam out of underdeveloped state improving well material and spiritual life of people, up to 2002 Vietnam has become an industrial country in the modern direction. Human power source, science and technology capacity, infrastructure, economic potential and national defense security are strengthened: Market economy orienting socialism is basically formed; Vietnam position is increased in the world rank.
- The biggest target: in2010, GDP increase at least twice compared with 2000; transferring strongly economic and labour structure, reducing labour rate in agriculture down to about 50%.

Some targets to develop to 2010 of Vietnam agriculture:
- Average value added of agriculture (including aquiculture, forestry) every year is 4-4.5%.
- By the year of 2010, total grain food products get 40 million tons.
- Density of agriculture in GDP is about 16-17%, breeding in gross output of agriculture increases about 25%. Aquiculture achieves output of 3-3.5 million tons (in which about ½ is breeding and growing product). Protect 10 million ha of natural forest and completing the program for growing 5 million ha of forest are prepared. Exporting agriculture, forestry and

aquiculture get to 9-10 billion USD, in which aquiculture is about 3.5 million USD.

5. The model of organization and management in Vietnam agriculture – four stakeholders combining model – must be studied, valued and expanded:

Potential (land, water, human and achievement….) we have programmed and targeted, the question is how to realize those programs and targets. This is a great problem, concerning many important fields not only in agriculture but also in the whole national economy, even with international community. This great problem is mainly to find out measures models of organization and management in agriculture. In Vietnam, the new important model is combining four stakeholders: Government, Farmers, Scientist and Businessman. Because this is a newly appeared problem, there are many discussions to make clear the problem around combining 4 stakeholders, as:

Why is there combining?
What is the role and duty of each stakeholder?
How to combine 4 stakeholders?
Were there models of combining 4 stakeholders?

5.1 First of all, it is necessary to mention the demands of market economy. Every producer in market economy should always solve the question:

What to produce?
How to produce?
How many to produce?

It is possible to understand in another way. It is when to produce which we must think about input output with productive requirements (productivity, profit, ever-increasing income) under competition condition on the market. It is difficult for Vietnam farmers to do these jobs, even it is impossible to do. But farmers can not do this work, especially Vietnamese farmers, while there is almost no necessary and enough condition. For example:

- Land is too little, in 2001, on the average about agriculture land and forestry land covered by trees, a country side. each person only has 3,550 m^2 but there are only 1,570 m^2 for agriculture land. On average a worker in agriculture, forestry only has 8,650 m^2 of agriculture land and forestry land covered by trees while there are only 3,830 m^2 of agriculture land. Whereas is land is divided into small plots, a part of 6 farmers on average have about 9,000 m^2 of agriculture land, but often comprising from 5-7 different plots.
- Agricultural productivity is still very low, in 2001, productivity of agriculture and forestry worker are only about 5.7 million VND (about 380 USD), and the value of farming yield on 1 ha of agriculture land has

only 13.9 million VND (about 920 USD). If compared with some countries in the region, labour productivity in agriculture of Vietnam is much lower, although this target of regional countries is also low if compared with many countries in the world. See the table 4:

(Because there is not GO of Agriculture and Number Employment of Agriculture, roughly GDP of sector I and employment of sector I are roughly calculated).

- Rural people's income is very low: according to investigation of living standard of family in 2002. Average income is 274,900 VND (about 18 USD)/person/month.
- Cultural level is low: up to now nearly 100% of farmers know how to read and write, but cultural level is low, many in provinces are trying to have elementary education.

Table 4. GDP of sector I per l Employment of sector I in 2001

	USD	Compare with VN
Viet Nam	295	1.00
Indonesia	570	1.93
Malaysia	4,083	13.84
Thailand	770	2.61

With the above materials, how can Vietnam farmers have information and know how to use information to decide what to produce? How many produce? How to have capital to invest and expand or change the purpose of business production, to apply new science and technology in all step of production, harvest, after harvest, preservation, processing and selling agriculture product? Supposing if they enjoin other investor, with such a low cultural and technical standard, how can they apply modern science and technology?

Thus, not only farmers themselves get on their rice fields but they also need to combine with many others, they hope to make Vietnam agriculture developed as the program and target initiated.

5.2 Farmers:

Farmers here are agriculture cooperatives, farmer stakeholders.

As the above evidences (5.1), first of all, Vietnam farmers with their hard working labour will be the people who directly apply technologies and techniques that they receive from the others fully and creatively. To a certain degree, they can invest in production from different capitals: of own farmers, of government, of business…..

In the process of receiving new technique, new investment, beside application, Vietnam farmers often have creativeness timely and property with each local condition, if their creativeness that are summed up and expanded will have great effects or agriculture production.

Because of the mentioned above features and small production, not few farmers didn't seriously carry out the state capital borrowing contacts, borrowing capital from bank of commerce; didn't implement the contracts with business when the business advances capital, breeds, fertilizer, food for breeding, machines…..with selling agricultural products for business.

5.3 The State (Government): This is an executive body, it is this State office that is greatly responsible for agriculture development.

- Creating the system environments with a system of laws and texts of under law to make a law basis for agriculture development in market economy (for example giving the right to use land to farmers….) and other fields concerning agriculture, supporting agriculture (finance, money, profit, lending, remitting agriculture taxes……).
- Setting up the planning and plans for developing agriculture, playing a leading and directing role in: production direction, transferring production system (in accordance with crops, cattle, fowls…..depending on ecology areas).
- Investing in building infrastructures to meet the demand of developing the countryside in general, agriculture in particular such as transport roads, electricity, schools, breed creating medical station (crops, breeding….)
- Investing in building and developing the bases concerning agriculture production, technology transaction, training a man power source for agriculture.
- Setting up the investment projects concerning agriculture attracting foreign investment capital as: projects of programs for gas, electricity, protein; projects of growing and processing manioc, coffee, tea, pineapple for export, mushroom; projects of producing breeds of milk cows, meat cows with high quality; raising milk cows and processing products from milk cows, breeding and processing pork, chicken, duck. The projects for growing mulberry, breeding silkworm, planting forest and cotton….. Projects of processing sugar canes, factory for producing food for cattle.
- Measures for creating products to service production and consumption of agriculture product.
- Methods for taking scientific technical workers to farmers to meet the needs of serving agriculture production, improving levels of education, health……
- Organizing the information on science and technique of agriculture, market (price, demand for each kind of agriculture products at home and

abroad….) and communicating to farmers through State offices: newspapers, broadcast and TV…..

5.4 With Scientists: According to the data about using scientific and technical worker (Doctors, Ph. D…..), it is clear that scientists mainly work in research institutes, Uni., hospitals....called as administrative units. There units themselves must also abolish subsidization in scientific research which follows the need of market (here it is agriculture) in order to:

- Decide the subjects of scientific research and organize research from production (growing, breeding, and carrying) to harvest, preservation after harvest, processing, processing agriculture products…… The subjects are partly assigned by Government an important part is to catch the requirements of business and farmers.
- Transfer research results to farmer including training, practicing to make farmers receive new technology.
- Sensitively help farmers to solve the questions about technique arisen from production process for instance worm and diseases of crops breeding…. timely.
- Help farmers to sum up the important experiences in organization in agriculture, discovery, technical improvement in all links of production process, harvest, preservation, processing to propagate widely or propose Government so as to readjust or issue policies properly; invention production tools (in Vietnam, there is a farmer who make rice plant cultivating machine, reaping machine suitable for water rice field in Vietnam……with the assistance of scientists to perfect, registered the copyright, there have been businesses which buy this license for mass production, consume all the country and export). In fact, this work done by scientists not only brings the knowledge and results of research to practice but also creates income for scientists and research institutes to continue expanding scientific research.

5.5 Businessman: here Businessmen work in many branches of national economy like in agriculture (businesses are connected with breeds, crops, animals….); in processing industry: making agriculture machines and instruments used in agriculture, harvesting machines, preservation, processing; the agriculture product processing businesses. Businesses work in the field of collecting and buying and consuming agriculture products at home and abroad; Businesses investing in agriculture development, work right in agriculture (now, Vietnam intends), develop farm economy among which there are some large scaled farms with equipment and technology of high quality (like breeding farms with big investment in breeding facilities of modern technique, high quality breeds, advanced breeding system, high productivity, reasonable cost)

and agriculture products of goods are in great quantity, hiring labour in which there are scientific and technical workers. The commercial banks are businesses working in money field, the satisfaction of capital borrowing needs of farmers are extremely great, and capital borrowing demand of scientists, businesses to serve agricultural production is not small either. The problem here is the loan system, loan contracts with low loan profits without mortgages under 10 million VND, the system for collecting back both capital and profit is in the stage of test. It is necessary to base on cooperation, support of 3 stakeholders with the support of environment and laws of the State (Government). These businessmen work according to business laws, close relation with farmers and scientists through economic contracts.

5.6 The role of each stakeholder in this combination model:
- This combination, first of all, it is the role of farmers because the farmers themselves raise the investment, research needs for scientists businesses and they themselves will "consume" the products of scientists, businesses; the farmers supply materials, agriculture products for businesses to process, provide for market at home and abroad.
- The role of Government is important because by its activities it creates condition for agriculture to develop totally, with high productivity and results, creating many agriculture products of goods for country, many agricultural products for export with good quality are not only for intermediate but also for the future, improving people's life in the country in general, farmers in particular. From the Government role too, the executive offices contribute to acting as arbitrator so that these combinations through economic contracts are realized.
- The role of scientists, businesses can not be lacked, contributing to agriculture to develop at the same time for scientists, businesses to exist and develop. The role of scientists, businesses should be positive (at first) in the relation with farmers, because they have condition of capital and scientific knowledge as well as have information and condition for processing information.

5.7 The principle of model combining 4 stakeholders:
- Have the same purpose to contribute to implementing the program and target to develop Vietnam agriculture up to 2010.
- With 3 stakeholders (without State), they are voluntary, find partners themselves cooperate, support each other; carry out in the size of laws through economic contracts.
- The State (Government) will help 3 households with systems environment, program, planning and the most important investments (in Vietnam now, the State investment still has a decisive part in total investment capital of

the whole society, including capital at home and abroad, as in 2002 this rate was 56%), as well as creating condition for 3 stakeholders to combine.

Results and Conclusion

At present, there are not yet many models about this combination, therefore there are not yet the summing- ups to assess positive sides and limitations in the course of operating these model. However in fact, there have been also models that are not yet comprehensive, full but are effective at first, as: Model of combination between LAMSON sugar factory (Thanh hoa province) with farmers around the region to become a stable material zone in quantity, quality and provided time, The factory is responsible for supplying breeder plant of sugar canes with high quality and productivity, fertilizer…… and buying all sugar canes with fixed agreed price (signing contract); The combination with scientists in research institutes and universities about technology transfer, equipments maintenance, guiding factory workers and farmers to apply production process. The factory pays the costs according to fixed agreed price in advance (when signing contracts), besides, the factory loans money from the banks to invest deeply…. In general, the contracts between the factory and farmers, with scientists, with the banks are implemented well. The production of the factory increases firmly, having profit and income of farmer households in the region, as well as high income of the factory workers, the research works of the institutes are applied at the same time contributing to increasing income for institutes, universities and scientists.

At first, everyone sees this model of combination of 4 stakeholders is necessary and sure to bring many profits for agriculture development in general, for all 4 stakeholders; hoping this model will soon be summed up, assessed in order to develop quickly, firmly, contribute to carrying out the programs and targets to develop agriculture of Vietnam up to 2010 and the following years.

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REORGANIZE THE STRUCTURE OF PRODUCTION IN HOANG LIET VILLAGE IN THE PROCESS OF URBANIZATION

Bui Thi An and Do Thi Lan

Foreword

Vietnam is an agricultural country, the population is about 80 million people in which 75% are living in countryside. From the poor country in 1970s, Vietnam had become one of the rice-exporting countries in the Asia. In the recent years, the cultivate land gets less and less narrow in some areas such as: Hanoi, Hochiminh City, industrial areas and processing zone. It not only displays the development of Vietnam, but also there are some problems that have to be solved:

- Due to the reduction of the cultivate land, there were not many works for the people, so they had left their home for the city to earn money, leading to many problems on law and order in the city.

- When the process of urbanizing occurred in these areas, some households had become the rich from trading in the real estate, at the same time it also caused the social evil.

- There were not many works for the women, especially, women at the age of 35- 45.

- It is necessary to transfer the science- technology in the countryside.

With the populations around 3,500,000, Hanoi is divided into 8 districts (Ba Dinh, Hoan Kiem, Hai Ba Trung, Dong Da, Thanh Xuan, Cau Giay, Van Xuan and Long Bien) and 5 suburban districts (Tu Liem, Thanh Tri, Gia Lam, Dong Anh, Soc Son).

During the last years, the process of urbanizing occurred strongly and quickly in the countrysides, leading to the fact that the area of the cultivate land was reduced. For example, in 2002, it had reduced about 1,000 ha in 5 suburban districts. From the fact, we decided to shift the structure of agriculture from planning rice to farming and ranching and setting up the area for planning flower (Tay Tuu- Tu Liem) and vegetable (Van Noi, Nam Hong- Dong Anh), ranching the cow milk (Phu Dong, Duong Ha- Gia Lam), lean pig (Yen Thuong, Van Duc- Gia Lam) and marine life (Yen So, Tran Phu- Thanh Tri).

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Transferring the structure of economy and applying the new technology in farming and ranching, especially, the high quality rice strain was

planted in many areas, the output of the cereal had increased continuously although the area of the cultivate land was reduced. However, this shift of the structure is not easy for the farmer in some areas, we need to research the real situation and give out the method to the problem.

Hoang Liet village was selected to apply the new technology, its process of urbanizing occurred very quickly. Our results and experiment are on the following:

1. The characteristic of Hoang Liet

Hoang Liet village is under Thanh Tri district, Hanoi, it is 2 km from Van Dien and about 10 km from Hanoi.

The areas: Total: 467.1 ha

in which: + agricultural land: 251.0 ha
                + specific land: 166.9 ha
                + land tenure: 43.0 ha
                + unused land: 6.3 ha
         * Before the urbanizing: 825 m^2/person
         * After the urbanizing: 462 m^2/person
in which: the areas of the cultivate land is 246 m^2/person

Distribution: including 5 villages (Linh Dam, phap Van, Tu Ky, Bang A, Bang B) and 2 collective quarters for the staff.

The population: Total**:** 10,221 person within 2,507 households

in which: + Man: 5,012
                + Woman: 5,209 (women at the age of 15- 49 are 2,921)
                + The labourforce: 5,582
                + The children: 2,130

The average of income:
         - Before the urbanizing: 250,000 VND – 300,000 VND/person
         - After the urbanizing: 420,000 VND/person

The knowledge of women:
         - primary education: 7.8%
         - Secondary education: 66.9% (middle school and high school)
         - industrial higher school: 2.1%
         - College: 2.7%
         - University: 0.5%

2. The structure of the economy

Due to the process of the urbanizing, the people had shifted from farming and ranching to doing business and developing the supplementary work linking with the traditional handicraft.

Agriculture:
- Farming: rice, vegetables
- Ranching: pigs, fish, chicken, duck

Other works:
- Set up the woodwork shop such as: Bang A, Bang B and Phap Van
- Form the rice vermicelli processing base: Tu Ky village
- Organize the wool-knitting base: Linh Dam village
- Services

industry: there are 31 companies

3. The structure of work

Through our investigation, the main work for the women is to working in the field, some of them work in the company and others attend the traditional handicraft.

4. The Estimation

As the statistic, the woman labour occupies 50%, in which the women who have finished the primary and secondary education, are 60%. When the process of urbanizing was occurred, they had lost their work. So, it is necessary to hold the train courses for them. However there are some problems:
- Which work will suit with them
- Which organization will help them
- Which product will have the high value
- The way of process and preservation
- Who will buy their product

5. The method
- To develop Center for community education.
- To help the farmer to have the information on market.
- To set up the trade school.
- To develop the service.

Distribution of the women's works

Work	Quantity	Rate	place
Rice and vegetable	459	54.9	Bang A, Bang B
Rice vermicelli, animal	180	21.7	Tu Ky
Woodwork, mechanic	34	4.1	Bang B
Service	93	11.2	Phap Van, Linh Dam
Other works	67	8.1	Phap Van, Linh Dam

URGENT: CALLING FOR ACADEMIC REVOLUTION

Teresita T. Tumapon

Introduction

Food security has been commonly defined as "access by all peoples at all times to sufficient food to meet dietary needs for a productive and healthy life," (USAID). The target year for reducing the number of undernourished people to fifty percent their present level is no later than 2015. This target is part of an ongoing effort to eradicate hunger in all countries. It is the commitment undertaken by the international community during the World Food Summit convened in Rome in 1996.

The World Food Summit, points to the fact that "more than 800 million people do not have access to enough food to meet their basic requirements" and that the major cause of this situation is dire poverty. Consequently, to address food insecurity is to address directly poverty eradication. Many and diverse are the efforts towards this goal. The question is, do these efforts guarantee sustainable progress towards poverty eradication? Since education is a critical factor in sustaining efforts towards poverty eradication, how have universities responded to the eradication of poverty and ease the problem of world hunger?

This problem has posed various challenges which, in order to address it, was to implement "a common vision for achieving the targets set by the world conferences of the past decade." A synthesis of these Conferences suggests "that we work for sustainable growth that favors the poor and provides more resources for health, education, gender quality, and environmental sustainability worldwide."

Need for concept shifts in university culture. Obviously, one social sector such as education cannot have all the answers nor the capacity to respond to these multiple challenges. But higher education, in particular, can do well to start and sustain an academic revolution as a support engine to poverty eradication and food security. This would consist in paradigm shift that can translate into relevant programs and projects into the traditional functions of universities – instruction, research, extension and production. Thus, these functions have to be appropriately reconceptualized. For this purpose. this paper will focus on what concept shifts universities can consider as their share in

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the world-wide efforts to achieve food security. Concrete examples will be described.

Nature of the shift. What would be the nature or direction of the shift? To Mcguire, Lindley and Willet as referred by Gasperini, agricultural education and training is "isolated from the market place and from the rest of the education system." This refers to both the higher education courses and vocational and technical training in agriculture which as Gasperini describes has catered only to a "reduced clientele" and therefore "has not addressed the needs of the vast majority of the population who represent a great percentage of the 800 million undernourished and illiterates."

In light of the multifaceted character of poverty eradication and food security, some concrete action that universities can undertake are the following:

1. Focus on Education and Food for All (Gasperini, October, 2000)

Education for All (EFA) means for the universities to widen access of the poorest of the poor to quality education and training. How? This is not meant to lower the standards for admission to university. It means awarding qualified University entrants opportunity to access university education. In so doing, curricula can be crafted for rural development and food security – to address Food for All. This may be done by initiatives for "participatory curriculum development and teacher training to respond to rural development needs and farmers' demands" (Wolfensohn, 2000)

An example in the Philippines of participatory curriculum development and teacher training are the inclusion of a course entitled *Community Immersion and Integration* (CII) in the teacher education baccalaureate program. Every semester the course is offered, the syllabus is developed through conferences, dialogues with the host community of the teacher college. The host community is the community where the teacher college is located. The CII course "immerses" the student in community extension work in a manner that "integrates" experiences which hone the skills of the student needed as a teacher such as social skills, planning, implementing plans, monitoring and evaluating the plan outcomes, etc. It aims to give students the opportunity to undertake "service learning." Hence, it does not only provide for unmet needs of a particular community; at the same time, it aims to enhance the competencies of students in delivering non-formal education and understanding and practice in community building and development. The institution partners with Local Government unit, for example, with the office of the mayor. A mayor is the head of a town or municipality.

One case is a state teacher college in Capiz, Philippines which helped won a national award for its partner LGU - a *Gawad* Award for a Green Revolution undertaking. This project consisted of education students enrolled in the CII course in which the project area was a district of a town. Major project component was training district folk maintain backyard vegetable and farming

and "greening" the streets – which means keeping streets clean and well maintained as well as planting shrubs all through the span of the municipal road to the city. Planting seeds and fertilizer were donated by the LGU. This project developed commitment in the rural folk to maintain and sustain the cleanliness of their district and the productivity of their respective backyard gardens.

2. Another means is for the university to craft programs on *Earn while you Learn*.

This consists of school projects that may be tied up with courses such as Aquaculture, Life Science, Agriculture courses, etc. aimed to develop healthy attitudes, values, knowledge and skills in livelihood enterprise and other forms of productivity. For example, at Surigao State College of Technology, prawn culture and production serves as a laboratory in aquaculture and at the same time an income generating project for the College where students are also compensated for their services in maintaining the fish farm. In the Home Economics Unit under Food Trades, the students prepare recipes according to a weekly plan which they help make and where their products are sold in the school cafeteria. The plan consists of the recipes to use and ingredients are from local sources and aquatic/marine produce. Students receive accumulated share in the proceeds during examination week or at semestral end to help pay their school fees. In shop courses such as automotive, welding and fabrication and mechanical technology, students likewise learn and earn through similar arrangements.

The Rizal Technological University in Metro Manila generated 95,885.75 PhP from its sale of mushrooms and orchids in AY 2001. Another such institution where students help generate earnings from gainful small scale projects is the Ifugao State College of Agriculture and Forestry. In FY 2002, net proceeds from poultry was 168,000 PhP, model farm – 56,136.94 PhP, and from Ruminants – 58,975 PhP. Still another such case is the Mariano Marcos State University. Its corn production earned 282,377 PhP for over a period of only six months while its vegetable production generated 51, 857.30 PhP for a period of ten months. Its 72 species of ornamental plants yielded a total sales of 35,381.00 PhP while its fruit tree projects generated 86,967.25 PhP from 6,274 kg of mango fruits of 113 trees which were induced to flower; 64,019.55 from its *calamansi* fruits harvested from 710 trees and 7,280 PhP from 1,456 nuts of 110 coconut trees. In addition, its poultry, dairy and livestock yielded a combined amount of. 7,692,109.53 PhP and 248,812 PhP from its fish ponds. Its farm products were utilized also for food processing. For *Iloko* wine and vinegar production, total sales was 1,449,080.00 PhP. This project is engaged mainly in the semi-commercial fermentation of the local wine and fruit wines from cashew and mango. Meat processing yielded 1,444,760.00 PhP with the native sausage having the highest sales. The fruit processing earned 37,860 PhP from the sale of assorted processed fruits such as mango puree, mango candy, native prunes,

candied cashew and banana chips. Processed dairy products earned P 511,737.00 for the same year – 2000. In all these both students and staff involved have a share in the proceeds.

The kinds of products sold are mentioned in the foregoing to illustrate the various courses through which students gain diverse opportunities to learn: Food Chemistry, Nutrition courses where metabolization of food as a dimension of food security can be learned, research methods, biotechnology, soils, cooking, meat processing, entrepreneurship, cooperatives, and a host of other subjects--- all these subjects can be redesigned where the maximum opportunity is given students to learn by doing what is or could be necessary for an enlightened entrepreneurial undertaking. As Confucius says, *I hear and I know; I see and I understand. I do and I will never forget.*

In the case of the academics, mounting such courses is an outlet for entrepreneurial science. Moving knowledge from the university to industry, embodying such knowledge in a technology for economic good – these are some by-products of the Earn while you Learn strategy. These are significant steps for the universities to become engines of sustainable development to help address poverty eradication and food security. At the same time such entrepreneurial activities contribute to the vibrancy of a market economy.

It is the multifaceted character of world hunger that in itself provides universities a wide avenue to contribute to its solution. When one takes note of the definitions of sustainable agriculture in the literature, one notes the general concern on the need for economically viable agricultural practices. These practices should meet human needs for food and that they be concerned for environmentally sound practice and the quality of life.

3. Another step a university can take is *Closing the Gap* between theory and practice.

This consists of reviewing curricula in which content and learning experiences appropriate to the program pursued are met. The gap between theory and practice in university courses have to be narrowed if not totally eliminated. Engineering programs can have several of such courses the objective of which, among other objectives, is to provide students the necessary knowledge of how technology can impact on the environment. Their practicum should involve concrete practices, for example of industries that secure clean air in their operations. Students in the social sciences, sciences and in law can be called upon to help town councils in crafting local, regional or even national laws or regulations such as the Philippine Clean Air Act which major feature is prohibiting vehicles from belching or black smoke emission that pollutes the air.

Another example of this paradigm shift in curricula is the pilot program at the Pontifical Catholic University of Rio de Janeiro (PUC-Rio) where the science-based engineering program has given way to the science-

based entrepreneurial engineer. The shift is a reflection of the university's awareness of a much needed change in institutional culture.

The challenges of the new millennium among which are the results of "fast paced technological advances, the new economic dynamics (increased value of market orientation, globalization, etc.), the new division of labor (standardization, automation, modularity, outsourcing, etc.), and the rise of new values, new problems and new opportunities – these have impacted on the university to try out a new theme of the engineering curriculum. As listed by Aranha *et al.* (___) for the prospective engineering graduates to ably meet this millennium's challenge, a set of skills is necessary. This consists of the ability to generate one's own information flow; to create, design and manage technological interventions, hence to be a problem solver; communication skills; ability to work in multidisciplinary teams necessary for leadership; ability to evaluate the social and environmental impact of one's interventions which means to have a perspective; development of market vision, business acumen, ethical behavior, and entrepreneurship.

Shifting university culture is a complex undertaking. The change can only impact on students if the university administration itself and the academics become role models for entrepreneurship. The classical concept of the university as one in its ivory tower, particularly in its research function and the imperatives for an entrepreneurial character of the curriculum have to be reconciled. For instance, in evolving "an abstract formulation into a marketable product where the R and D community and the entrepreneurial communities interact in close proximity so that one may count on the presence of the other right from the inception of an opportunity." The university has to adopt a mechanism that establishes "a new and integrated mode of knowledge production endowed with a more evenly distributed motivational drive across the concept-to-market spectrum."

4. Another aspect where to change paradigm is in the University's extension services function. Extension services are not an outlet for doles such as the traditional stance of community kitchens, the nutri-bun program and other nutrition-aimed activities where food is doled out. Cooperative extension provides for the rural communities served by the university training in livelihood enterprises in which literacy including financial literacy and values development are integrated. Post training assistance is in the form of financing for setting up a small scale enterprise with the assistance of cooperative workers. Thus the university partners with GO's and NGO's for such activities. Market study service and expertise on cooperatives or livelihood ventures are provided until the enterprise becomes stable. An example of provision of cooperatives expertise and of capital are the United Coconut Planters Foundation and its affiliate rural bank, an NGO that performs such services for coconut farmers.

5. Instruction-wise, the university can utilize case studies and simulation as a phase in the exposure of students.

Simulations could use ordinary material. It is how the activity can approximate the real life situation that could evoke interest and understanding of concepts. An example is a simulation to illustrate market economy. Owens' The Paper Airplane Challenge provides students the opportunity to understand the characteristics of a Market Economic System. Through this simulation, the students will be able to "define the term *Market Economy* and identify a variety of vocabulary associated with the definition." The same exercise could enable the students to "list the advantages and disadvantages of the current type of economic system used" in their country (such as the Trade and Tariff Act the Philippines adopted); and finally "to evaluate the level of government intervention" currently found in a given form of market economy.

The simulation consists of several teams outnumbering the paper planes which they designed within a three-minute period. One in each team throws as many paper planes as are available through the hula hoop which is fixed at a certain distance and where the paper planes are thrown from behind a fixed line. This latter activity is still part of the three-minute period. The instructor goes around during the simulation and observes the methods used by the teams such as assembly line, all for one, etc. and listen for comments the teams make. After the simulation, the instructor asks how many planes each team were able to fly through the hoop. Very likely, as Owens comments, only the person who threw the planes and the counter can give the correct number (a by-product of specialization). This is to be done for each group and winner/s are declared.

Debriefing session consists of discussing the answers to these questions: "(1) Why didn't each group design one perfect plane, make it, and throw it through the boundary? Three minutes was surely enough time for that." Responses will range from "We wanted to win," "to compete" etc. Instructor records the responses on a flip chart; adds his observations made while watching and listening to the groups. At the end of five minutes, there will be a list of adjectives that describes a market economy. For example: competition, winners, losers, specialization, assembly line, marginal returns, research and design, quantity, quality, etc. The instructor clarifies any confusing terms and adds a few more and asks for their definition.

The next phase is the debriefing proper. Instructor asks the definition of market economy and then compares the definitions with that written on a flip chart which is "A Market Economy is a type of economic system where supply and demand regulate the economy rather than government intervention." Instructor double checks for understanding of the definition.

The third phase is wrapping up. Instructor poses these questions "What countries do not have a market economy? Are there examples of *pure* market economy? What are the advantages and disadvantages of a central economy? Of a market economy? Can government interventions solve the disadvantages? Give examples from current events of government interventions. Are they successful? Why? Why not?" The exercise can be covered by a one hour session.

Conclusion

It may be said that universities have a critical role in sustaining efforts toward alleviating world hunger. They can start from their own "backyards," in their host communities or adopt a rural district and focus services of specific curricula or programs and projects such as that in agriculture and teacher training. In the case of agriculture, it should continue to protect the soil and resources, respond to demand for food and fiber as well as on production resources and at the same time with motivation for entrepreneurship. The change in paradigms could be done through innovative, interesting and challenging means. There is much among universities that can be shared in this regard. This Alumni networking symposium is a great forum for such sharing.

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Supplement

SOIL MICROBES-PLANT COMPETITION FOR P IN THE SOIL AMENDED WITH PLANT MATERIALS FROM FALLOW VEGETATION

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Abstract

The use of plant materials for sustaining soil nutrient in slash-and mulch agricultural system has been reported causing nutrient immobilization by soil microbes, which in turn leads to inhibition of crop growth. Nutrient immobilization occurs mainly at the beginning of plant materials amendment. Immobilization period is very crucial to recognize in order to set a strategy of mulching management in sustainable agricultural system.

A simulation on soil microbes-maize competition was carried out in green house experiment to answer the question whether amendment with plant materials could improve P uptake by maize or whether it would cause reduction of available P due to microbial consumption (immobilization) during growing period.

Three percent (w/w of soil) of the fallow vegetation materials (Ficus, Albizia, Chromolaena, Macaranga and Trycospermum) were mixed with the top part of pre-incubated soil in the pots (1-3 cm). This set of treatment was contrasted with control (without amendment). Seeds of maize were sown at the time of plant materials amendment. Maize growth, soil P availability, P uptake and soil microbial P were investigated during growing period.

Amendment with plant materials into the soil significantly declined the maize biomass and P uptake particularly at 4th and 6th week after sowing. Extension of growing period up to 10 week enables the recovery of P uptake by maize grown on amended soil. The reduction of P uptake was due to declining of P concentration in the plant and inorganic P in the soil solution. At the period, in which, the biomass and uptake of maize grown on the amended soil were lower than those of control, the microbial-biomass P in the amended soil was significantly higher than in the control. The presence of plant on the amended soil resulted in a reduction of microbial biomass P.

Key words: plant material amendment, P-uptake, microbial-biomass P, inorganic P

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Introduction

The activity of soil microorganisms plays a major role in resulting the transformation or mineralization of soil organic phosphorus compounds into dissolved or soluble phosphorus in the soil solution (Coale, 2000). In general, the rate of organic P mineralization is more rapid in tropical soils (Tiessen *et al.,* 1983; Sharpley and Smith, 1983 and Nyami, 1991) where organic P is an important source of available P (Morris *et al.,* 1992).

Direct planting immediately after amendment with plant material might increase the transformation of available inorganic P to microbial biomass P. In the soil amended with plant material, a high concentration of soluble phosphorus in the soil solution stimulates short-term accumulation of organic P into microbial biomass P, which comprises 2-3% of the total organic carbon in soil (Morel *et al.,* 1996), by means of immobilization of phosphorus (McLachlan *et al.,* 1988). In the soil low in available P, during immobilization of P, the concentration of available P for crops may decrease and cause the plant deficient in P. Under these circumstances, it is hypothesized that, the presence of microbes due to plant material amendment might compete with the plants in utilization of released P. This indicates that microbial biomass P plays a central role in P cycling. The biomass P can be an important source of available P in the next cropping period (Hedley *et al.,* 1995).

The main objective of the experiment was to answer the question whether amendment with plant material could improve P uptake by plants or whether it would cause reduction of available P due to microbial consumption (immobilization) as identified in the incubation study.

Materials and Methods

Growth Chamber Preparation

Two weeks before the experiment, the climatic conditions of the growth chamber were established. The average temperature in the growth chamber was set to 27.6 ± 3.8^0C; the minimum and maximum temperatures were 24.3 ± 1.9^0C and 30.9 ± 1.7^0C, respectively. The average relative humidity was $76.0\pm5.3\%$, and the minimum and maximum relative humidity values were $71.4\pm2.3\%$ and $80.7\pm1.8\%$, respectively. The daily light period was set for 10 hours (07:00 to 17:00) with a light intensity of 60,000 lux.

Soil Preparation

The soil was from a research station of the Brazilian Pacajus national centre for cashew research (CNPCa/EMBRAPA) and had been stored for several years. The chemical composition of the soil is presented in Table 1. The soil was air-dried and screened by using a 5 mm sieve, and pre-incubated. The

soil moisture was brought to 80% of the total water-holding capacity. The water-holding capacity of the soil was 265 ± 19 g water kg^{-1} air-dry soil.

Table 1. Soil chemical and physical properties

Soil properties		Soil properties	
pH H_2O	5.6	Na (me $100g^{-1}$)	0.14
$CaCl_2$	4.9	Al (me $100g^{-1}$)	0.10
C organic (%)	0.73	H (me $100g^{-1}$)	0.20
N total (%)	0.04		
Available P Bray-1 (μg P g^{-1})	2.3-5.1	Physical properties	
Olsen P	4.0-5.7	Sand (%)	91.5
Water soluble P (μg P g^{-1})	0.29	Silt (%)	3.0
Ca (me $100g^{-1}$)	0.72	Clay (%)	5.5
Mg (me $100g^{-1}$)	0.48		
K (me $100g^{-1}$)	0.08		

Soil Amendment with Plant Material

The plant materials originating from fallow vegetation, namely: *Ficus, Albizia, Chromolaena, Macaranga* and *Trycospermum* were involved in this experiment. Each pot contained 2 kg of dry soil. Three percent (60 g/pot) of the plant material was mixed with the top part of soil in the pots (1-3 cm). The soil-plant material mixture was placed on the top of the soil in the pots.

Maize Growing

Immediately after adding the plant material to the soil, four maize seeds per pot were planted at a depth of 1-2 cm. At 4 days after planting, the two smallest plants were culled and the vigorous plants were retained. At 7 days after planting, a nutrient supplement (Lange Ness, 1998) was given. During the first 4 weeks of the growing period, the pots were watered once a day in the morning by replenishment to 80% of the water holding capacity.

Plant and Soil Sampling

Plant harvesting was conducted at 2, 4, 6, and 10 weeks after planting. At each harvesting, the fresh biomass production of maize, which consisted of leaf,

stem and root, was determined. The plant fractions (leaf, stem and root) were dried at $70^{o}C$ for 48 h to determine the dry weight production.

Experimental Design and Statistical Analysis

Two groups of growth media, composed of soil with plant material and soil without plant material (control), were used in this experiment. Both media were divided into two groups: planted and unplanted, generating four combinations of treatments. Each treatment was replicated 4 times and sampled at each harvest period.

Results and Discussion

Biomass Production

As shown in Figure 1, in comparison to the control, adding plant material to the soil led to reduced shoot dry weight (SDW) ($p<0.05$). During the first two weeks of growth, SDW of control and amended soil showed no differences. However, after the two 2 weeks, the SDW of the amended soil was lower than that of the control. The increase in SDW from the first week of growth to the 10th week was 9 times for the amended soil, compared to 12 times for the control. Compared to the SDW, amendment with plant material tended to increase the root dry weight (RDW) over the control. Apparently, the adding of plant material improved the physical properties of the soil (Li *et al.,* 1985 and Tate 1985).

A lower SDW in the amended soil than in the control may reflect a decline in nutrient availability due to nutrient immobilization after plant material was added. This was associated with the change of the C/N ratio after treatment and/or reduction of available P. Amendment with plant material at the beginning resulted in a C/N ratio up to 28 ± 4 compared to the C/N ratio of the control, which was significantly lower (16 ± 3). However, the C/N ratio of both soils tended to narrow (16 and 14 for amended and control, respectively) towards the end of the experiment.

Phosphorus Uptake

As depicted in Figure 2, the plant material resulted in a lower ($p <0.05$) P uptake at the 4th and 6th week of growth in contrast to the control. The leaf P-uptake of the control plants was decreased with extension of the growing time up to 10 weeks, but it was relatively stable after the 4th week when the soil was amended with plant material. Four to 6 weeks after sowing, stem P-uptake of amended soil was lower than that of the control.

By 10 weeks, the stem P-uptake for amended soil was the same as for the control. There was a tendency for stem P-uptake to increase with increasing

maize age. Amendment of the soil with plant material significantly ($p < 0.05$) increased root P-uptake, particularly 4 weeks after sowing.
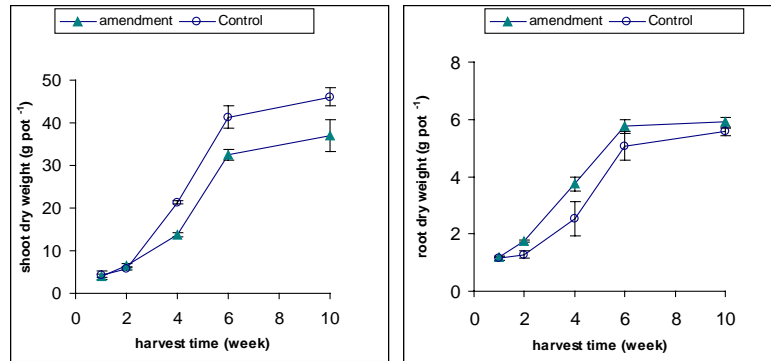

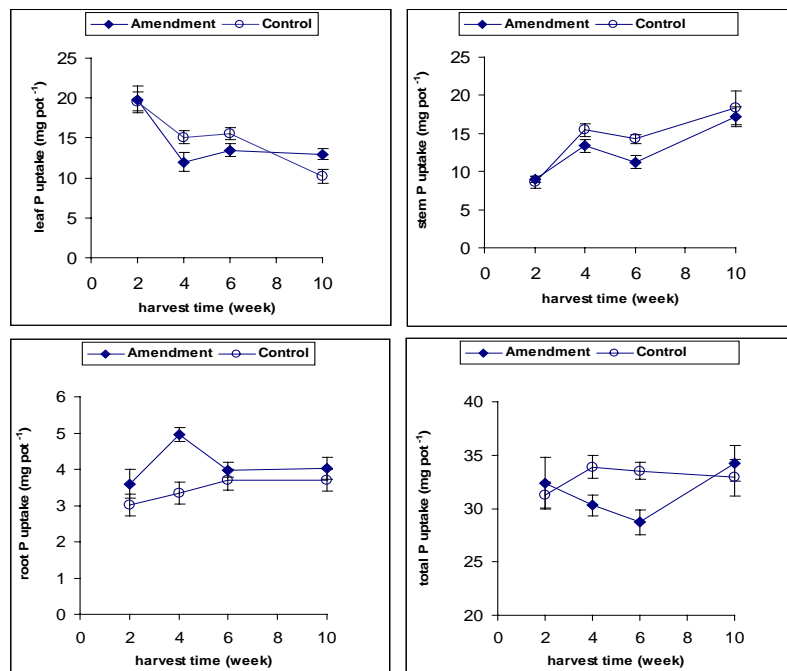**Figure 1.** Effect of plant material amendment on Biomass production of maize

Figure 2. Effect of plant material amendment on P-uptake of maize

Total P-uptake was considerably influenced (p<0.05) by amendment with plant material. No differences were observed between the total P-uptake in the control or amended soil at the beginning of the growing period. However, by the 4th and 6th week, total P-uptake in plants grown on amended soil was 11% and 14% respectively lower, than that of the control, but this difference disappeared by the 10th week. This corresponded with the concentration of available P in the soil.

The reduction of the P uptake by the maize as a result of plant material amendment was determined mainly by a reduction in the biomass production of the maize, and a reduction in the P concentration of the plant fractions, except in roots as we found in this experiment. Immobilization during plant growth seemed to be a major factor inducing the lower P uptake by plants grown on amended soil. The reduction of available P in amended soil was determined by the competition between root uptake and P immobilization by soil microbes. This was indicated by the microbial biomass P value, which rose and reached a maximum level over this period.

Inorganic P Soil Solution (Sp_i)

This P form can immediately be taken up by the plant roots. Amendment with plant material increased SP_i about 25% as compared to the control at planting time due to the release of readily available inorganic P from the plant material (Figure 3). In the soil without plants, amendment with plant material resulted in a lower concentration of SP_i at week 4 and 6, but higher at week 10 than that of the control. The presence of roots in the soil significantly reduced (p<0.05) inorganic P of the soil solution, suggesting that P in the soil solution was taken up by plant roots. However, inorganic P of the soil solution of amended soil was not significantly different from inorganic P of the soil solution of the control.

Microbial-biomass P during Growth

Microbial biomass P of both planted and unplanted soil increased considerably when plant material was added. At the beginning of the growing period, when the plant roots had not yet developed, soil amendment with plant material increased microbial biomass P seven- to fourteen-fold as compared to the control (Figure 4). However, once the roots had developed, particularly after the 2nd week, microbial biomass P stabilized, and between 6 and 10 weeks even declined.

The reduction in microbial biomass P due to plant roots was clearly identified in the amended soil. Microbial biomass competed with the roots in utilization of inorganic P in amended soil. This was supported by a significant negative correlation between P uptake by the plant and microbial biomass P ($P_{uptake} = 54.03-1.44P_{mic}$; r = 0.60) in the soil, suggesting that P uptake by the plant reduced microbial biomass P.

Microbial-biomass P of the control in both planted and unplanted soil were not different. In the control, there was a little competition in P utilization between soil microbes and plant roots, because in the control soil there was no addition of nutrient originating from plant material, which can stimulate the activity of soil microbes.
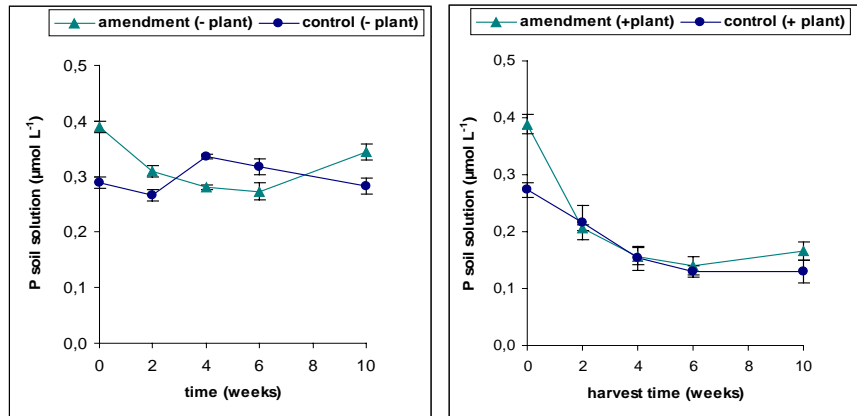

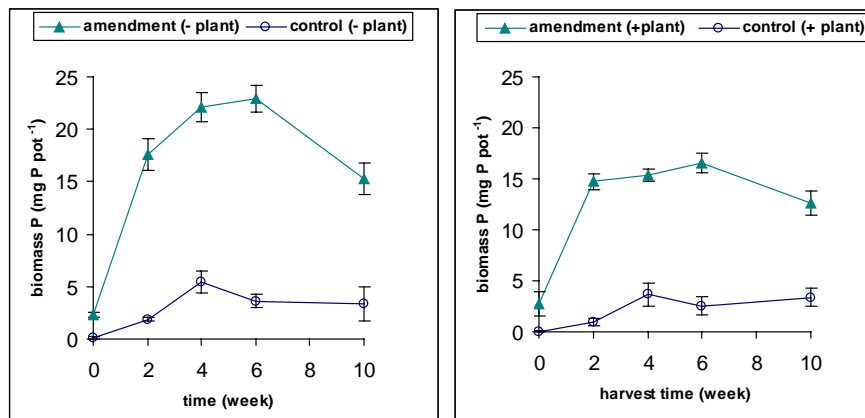**Figure 3**. Effect of plant material amendment on plant P available

Figure 4. Effect of plant material amendment on P-microbial biomass

Conclusion

According to the results of the experiment in growth chamber, it is clearly observed that planting maize immediately after amendment (incorporation) of poor quality plant material in large quantities caused high immobilization of P in the beginning of the growing period, which, as a consequence, led to a reduced biomass production and total P uptake. Later in the season, remineralization of P occurred and increased the availability of P. In this study a significant negative correlation between soil microbial biomass P and P uptake by roots was observed, suggesting that the presence of root in the system compete soil microbes for P.

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FERMENTATION OF RICE BRAN TO INCREASE PHOSPHOROUS AVAILABILITY BY USING RUMEN LIQUOR

R.I. Pujaningsih

Abstract

Rice bran as the source of phosphorous for the monogastric animals has the highest levels of phytate. Monogastric animals e.g. poultry, utilize this source of phosphate poorly at the best, lacking the requisite gastrointestinal tract enzyme(s) for release of the phosphate from the organic complex of phytate. The inability of poultry to utilize phytate P necessitates the dietary addition of inorganic P; this adds to increased feed costs, increases P excretion, and creates an environmental contaminant. By the way, phytate phosphorous has been considered to be absorbed easily in ruminant because of microbial phytase degradation in the rumen. This study would try to use rumen liquor as starter for fermentation processing. The aim of this study is to increase phosphorous availability of rice bran by using rumen liquor. The experimental design was selected to compare the effects of rumen liquor levels on the fermentation process. Besides, it is used also to find the best treatment and time of the fermentation. Factorial model based on completely (block) randomised design was employed through out the experiment. Two factors have been evaluated (i) the level of rumen liquor's addition (15; 30 and 45%), and (ii) the length of fermentation (0; 2; 4; and 6 days). Data were subjected to ANOVA using the general models procedure of SAS. Duncan and Orthogonal test was used for further analysis. The result of this study presented that fermentation process which used rumen liquor would slightly decreased after the fourth day of incubation period. The addition of rumen liquor and the use of microbial phytase as a starter in the fermentation of rice bran reduced the phytate phosphorus of FE, FR 15%, FR 30% and FR 45% for 19%, 11%, 18% and 7% of dry matter content, respectively.

Key words: Phytase, Phytate-Phosphorous, Rice Bran, Fermentation, Rumen Liquor

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Introduction

Rice bran as the one of unconventional feed, especially in Indonesia, is recommended to use for livestock feeding. It was based on the annual availability and the low-price of rice bran. Moreover, rice bran shows no competition to human diets. The limitation of rice bran results from the high content of crude fiber and the content of phytic acid. Phytic acid has the ability to chelate minerals. Because of this chelating ability phytic acid in the rice bran can be regarded as an antinutritional factor. It will be caused of reducing the bioavailabilities of the minerals e.g. phosphorous.

Phosphorous is an essential mineral involved in energy metabolism of all living organisms and it is necessary for bone development. Since about two-thirds of the phosphorous in plants is present with a phytic acid linkage, it is important that the chemical form of the phosphorous is considered when assessing minimal dietary phosphorous levels. In order for phosphorous to be utilized by poultry, phytate must be hydrolyzed into inorganic phosphorous within the digestive tract. Because, this undigested phosphorous has been identified as one of the major pollutants of surface waters in many places in Europe and the United States, and other poultry-producing states.

Phosphorous from phytate is poorly available to the chicken due to lack of intestinal phytase in the digestive system (Rao *et al.*, 1999; Moughan *et al.*, 1999). Phytase is the enzyme that is necessary for breakdown of the molecule and subsequent release of phosphorous for absorption. Because of the low amounts of phytase in the digestive system of monogastric animals, the use of phytate phosphorous by these animals is negligible.

During the last decade much researches focused on the use of microorganisms or parts of it (especially enzymes) for the production of fine chemicals. Especially the microbial multi-phase reaction system in which organic substrates are converted into new products, or products that are difficult to produce economically by classical chemical synthesis is rapidly gaining interest One aspect is the use of microbial phytase as a mean of releasing the phosphorous from phytate. This aspect was not new but gaining greater prominence because it was reducing the need for inorganic phosphate supplements in feed formulations and the excess amounts of phosphorous excreted in manure as reported by Simons *et al.* (1990). However, this product is too expensive for the small holder farmers.

Reid *et al.* (1947) and Raun *et al.* (1956) as reviewed by Ellis and Tillman (1961) have shown that rapid hydrolysis of phytate occurs in the rumen. It was also found that rumen microorganisms produce phytase. This suggests that the hydrolysis of phytate in the rumen is independent of the phytase found in the feed. Scheuermann *et al.* (1988a) and Park *et al.* (1999) recommended that for ruminants, phytate presents a simply available of phosphorous – source. In

addition, phytate phosphorous has been considered to be absorbed easily in ruminants. And as mentioned above, it is because almost all of phytate could be degraded in the rumen. The phosphorous combined as phytate in forages is split off in the rumen. It was studied by Hungate (1966) that from 32 to 100% of feed phosphorous is absorbed, chiefly in the abomasums.

Amalia (1997) informed that the using of 25% rumen liquor (as starter) during 2 weeks of incubation has given the best result of calcium and phosphorous content. Based on the research, which was done by Suyatno (1997), the using of 40% of fermented rice bran on the diet of indigenous chicken from Indonesia showed the better result of the availability of metabolizable energy. In addition, the using of 60% of fermented rice bran on the diet reported the increasing of phosphorous content in the blood.

The present study contains observations on the fermentation of rice bran with rumen liquor. The objective of this experiment was to evaluate whether the fermentation processing with rumen liquor as waste product from the slaughterhouse could significantly increase the phosphorous availability of rice bran.

Methods

This research was conducted at the Laboratory of Chemistry, the Laboratory of Microbiology Research and the Laboratory of Integrated Research of Bogor Agricultural Institute, Bogor, Indonesia. Rice bran from the third grade was used to fermented by rumen liquor. Rumen liquor, which was used in this research, was taken directly from the slaughterhouse, from cattle of the species of Ongole (F1). As control of the experiment, a commercial microbial phytase was used as the standard for phytase activity. The control was used for comparison to the phytase activity of the rumen liquor.

The experimental design was selected to compare the effects of rumen liquor levels on the fermentation process. Besides, it was used also to find the best treatment and time of the fermentation. Rice bran was treated with different level of rumen liquor i.e.: 1) addition of 15% rumen liquor (FR 15%), 2) addition of 30% rumen liquor (FR 30%), and 3) addition of 45% rumen liquor (FR 45%). The fermentation proceeded for 6 days. Each treatment was done in three replicates. As control of the fermentation process, microbial phytase was used in place of rumen liquor (FE). The length of the experiment was six days. Samples had been collected every two days. After all of the samples were analyzed for the activity of enzyme phytase, the sample preparation started to determine the content of phytate phosphorous, then followed by the other analyzing processes followed (Weende analysis for mixtures). Phytate phosphorous determination was carried out according to the Association Official Agriculture Chemists (AOAC-Method Nr. 986.11). Phytase activity was

determined after the method of Engelen *et al.* (1994). The Weende Analysis was employed to determine the content of water, crude protein, nitrogen free extract, crude fat and crude fibre.

Results and Discussions

The results obtained for nutrient composition parameters such as crude ash, crude fat, crude protein, crude fiber and NfE could indicate that the use of rumen liquor nor microbial phytase was not affected by the experimental condition. But based on the statistically analysis it was shown that the incubation of rice bran with an addition of 30% rumen liquor (FR 30%) significantly decreased crude fiber content (31, 3%). Referring to Hall et al. (1961), many authors observed that phosphorous has been shown to be essential for maximum cellulose digestion by rumen microorganisms. When the rumen was phosphorous depleted, cellulolytic activity rapidly decreased then, decreasing both diet utilization and animal production (Bravo *et al.,* 2000). So, it can be concluded that phosphorous content in the mixture could become one of factors, which influenced the decreasing of crude fiber on the mixture.

After the calculation, the contents of phytate-P in the mixtures showed, there was significantly effect for the length of day's incubation (p <0.01). Duncan test was used for further analysis. The results indicated that the content of rumen liquor had no significant effect on degradation of phytate. Furthermore, rumen liquor gave practical the same effect like supplement microbial phytase (FE). After incubation of 4 days, phytate phosphorus was significantly decreased. A longer incubation period had no further effects. Phytase activity from the mixtures is summarized in table 1.

Table 1. Phytase activity of the mixtures (FTU/Kg of dry matter) depending on stage of incubation in % of dry matter content

Day Samples	0	2	4	6
FE	267 ± 1	247 ± 1	201 ± 10	193 ± 2
FR 15%	208 ± 3	228 ± 2	175 ± 2	185 ± 3
FR 30%	236 ± 1	271 ± 5	229 ± 3	218 ± 4
FR 45%	239 ± 2	201 ± 9	177 ± 2	187 ± 2

Analysis of variance from the activity of phytase showed significantly difference (p>0.01) for the two factors and also for the interaction between factors. Further analysis was done by Duncan test to find the differences among those factors. The result described that the means value of phytase's activity between FR 15% and FR 45% was not significantly different. The differences

appeared among the means value of phytase's activity from FR 30%, FE and the two other treatments (FR 15% and FR 45%).

The means value of phytase's activity on the mixtures were not significantly different at the beginnings until the second day of incubation process. The difference was found at the fourth day of incubation. But then, the activity of phytase between the fourth day and at the end of monitoring of incubation did not show any difference.

At the beginning of incubation process, the activity of phytase showed significantly difference ($p > 0.01$) for each treatment, except for the means value of the FR 30% and FR 45%. The activity of phytase between these two factors did not show any difference. The effect from the addition of rice bran with rumen liquor or phytase to the phytase's activity was significantly different ($p > 0.01$) at the second day of incubation process. Activity of phytase from each treatment did not show the difference at the fourth day of incubation. At the end of the monitoring from the incubation process, the activities of phytase were not significantly different among FR 15%, FR 45% and FE. But, those treatments showed significantly difference ($p > 0.01$) with FR 30%.

Further analysis was done by Duncan test to know the effect of treatment to the phytase's activity during 6 days of incubation process. The addition of respectively, 15% and 45% of rumen liquor in the rice bran showed that the activity of phytase was significantly different ($p > 0.01$) during the 6 days of incubation process. The use of microbial phytase showed the significantly difference ($p > 0.01$) for the activity of phytase only at the beginning until the second day of incubation. At the fourth day and the end of monitoring incubation, the difference was significant at $p > 0.05$. Statistically, the activity of phytase on the FR 30% showed the significance at $p > 0.01$. But, the phytase's activity on the rice bran with the addition of 30% rumen liquor at the beginning of incubation was significant only at $p > 0.05$, compare to the phytase's activity at fourth day of incubation.

According to table 2, the degradation of phytate phosphorus content indicated to increase until the fourth day of incubation period. The next incubation period had no further effects for reducing the phytate-P content in the mixtures. It can be assumed that the maximum process of phytate-P degradation by rumen microbes was reached at the second day of incubation period. This result was agreeable to Hungate (1966), which observed that in the period of 8 to 24 hours after feeding, the digestion in the rumen was made. Furthermore, it was recommended that after 16 hour of feeding time the percentage of digestion in the rumen reached about 35% and 0, 55% by sheep and cow, respectively.

Table 2. The sum of phytate-P contents in the mixture (calculated as % of total P)

Mixtures	Day 0	Day 2	Day 4	Day 6	Means
FE	42.8 ± 1,3	41.4 ± 4.8	35.5 ± 4.8	35.2 ± 2.2	38.7[b] ± 3.3
FR 15%	43.6 ± 3.4	41.8 ± 2.1	38.9 ± 3.7	39.4 ± 5.2	40.9[ba] ± 3.6
FR 30%	43.7 ± 3.8	42.5 ± 1.4	36.2 ± 5.9	35.7 ± 4.8	39.5[ba] ± 3.9
FR 45%	44.8 ± 2.5	42.7 ± 1.8	40.9 ± 0.4	40.6 ± 2.5	42.2[a] ± 1.8
Means	43.7[A] ± 2.6	42.1[A] ± 2.5	37.9[B] ± 3.7	37.7[B] ± 3.7	

Following the result of phytate phosphorus degradation, phytase activity showed significantly difference from the Day 0 until Day 4. After the fourth day of the incubation period up to the end of incubation observed, there were no more significantly difference for phytase activity among each treatment. The explanation followed to the pH and average temperature degree during the last two period of incubation (Day 4 and 6). It was showed that pH value from the Day 4 and Day 6 a little bit high compare with the pH recommended. The temperature degree did not give any support for longer activity.

The used of microbial phytase in the mixture (FE) showed that there was a significant effect of its addition for phytate degradation compare with the addition of 45% rumen liquor in the mixture (FR 45%). It was suggested that phytase activity in the mixture mixed with microbial phytase was enough to meet the condition for releasing phosphorus from the phytate bound. Simon *et al*. (1990) recommended that the activity of the microbial phytase showed pH optimal at pH 5.5 and 2.5. As presented in table 4, pH observed for the used of microbial phytase in the fermentation of rice bran was in the range of 5.5 - 5.6 during period of incubation process (Day 2, Day 4, Day 6). While the temperature degree of the mixture could not meet the condition recommended, then the activity slightly decreased. Based on Igbasan *et al.* (2000), bacterial phytases exhibited their optimum activities at higher temperatures than their fungal counterparts. It is worth mentioning here that the optimum temperatures (50 to 60°C) of the phytases are higher than temperature (about 38°C) obtainable in the body. Therefore, the maximal phytase activities could not occur in the body.

The addition of rumen liquor and the use of microbial phytase as a starter in the fermentation of rice bran reduced the phytate phosphorus of FE, FR 15%, FR 30% and FR 45% for 19%, 11%, 18% and 7% of dry matter content, respectively. According to the statistical analysis, there was no significantly different effect of rumen liquor level addition for the reducing of phytate phosphorus content in the mixture. The significant difference showed only between the used of 45% rumen liquor and the addition of microbial phytase in the mixture.

Results of this experiments demonstrated that the fermentation of rice bran by using some levels of rumen liquor (15%, 30% and 45% of rumen liquor, respectively) provided no significantly difference in reducing the phytate phosphorus in the mixtures. Compare to the addition of microbial phytase, the level addition of 45% rumen liquor performed significantly difference in the amount of phytase activity (FE vs FR 45% of 699 FTU/kg vs 492 FTU/kg) and also the availability to the phytate P degradation (FE vs FR 45% of 38.7% vs 42.2%). The additional level of 45% rumen liquor in the mixture suggested that the mixture could not present enough nutrient requirements for the microbes, which must be met to survive and propagate. It supposed that the amount of microbes in the 45% of rumen liquor could not meet their requirements in this mixture.

Conclusion

The result of this study presented that fermentation process which used rumen liquor would slightly decreased after the fourth day of incubation period. A longer incubation period would give no further effects to the phytase activity and phytate-P degradation of the mixture. The level of rumen liquor addition (15%, 30%, 45%, respectively) demonstrated no significant results for the effect of phytase activity and phytate-P degradation. But, the use of 30% rumen liquor addition was recommended. Compare to the standard (the use of microbial phytase), the results of mixture used 45% of rumen liquor showed relatively low. Additionally, the results of this experiment could be used for further study, especially in the part of the phosphorus available supply of the poultry's diet.

Acknowledgment

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MORPHOLOGICAL VARIABILITY OF IRONWOOD
(*Eusideroxylon zwageri* T. et B.) IN NATURAL FOREST

B. Irawan[1] and F. Gruber[2]

Abstract

Ironwood (Bulian/ulin/belian/borneo ironwood) (Eusideroxylon zwageri T.et B.) belongs to family of Lauraceae, tribus of cryptocaryeae and subtribus of Eusideroxylineae. It is one of the most important construction wood in Indonesia because it is not vulnerable to termites and other ubiquitous tropical wood-destroying insects and fungi. Research on morphological structures of ironwood was conducted in order to obtain information on variability of ironwood, which can be used as basic information for ironwood cultivation and breeding. The variability of ironwood has been already discussed since the beginning of last century but until today there is no detail information on it. The research is one part of comprehensive research on variability of ironwood including ecology, anatomy, morphology and genetic variation point of view. The research has been carried out in Jambi province – Indonesia for three months from 10 October 2001 to 23 December 2001.It was conducted by direct observation to field using purposive random sampling. Practical experiences of local people were used to determine sample trees. The result shows that morphological structure of ironwood significantly varied on almost all of traits. Ironwood's seeds have various form and size, each variety has specific seed's characters. The leaf form of ironwood variety are also different, the forms of sirap's leaves are oblong to elliptic. Tanduk's and daging's leaves tend to obovate while kapur's leaves tend to ovate. The most different form and color of ironwood bark surface is form and color of kapur variety. It is smooth and white color that can not be found on any other varieties.

Key words: *Ironwood, morphological structure, variability*

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Introduction

Background

Bulian/ulin/belian/borneo (ironwood) (*Eusideroxylon zwageri* T.et B.) belongs to the family of lauraceae, tribus of cryptocaryeae and subtribus of Eusideroxylineae (Kostermans, 1957). Ironwood is one of the most important construction wood in Indonesia. The wood is used for making furniture, window and door frames, harbors, heavy constructions, roofs, bridges, railway sleepers, marine pilling, boat constructions, fence posts, heavy duty industrial flooring, shingles and vehicle body work.

The ironwood most valuable characteristic is that it is not vulnerable to termites and other ubiquitous tropical wood-eating insects and fungi. For this reason, the wood is in great demand for construction throughout Indonesia (Peluso, 1992). Martawijaya *et al.* (1989) explained that physical characteristics of ironwood are excellent. Class of strength is one, durability class one and it is very hard with specific gravity of 0, 88 – 1, 19.

Several varieties can be possibly be distinguished within ironwood, based on the form and size of the fruits. In practice, "bulian *sirap*", having wood suitable for manufacture of shingles, is sometimes distinguished from "bulian *tanduk*" or "bulian *daging*", which suitable for the production of timber (Heyne 1927; Soerianegara and Lemmens, 1994). De Wit (1949) suggested that the purpose of the present study was to investigate whether actually no correspondence whatever between fruit character and other characters (flowers, leaves, timber) existed. The opinion of earlier observers was confirmed and, as no detailed investigation had been carried out till now, received a firmer basis. The size may vary somewhat but one individual produces one single kind of fruit. As in nature several kinds of fruit are found in one locality this points to the possible occurrence of varieties or taxa of lower rank of ironwood.

Each variety of ironwood is so far never thoroughly investigated. The different characteristics among them could be recognized only by the local people mostly from the wood and other morphological structures. Therefore, it is important to conduct a research on morphological variability of ironwood as a part of a comprehensive research on variability of ironwood including ecology, anatomy, morphology and genetic variation. The term of variety with local names of *daging, kapur, sirap* and *tanduk* are used to describe the variability of ironwood.

Research hypothesis and objectives

The hypothesis of research is there is any variability on morphological structures of ironwood related to its varieties. While the objectives of research were (1) to identify morphological structures of ironwood related to ironwood varieties especially on morphological structure of seeds,

stems and leaves, (2) to compare morphological structures of ironwood among its varieties (3) to provide information on variability of morphological structures of ironwood, which can be used as basic information for ironwood cultivation and breeding.

Literature review
Leaf morphology

Leaf morphology of native vegetation has often been interpreted as a sensitive indicator of environmental conditions, presumably as a result of natural selection. If environmental pressures act as a selective force on community leaf morphology, then we would expect a high degree of similarity in similar environments, regardless of biogeographic origin of the flora. The results of the experiment suggest that plant community morphology is an emergent property, the magnitude of which is environmentally constrained (Halloy and Mark, 1996). The wide variation of leaf characters and their importance in systematic descriptions has resulted in the accretion of a large collection of descriptive terminology. The observation of leaf morphological traits is suitable to confirm the species status of population (Dickison, 2000; Finkeldey, 2001).

The leaf characters of Lauraceae family are as follow: the leaves are usually leathery and (on the upper surface) of a waxy, glossy dark green color; the lower surface is often glaucous (layer of wax). The dried leaves have a definite color in different species. The lower leaf-surface is often provided with domatia in the nerve-axils; they appear to represent a constant characters for certain species and not to be caused by insects. Pinnately veins leaves are a rule, but in several genera triplinerved leaves occur. The venation, which becomes visible after drying, is either lax or very dense. The leaves are spirally arranged (phyllotaxis 2/5 and 3/8) sometimes subopposite to opposite. Stipules are absent (Kostermans, 1957).

Seed morphology

Corner (1976) characterized on dycotyledon seeds for each family including information on the seed of seven lauraceous genera. These are described as usually having the testa (seed coat) at outer part closely adherent to a lignified, stelate-or undulate-faceted endocarp; the outer epidermis of the testa is unthickened, the mesophyl usually multiplicative, and the inner epidermis composed typically of short tracheids. The inner layer of the testa, the tegmen, is ephemeral. The pericarp of the fruit has oil cells and often stone cells. Kostermans (1957) explained that the seed of lauraceae is composed of two large, flat-convex cotyledons that are easily separable; as a rule the cotyledons are whit, rarely pink; they contain fatty oil, carbohydrates and proteins. The outside of cotyledons is either smooth or irregularly sulcate. The radicle is as rule a rather small, rarely swollen. The testa is thin and smooth.

Stem morphology

The bole form of a tree is that portion of the stem that has no live branches. Bole form refers to the number of dead branch stubs the evident and amount of paper from the ground to the base of the crown, or even higher; also the nearness to a circular cross-sectional shape that the bole attains needs to be considered in judging form, as well as the amount of sweep and the number of crooks (Hocker, 1979). The bole of lauraceae is usually smooth (although thick, deeply fissured barks occur too) and then often covered with numerous large, round, flat lenticels. The dead bark is as a rule very thin and is shed in small fragments. The living bark is either thin or may be very thick; its color varies between white, yellow, pink and dark red; it is usually brittle, but for an inner fibrous layer; often it has a more or less pronounced aromatic smell (Kostermans, 1957).

Materials and methods

The material that used were film, and natural stand of ironwood while the instruments are camera, micrometer screw, GPS, Leaf area meter type CL-202, oven (Memmert), balances (Sartorius type 2842 and Oertling) and stationery. This research has been carried out for about 3 months from 10 October 2001 until 23 December 2001 at Senami natural forest stand Jambi - Indonesia. It was conducted using purposive random sampling. The practical experiences of local people were used to determine sample trees. The characters that were used to determine variety by local experts were split ability in radial direction of wood, the form of shavings (straight pieces, waving pieces or fractures), wood smell and color, the form, surface and color of trunk. Two local experts who have worked for this research were Rizal (38 years), who has experienced with ironwood for about 14 years and able to recognize ironwood variety and Umar (35 years) also a local person who has responsible as a local forest ranger at Senami forest stand. To increase the validity of sample trees, each of sample tree was observed thoroughly on the characters of leaves, flowers, fruits, seeds, stem, bark and young seedlings. Those data were used to verify the identification results that conducted by local experts.

The number of sample trees varies from 5 until 10 trees for each variety. The space between each sample trees varied from 500 meters to 1,500 meters. The sample leaves were taken 10 to 20 leaves per sample tree. The leaves were taken as samples were mature leaves (green until dark green color) and located at the tip, middle and base part of twigs. The number of leaves for each variety were between 100 – 120. While the sample seeds were taken from selected sample tree with the number varies from 25 to 30 seeds per sample tree. The number of seeds that were collected were 150 – 200 seeds for each variety. They were taken from the ground around of sample trees. The qualitative data

were compared qualitatively to each other among varieties and quantitative data were analyzed statistically using two-sided of t-test.

The parameters are:
1. Morphological structure of leaf parameters including (a) lamina length (cm), (b) lamina width (cm) (c). lamina length: width ratio and (d). dry weight (gr).
2. Seed parameters that were observed are (a) seed length (cm) (b) seed diameter (cm) (c) seed length : diameter ratio (d) seed weight (gr) and (e) seed coat thickness (mm)
3. Stem morphological traits (form and color of bark surface)

Results and Discussion

Leaf morphological traits

Table 1. Mean values of leaf traits of four varieties of ironwood (*Eusideroxylon zwageri* T. et. B.) that analyzed using two-sided of t test.

No.	Varieties	length (cm)	width (cm)	Length : width ratio	dry weight (gr/cm²)
1	*Tanduk*	26.34699[b]	10.1157[c]	2.6104[a]	0.00894[bc]
2	*Daging*	27.2253[a]	9.8048[c]	2.8592[b]	0.00987[a]
3	*Sirap*	28.48072[a]	12.8639[a]	2.4319[c]	0.00902[b]
4	***Kapur***	27.48735[a]	11.3229[b]	2.2107[d]	0.00827[c]

Note: The mean values that follow by the same alphabets are not significantly difference based on 5% of two-sided of t test.

Table 1 shows that mean leaf length of *sirap*, *kapur* and *daging* varieties are not significantly different based on two-sided of t test but they are significantly different to *tanduk* variety. The mean leaf width of *sirap* variety is the widest and significantly different to other varieties. While *Tanduk* and *kapur* varieties are not significantly different one to another but they are significantly different to *kapur* variety. Mean length: width ratio of leaves of *daging* variety is the highest while *sirap* is the lowest. Both of them are significantly different one to another as well as other varieties. The statistical analysis shows that the mean dry weight of 1 cm² of leaves of four varieties are vary from one variety to another. *Daging* is significantly difference to other varieties. *Sirap* is significantly different to *kapur* but not significantly different to *tanduk* variety while *tanduk* and *kapur* are not significantly different from each other.

The color of mature leaf of ironwood is green until dark green while the young leaves are reddish brown until yellowish red. There seems no relationship between leaf color (mature and young) with the varieties. The leaf shapes of ironwood variety are different, *sirap* is widest and tapered to both ends but with the sides more or less parallel therefore its shape is elliptic to oblong. *Tanduk* and *daging* tend to obovate while *kapur*'s leaf shape tends to ovate (see fig. 1). The leaf apexes are acuminate while the leaf bases are rotundate for *sirap* and *kapur* while taduk and *daging* tend to obtuse until rotundate. Upper surface smooth; having a surface without hairs or any unevenness (glabrous), lower surface covered by fine soft hair on the larger veins (pilous). Leaf venation of all varieties is penninervis.

The obovate leaf shape of ironwood also reported by De Wit (1949). He noted that in billiton (the venacular name "billiton" used for a kind of ironwood that common grows near Tanjung Pandan, Bangka Belitung Province) apparently only the long cylindric kind of fruit is found with clearly attenuated top and base. The leaves tend to obovate. Based on the fruits and the leaves characters, the billiton has the same characters as *tanduk* variety.
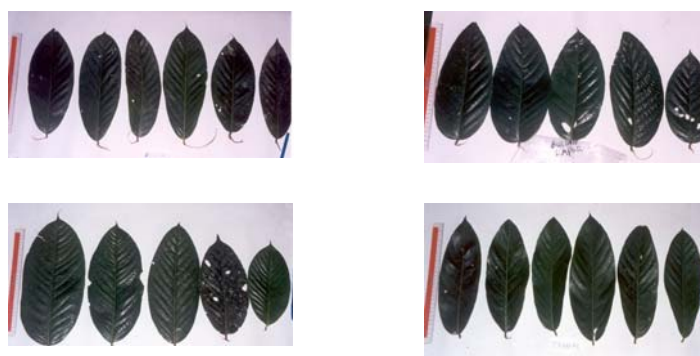
Figure 1. Showing the different characters of ironwood leaves. From left to right: *Daging*, *kapur*. *Sirap* and *tanduk* variety.

Seed morphological traits

Table 2. shows that mean seed length of ironwood varieties are significantly different from each other. The longest seeds belong to *tanduk* while the shortest seeds belong to *kapur*. The mean diameter of seeds of four ironwood varieties are only slightly different (table 2). Three varieties (*tanduk*, *sirap* and *kapur*) are not significantly different from each other but they are significantly different to *daging* which has smallest diameter. The statistical analysis results on seed weight of ironwood show that *tanduk* is significantly different from

other varieties. *Sirap* is also significantly different to *kapur* and *tanduk* but they are not significantly different one to another. Table 2. shows that seed coat thickness of *tanduk* and *kapur* are not significantly different one to another but they are different significantly to other varieties while the last two varieties (*sirap* and *daging*) are significantly different one to another. Table 2. Shows that highest value of mean length: diameter ratio of seeds belongs to *daging* variety and the lowest value belongs to *kapur*. However mean length: diameter of seeds of four ironwood varieties are significantly different to each other.

Table 2. Mean values of seed traits of four varieties of ironwood (*Eusideroxylon zwageri* T. et. B.) that analyzed using two-sided of t test.

No	Varieties	Length (cm)	Diameter (cm)	Length : diameter ratio	weight (gr)	Seed coat thickness (mm)
1	*Tanduk*	12.5035[a]	4.7539[a]	2.6603[a]	162.3808[a]	3.8448[a]
2	*Daging*	11.4593[b]	3.9153[b]	2.9519[b]	95.2881[c]	2.9853[b]
3	*Sirap*	9.6076[c]	4.7369[a]	2.0408[c]	123.4010[b]	3.1295[c]
4	***Kapur***	7.9484[d]	4.6728[a]	1.7146[d]	96.3409[c]	3.7035[a]

Note: The mean values that follow by the same alphabets are not significantly difference based on 5% of two-sided of t test.

Ironwood seeds have various shapes (see fig. 2). Relatively, *tanduk* has long cylindrical shaped with clearly attenuated top and base while *daging* variety has slender seed shaped. In general, *Kapur* has rounded seed shaped while *sirap*'s seed shape is in between long cylindrical and rounded. Those seed shapes are the common seed shape in the nature however, there are also could be found other seed shapes from the same variety, e.g. in the field could be found *daging* variety with rounded seed shapes but they are asymmetric in one direction while rounded shape of *kapur* seeds is symmetric. Another characteristic of *daging*'s seeds is bent (crooked) and clearly sharp tips at both sides. *Tanduk* also has rounded seed shapes but they are commonly bigger than the other rounded seeds.
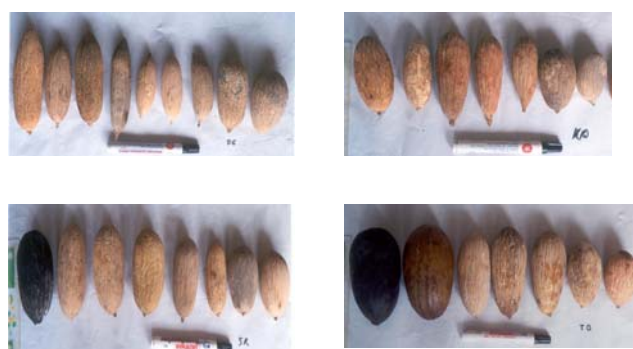

Figure 2. Showing the different characters of ironwood seeds. From left to right: *Daging*, *kapur*. *Sirap* and *tanduk* variety.

        The result of study conducted by Sindhuveerendra *et al.* (1999) on seed characters of clones of teak (*Tectona grandis*) showed that three seed characters i.e., seed length, seed width and seed weight of clones of teak revealed good amount of genetic variability. The significant amount of variation of these clones may be attributed to several factors including reduced gene flow due to spacio-temporal variability phenological characters, variation in selection intensity over a small geographical scale and genetic drift due to low population density combined with limited gene dispersal. The study conducted by Gabriel (1978) on Sugar Maple (*Acer saccharum* Marsh.) also revealed that seed and fruit characters varied genetically among and within provenances.

        The different seed shapes of ironwood has not directly reported by scientists before, most of them reported on various fruit shapes of ironwood (e.g. Koopman and Verhoef 1938; De Wit 1949; Soerianegara and Lemmens, 1994). The fruit and seed characters could be used as basic consideration in separating two genera or species e.g. Hayland (1989) who stated that the considerable number of differences in their infructescence, fruit and seed suggest that *Beilschmeida taraire* and *B. tawa* are probably not closely related to one another.

        The most different form and color of the ironwood bark surface are form and color of *kapur* variety. It is smooth and white that could not be found on any other varieties. This phenomena also already reported by Alphen De Veer (1954). He reported that in the ironwood plantations in Semandai (South Sumatra) some smooth-barked trees have been noted with a white color, wholly different from the normal trees. It supposed that these smooth-barked individuals may be presented as abnormal types, in the same manner as the smooth-*barked Tectona grandis* and *Pinus merkussi*. While the color of *daging*, *tanduk* and *sirap* are mostly brown or gray brown with thin cracks and debarking in small subquadrangular pieces. Bark surface with some bruises also could be found on *tanduk* variety. Whitmore (1962) explained that the bark color, which is often a distinctive characters of taxonomic value, depends on the tissue forming the surface and so depends on the plane of sloughing and the degree of subsequent erosion by external weathering. Another scientist (e.g. Soerianegara and Lemmens, 1994), argued that the white color is likely to be induced by external factors (fungi). The results of field observation indicated that this color is not induced by fungi because at that bark could not be found any mycelia or other fungi organs and also it is distributed smoothly to whole stem.

Stem morphological trait (form and color of bark surface)

Figure 3. Stem and bark performance of ironwood varieties (left to the right:
Daging, *kapur*, *sirap* and *tanduk* variety.

Conclusion

1. In the natural forest, morphological structure of ironwood significantly varies on leaves, seeds and stems (bark surface).
2. Ironwood's seeds have various form and size, each variety has specific seed's characters. Tanduk has cylindrical seed, daging variety has slender seeds, Kapur has rounded seeds while sirap has seed shapes in between cylindrical and rounded.
3. The leaf form of ironwood variety varies, the forms of sirap's leaves are elliptic to oblong. Tanduk's and daging's leaves tend to obovate while kapur's leaves tend to ovate.
4. The most different form and color of ironwood bark surface is form and color of kapur variety. It is smooth and white that can not be found on any other varieties.

Recommendations

1. In order to obtain comprehensive information on ironwood variety, it is important to conduct research on ecology, anatomy, morphology, seedling characters and genetic variation of ironwood
2. To make sure whether the characters of ironwood varieties are inherited or not, long term research on seedling test is required.

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Authors Index

A. Malik 101