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FOREWORD

Food shortage in the world stills a serious issue in the next decade. The world population is forecast to reach 8 billion by 2020, far exceeding the food production-increasing rate. Adoption and implementation of agricultural technology to increase food production is a top priority. Empirical study showed that centralized top-down policy and heavy subsidy implemented by many countries have increased agricultural production, but is not sustainable. Therefore, suitable, transferable, sustainable and acceptable technology must be identified, and the way to transfer this technology to farmers must be strategically formulated, depending on the various conditions of APEC member economies.

APEC member economies decided to organize a series of seminars seeking for the ultimate goal of "increasing farmers' income and self-reliance". The first seminar on Agricultural Technology Transfer and Training (ATT&T) was held in February 2001 in Yogyakarta, Indonesia, where farmers' participation in agricultural technology transfers was discussed. The second APEC seminar in Denpasar, Bali, Indonesia –held in 24 – 26 July 2003-, which had successfully identified the important factors in improving farmer's income and promoting self-reliance welfare such as technology and ATT&T aspects. The second seminar recognized the importance of sharing experiences, methods and strategies on formulating efficient technologies for agricultural production and value added agricultural products, and strengthening farmers led extension system through partnerships among researchers, extension personnel and farmers' leaders of the APEC member economies. Based on the recommendation of two in series of APEC seminar, therefore "lessons learned" discussed in the Third APEC training workshop, which held in Jakarta and Bandung on 18 – 22 July, 2004.

The themes of the Training Workshop of Third APEC Agricultural Technology Transfer and Training (ATT&T) 2004 focused on (1) Sharing experiences on the method and formulating strategy for increasing farmers' income and promoting their self-reliance through efficient agricultural production technologies and value added agricultural products, and (2) Strengthening Agriculture Extension Services (Farmers led extension system) for agricultural technology transfer and training.

This seminar was attended by 22 delegates from 10 Member economies (Brunei Darussalam, China Taipei, Chile, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Papua New Guinea, and Hongkong), Farmer Leaders from Malaysia, 29 delegates from 19 Provinces in Indonesia consisting of Research and Extension Institutes, Research and Assessment Institutes, Universities and Farmers Group Leader (KTNA) and 4 delegates from international organization.

The Seminar has discussed 9 (nine) Invited seminar papers to be presented by invited speakers from APEC member economies, poster Session and Contributed papers from Indonesia.

The invited papers, the contributed papers, and the results of the seminar that would be valuable to APEC member economies were documented on this proceeding

Bandung, December 2004.

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TRAINING WORKSHOP ON AGRICULTURAL TECHNOLOGY TRANSFER AND TRAINING
Bandung, July 18 - 22, 2004

Introduction

The Asia Pacific Economic Cooperation (APEC) Training Workshop on Agricultural Technology Transfer and Training was conducted on July 18 – 22, 2004 at Grand Aquilla Hotel, Bandung. The Training Workshop consist of Seminar to discussed 10 invited papers, and to enrich discussion, the seminar was supplemented with field training to observe and exchange information with farmers, farmers' group, women farmers group, entrepreneurs, extensionists and researchers in adopting less input technology, rural industry development and partnership between research-extension-training institution – private sector and farmers in generating and adopting agricultural technology and technology transfer and training.

The Training Workshop was attended by 78 participants from APEC member economies: Brunei Darussalam, Chili, Chinese Taipei, Hongkong, Japan, South Korea, Thailand, Malaysia, Papua New Guinea and Indonesia. There were 10 farmers from Malaysia and Indonesia attended the Training Workshop, and many other farmers, including Women Farmers Group, actively provide and share information and experiences with the participants during field trainings.

Opening Session

The Secretary of the Indonesian Agency for Agricultural Research and Development (IAARD) as the Project Overseer of ATT&T delivered the welcome address by saying warm welcome and expressing his deep appreciation and also hoping participation and contribution to all participants from the APEC member economies in this workshop, which indicate their interest to review, discuss and share experience in the dissemination of technology. He cited several interesting points from the first seminar in Yogyakarta, Indonesia, on 20 -22 February 2001, and the second Seminar held in Denpasar, Bali on 24 – 26 July 2003, that recommended to carry out the Training Workshop. Those previous seminars recognized the importance of sharing experiences, methods and strategies on formulating efficient technologies for agricultural production and value added agriculture products, and strengthening farmers led extension system through partnerships among researchers, extension personnel and farmers leaders of APEC member economies. The Training Workshop discussed this important recognition during room discussion as well as field visits to relevant location.

The co-shepherd from Japan in his keynote address emphasized the important role of the workshop to answer the recommendation raised during the previous seminar. As the co-shepherd he pointed out that he was very happy and proud being a partner of Indonesia. He mentioned that most of the preparation of the workshop has been done by Indonesia and no-doubt that the Training Workshop would be success with the participation of all APEC member economies.

The ATCWG Lead shepherd in his keynote address reminded the participants that this occasion is the third opportunities for the APEC member economies, for gathering here in Indonesia to address potential problems of food shortages. Agricultural development has been launched globally for many years and improving agricultural technology has been one of the main focuses. In relation to this, many countries have been implemented centralized top-down policy and heavy subsidy that have increased agricultural production but is not sustainable. The quality of agricultural products has also improved significantly. However farmers, the key implementer of agricultural development, have not fully enjoyed the benefits of the development. They are still left behind in terms of their income improvement. Therefore, suitable, transferable, sustainable and acceptable technology must be identified, and the way to transfer this technology to farmers must be strategically formulated, depending on the various conditions of APEC member economies.

In his opening remark the Director General of the IAARD raised the history of establishment of *The APEC Agricultural Technical Cooperation Working Group* (APEC-ATCWG) in Bogor in 1994. He emphasized that the agricultural technical cooperation, together with the development of agricultural resources will lead to improvements in production capacity, capability, and food variety and quality. The ATCWG initiative provides an opportunity to enhance the ability of agriculture and its related industries to contribute to the region's economic growth and social welfare. *The APEC Agricultural Technology Transfer and Training* (APEC ATT&T) is one of seven areas for cooperation among member economies, where Indonesia has been appointed coordinator and Japan as co-coordinator. This area is still very important since the Asia-Pacific region is still facing many difficulties, one being disparities between food supply and demand. To response to some of the challenges, the APEC Food System was launched to focus on the three goals: (a) the development of rural infrastructure, (b) the promotion of trade in food and (c) the dissemination of agricultural technology. He believes that all the APEC member economies agree that the dissemination of technology is especially important. That the reasons why we conduct this very important gathering in the form of 4 days Training Workshop in Bandung.

Paper presentation

The Fisrt paper:

IMPORTANCE OF CROPPING SYSTEM AS THE BASIC TECHNOLOGY INPUT SUSTAINABLE AGRICULTURE IN INTENSIVE VEGETABLE PRODUCTION

. Mitate Yamada
(Japan International Research Center for Agricultural Sciences – JIRCAS)

Vegetables are often grown under continuous cropping in Japan, but crop damages due to certain diseases usually associates with the continuous cropping system. Most of the pest and disease control used chemicals, but the importance of promotion sustainable cultivation and environment friendly technologies is increasingly recognized. Plant diseases such as clubroot, yellow bacterial wilt are major diseases to cabbage and chinese cabbage. Crop rotation with sweet corn, introduction of radish resistant varieties as trap crops are promissing.

Practical methods using antagonistic plants such as marigold is widely used and effective in controlling nematodes of radish. Only one season is required to introduce the antagonistic plants with only minor changes in existing cropping systems. Selection of crop combinations is essential. Taro is injured severely by root lesion nematode (*Pratylensuchus coffee),* and knot nematode (*Meloidogyne incognito*), while radish (*Raphanus sativus L.)*is damaged by root lesion nematode of radish (*Pratylenchus penetrans*). The combination of the two crops, however, with the third crop such as vegetable soybean (*Glycine max*) minimiazse the damage caused by the three nematodes.

Selection of cropping system is strongly affected by economical aspects such as price of vegetables, availability of capital, land ownership, labors and agricultural machineries, improving cropping systems are often conflict with farmers' selection. Development of new technologies that are compatible with the economic and natural conditions of a certain environment is very important. In this regard, a participatory

approach involving a close collaboration between researchers and farmers should be promoted on identifying the most suitable technologies for specific local conditions.

The Second Paper:

LESS INPUTS OF PRODUCTION TECHNOLOGY THROUGH OPTIMIZATION OF AGRO-ECOLOGICAL ZONE APPROACH IN INDONESIA (CASE IN NORTH SUMATRA PROVINCE)

Hasil Sembiring, Endang Romjali, M.A. Girsang, Darwin Harahap and Timbul Marbun
(North Sumatra Assessment Institute of Agriculture Technology)

Each province in Indonesia has complex biophysical and social characteristics which differ from one location to the other, therefore to generate local specific technologies AEZ approach has been used widely. This approach has been started since 1997 and the improvement on the methodology has been also made.

The main factors of AEZ approach were climate, land physiographic and humidity regime. North Sumatra consisted of 6 zones and 11 sub zones where land suitability for certain crops and their distribution, which is also considering socio economic factors, has been established. Additional information of the zone such as P and K status for irrigated rice was also integrated.

The benefits of using AEZ approach in North Sumatra were as guidance for agricultural planning, intervention needed for the zone, research and dissemination plans. Another advantage of this approach was that transferring the technologies is easier because each AEZ has uniform characteristics; therefore, technology transfer should be cheaper and easier. For P and K status map, it has been proven that this information could save a lot of money compared to normal recommendation.

Although a real example on how this zoning has not drawn interest of agribusiness investor yet, this approach is a good one, that means to start with to develop and stimulate rural investment strategy. This is indicated by the fact that some of the stakeholders have allocated their own budget to adopt AEZ approach to follow up these works e.g. by making crop suitability maps in bigger scale.

The AEZ approach combined with socio economic factors and transportation and other technologies looks promising to address various and complex conditions of Indonesia in developing efficient and sustainable agricultural production system.

The Third Paper:

INTENSIFYING THE ROLES OF WOMEN IN AGRICULTURAL PRODUCTION AND IN INCREASING VALUE ADDED AGRICULTURAL PRODUCTS IN CHILI

Laura Cecilia Rojas
(Studies and Agrarian Policies Bureau, Ministry of Agriculture, Chili)

Agricultural land is about 75.6 millions of hectares of continental land, and only one third has some agriculture and forestry potential. Those 25 millions hectares are divided into: forestry potential (11.6 millions hectares), livestock breeding (8.5 millions hectares), and 5.1 millions hectares tillable land that consists of 1.8 millions hectares of irrigated land, 1.3 millions hectares of land with possible irrigation, and 2.0 millions hectares dairy land.. Agriculture through out the country is categorized as follows: (i) the Northern agricultural production area in regions I to III is not as important as mining; (ii) Central Chilean agriculture (from regions IV to VII) usually relies on artificial irrigation and has horticulture and fruit production activities that strongly export oriented. The Southern Chili (regions VIII to XII) cattle farming and annual crops, cater mostly for domestic consumption.

The 1997 census indicated that 16.1 % of farmers engaged in crops are women, and about 15 % of farmers engaged in livestock husbandry. The women, however, are more important in fruits and flower production. The sixth region of Chili is the most important one in term of fruit production as well as in term of temporary workers (about 86.000 persons) from which approximately 50 % correspond to women. Their participation is very significant in packing plants, especially referred to pomes, the major regional production, where they carry out post harvest handling, thus contributing to adding value to the agricultural products.

Temporary works is likely to be the main labor option of women in this region, as involve a greater percentage of occupied women (60 %) than other remunerative activities (for example services, commerce, etc.). Women temporary workers, unlike men, tend to come more from urban than rural areas.

In relation to segmentation of tasks according to sex, in fruit orchard about 60 % to 70 % of day's work are occupied by men, as in packing about 75 % are occupied by women. Another agricultural activities, in which participation of women is very significant is in flower production. There is an interesting experience in relation to carnation culture in the 5th region, where a category of small women entrepreneurs has emerged. Carnation is a labor intensive culture and responds very well to delicate and meticulous work, in which women have special abilities.

The Fourth Paper:

POST HARVERST TECHNOLOGY FOR SMALL FARMERS IN THEIR PRODUCTION AREA, INCLUDING THE ROLES OF WOMEN, IN THAILAND

Dares Kittiyopas
(Agricultural Engineering Promotion Division, Bureau of Agricultural Product Quality Development, Department of Agricultural Extension, Thailand)

Approximately 41 % of total area of 514,000 sq. km. of the Kingdom of Thailand is under agriculture. The main crops are rice, maize, cassava, sugarcane and fruits. The post harverst usage in Thailand keeps rolling forward due to agricultural purpose changes from domestic consumption to competitive business. Post harvest handling, loss reduction and improvement of quality becoming more and more important in Thailand. However, the level of post harvest utilization still differs by crops and land conditions, socio-economic status of the farmers and other constraints.

About 35 % rice harvesting is operated by 3,000 local combine harvesters, and the use based on customer hire service. About 57 %, however, rice is harvested by labor, while the rest is harvested by reaper binder. Rice threshers are usually used by farmers in threshing the rice, and 88 % are in hire service in small area. Sun drying is the usual practice in drying the rice, due to costly operational cost of dryer operated by machinery. Appropriate harvesting period and adoption of high yielding rice varieties are promoted to improve production efficiency, preventing excessive losses in both quantity and quality of rice. The use of machinery for field crops is not as intensive as for rice.

About 27.7 million of Thai or 44 % of total population are engaged in farming. Women constitute about 51.6 % of the agricultural labor force. In the field, women are engaged in harvesting, threshing and marketing. The major roles of women, however, are in food production and preserve processing. Women are encouraged to be members of "Farm Women's Club" (FWC). Based on the Food Safety Policy, the FWC has been assigned to improve food production process in accordance with the General Principle of Food Hygiene to0 develop farmwomen's products having food safety product standard.

The Fifth Paper:

PARTICIPATORY EXTENSION APPROACH; INDONESIAN EXPERIENCE

(A Case on MP3 Model)

Soedijanto, Kazuhiko Yagi and Asep Adinata

(Indonesian Agency for Agricultural Human Resource and Development)

The concept of development regards to a **human enterprise** emphasizes on (i) a process, not a state; (ii) process ultimately refers to quality of life of the people, and (iii) the people are involved in the process. For those above reasons it means development is a **battle** against **poverty** and **unemployment.** The front of the battle is in the rural area. The motor of the battle is **agricultural development**. Consequently agricultural development will be the motor of national development, through which poverty is alleviated and unemployment is reduced.

Therefore Indonesia must develop competitive strength and people oriented agribusiness in addition to sustainability and decentralization agribusiness. The first is indicated by market orientation that being able to compete in the local, national and global market, whilst establishment of farmers owned small and medium scale agribusiness in the rural areas indicate the second. The farmers act as the prime actor of agribusiness development and employ in their own agribusiness. They do not necessary to urbanize to neither town nor migrant to other countries. This agribusiness development will cope the problem of unemployment in the rural areas.

Agricultural extension with participatory approach is the most crucial element to support agricultural development in Indonesia to develop competitive strength of agribusiness, people oriented agribusiness, sustainability agribusiness and decentralization agribusiness, mainly to improve the quality of life of the farmers through poverty reduction and increase rural employment. With the participatory agricultural extension approach agricultural extension program planning could be controlled locally, the content fixes the needs and interest of farmers, enhances the learning process of the beneficiaries, reduce the total cost of the extension system, and stimulants increased confidence, awareness, and activity among farmers and other beneficiaries.

Since 1999 Indonesia has successfully implemented MP3 model of participatory agricultural extension approach through a join project between AAHRD (Agency of Agricultural Human Resources Development) Ministry of Agriculture Republic of Indonesia and Japan International Agency (JICA) of the government of Japan. The success of MP3 model to increase participation among farmers and another extension beneficiaries is characterized by five key successes such as: (1) participatory approach, (2) bottom up approach, (3) on the job, (4) positive approach, and (5) experiential learning cycle. Through 5 sessions of training and 3 field works, during 15 weeks, the MP3 model pursues advanced and/or outstanding cases being practiced in actual agribusiness such as innovative marketing, processing and input supply, well management farmers

organization and environmentally sound farming, and further disseminates the cases to farmers as keys to a profitable and successful farming in diversified rural communities.

The Sixth Paper:

FARMER-DRIVEN TRANSFORMATION OF AGRICULTURAL EXTENSION

Salmon Padmanagara
(Extension Expert and Former Director General of Indonesian Agricultural Human Resources and Development)

The position of farmers in the conventional agricultural extension system in Indonesia is that of passive receivers of messages coming from experiment stations and delivered by the Agricultural Extension worker. In the mean time, the position of the extension worker is that of middlemen between the experiment station and the farmer. The extension worker is also the teacher of the farmer. He persuades farmers to adopt the recommended practices. The persuasive one-way approach easily becomes a compulsory approach. The end of the 1950's announced the overriding priority program, the rice intensification program. Agriculture Extension became the tool and the channel for achieving targets of the program. Farmers and agricultural extension workers alike were in no position to reject the program or to alter the approach.

During the *Bimas Rice Intensification Program* (started in 1969) the focus was on achieving rice production targets. The Training and Visit (TV) approach of the *Bimas* period did not alter the position of farmers as well as the relationship between extension worker and farmer. The *Bimas Program* with TV extension approach and with its technology and input package succeeded in increasing substantially the rice production and self-sufficiency was achieved one time in 1984. Farmers became familiar with modern rice production technologies and with the use of chemicals (fertilizers as well as pesticides). In spite of all the achievement in rice farming, the farmers are still passive receivers of messages and programs coming from outside or from others (government).

During the persuasive extension approach in the 1950's, and at later period, Senior Agriculture Officers were already thinking educating farmers to educate themselves and farmers to become the subject of development. The compulsory approach in support of rice production program however pushed that idea into the background although not entirely. Farmer-trainers were already active. They were called Farm Cadres (*Kader Tani*), later to become Contact Farmers (*Kontak Tani*), the elected leader-trainer of the farmer group. Agriculture Extension operates in the rural area (villages). It has relations and come in contact with farmers (village people) and influences farmers in their behavior, in

adopting technologies. Agricultural Extension is an ideal entry point for also introducing new social relations in the villages and new relations between farmers and extension workers.

Prior to DAFEP (Decentralized Agricultural and Forestry Extension Project) in selected parts of Indonesia several projects have been already carried out (IPM, KUF, Deliveri, Prospek). Those projects introduced new concept in implementing agricultural development, rural development, and community development. The Agricultural Extension approach of those development activities is the participatory approach. The results were satisfactory. The farmers responded positively to the new roles offered to them, that is as participant of activities and or partners in activities. The right approach, method and techniques plus the already changing times (reformation, globalization) are conducive for the change to take place, that is the position of farmers from object to subject of development. This new position of farmers is the main factor, the main basis for the sustainability of programs dealing with agricultural development and farmers.

DAFEP comes into the picture at the right time as follow up to the previous projects and at a time when the reformation fever is still warm. Farmer respons in DAFEP villages are positive. They consider DAFEP as useful in helping them to acquire new knowledge and skills, in improving their understanding that management, planning and bookkeeping is important for the progress of their farm business. DAFEP recognizes the existence of master-farmers (*petani ahli*) in the villages and their capabilities for training other farmers. DAFEP is also instrumental in bringing farmers closer to each other through meetings, training activities, and planning exercises, etc. Farmers feel that they are being treated as human beings. This is the main reason for their positive response to DAFEP. Their latent energies, suppressed for a long time, found an outlet opened up by DAFEP principles. Dormant farmer groups are awakening and become active in planning and training exercises. In a relative short time DAFEP proves to be applicable as an extension concept and as an operational organization for empowering farmers.

It is worthwhile considering the possibilities of re-installing extension workers as national employees to secure their position and careers as functional extension officers and their mobility for transfer to other areas where they are needed. They should be seconded to the district extension office and report to its chief without jeopardizing their accountability to the farmers. A strong continuous training program and a HRD plan for those extension workers should be further developed to strengthen their position as partners of village farmer trainer and facilitators of farmers' activities. The apparent success at this early stage of the duet of farmers and extension workers is a firm foundation for the continued implementation of DAFEP principles. Continued support from the District Extension Office will further strengthen this foundation, especially by an attitude with the spirit of DAFE.

There is a need for improving the understanding of district officials and district parliament members. They should grasp the importance and the strategic position of agriculture extension as an investment for the development of agribusiness leading to increased economic activities and higher incomes of the rural communities. They should understand that a prosperous rural community will contribute substantially to the district PAD (District Treasury) and therefore the provision of funds for extension activities and for the running of the district extension office should be improved and sustained.

A continuous effort should be made to build a spirit of solidarity and understanding from other *Dinas*/Institutions at the district as well as at the national level. A strong ministerial policy statement and its strong implementation, that DAFE is the National Agricultural and Forestry Extension System could overcome the long history of independent sub-sectoral chauvinism and quarrel about a unified or a diversified extension organization. In this connection the promulgation of National Extension Law is urgently needed. Measures to that effect have already been taken by the agency for agricultural HR development and parliament is favorably cooperative toward that end.

The need of sub-sectoral institutions for personnel in their discharge of their duties in rural area can be overcome by strengthening the sub-district agricultural office with the appointment of agricultural officers. Their duties would be in the service and regulatory function of Agriculture Administration. The common practice of using extension workers for service and regulating functions should not be allowed to happen again. The creation of PPL (field agricultural extension worker) in the early 1970's separated from the post of sub-district agriculture officer is for the sole purpose of educating farmers.

The Seventh Paper:

IMPLEMENTING AGRICULTURAL TECHNOLOGY PROMOTION AND TRANSFER PROGRAMME: THE MALAYSIAN EXPERIENCE

Zulkifly Mohd Zain and Mohammed Selamat Madon

(Malaysian Agricultural Research and Development Institute – MARDI)

Aggressive measures have been to establish linkages with the various Federal and State agencies entrusted with extension and overall development of agriculture. The plans involves development, promotion, and transfer of technology and focuses on commodities and entrepreneurship development in the food processing industry.

Malaysian Agricultural Research and Development Institute adopts three main strategies to ensure the effectiveness of its programme:

i. Aggressive “Industry Linkages and Technology Promotion” to the target group.
ii. Conduct “Technology Development, Transfer and Commercialization” projects based on the developed technology, with active participation of the target groups.
iii. Provide quality “technical Support Services” to the target groups.

The successful ATT & T and commercialization program mechanism include training, technical advisory services, up scaling, pilot project implementation and large scale commercialization. The success of the mechanism, highlight the importance of Research – Extension –Farmers – Private sector linkage on ATT & T and commercialization. It also illustrates the importance of public-led ATT & T in determining the success of agricultural development.

The continued active participation of the private sector is also essential for the successful implementation of ATT & T and commercialization in line with the National Agricultural Policy. The public sector will facilitate and enhance the delivery of support services to farmers and private sector enterprises to achieve their income and business objectives.

The Eighth Paper:

FARMERS · PARTICIPATION, INCLUDING WOMEN AND YOUTH FARMERS, IN THE IDENTIFICATION OF FARMERS · TECHNOLOGICAL NEEDS AND PROBLEM SOLUTION IN KOREA.

Woo Gun Lee
(Public Service Center, Rural Development Administration, Korea)

After Korean War, the resource less poor country faced by problem of starvation. In 1906, the Agricultural Demonstration Station was established for primitive agricultural experiment and research in Korea. After the national independence (1948), the Korean War (1950~3), and the passing of the Agricultural Extension Law (1957), a modern type national agricultural extension service system was developed as a post-war rehabilitation. In that time, there were overlapping and competition between the agricultural extension and community development. Thus, in 1962, agricultural and community development and other related functions of various organizations were integrated under the Rural Development Administration (RDA).

The RDA developed high-yielding rice varieties and well-educated extension agents disseminated the new technologies with various extension methods. It took about 20 years to achieve self-sufficiency in the main food and 10 more years in year-round fresh

vegetables. FAO and many countries report this agricultural development a successful case.

However, from the beginning, the research results were transferred to the farmers by a "top-to-down" enforcement type through the government's bureaucratic organizations. It was not a perfect method for the farmers. In the 21st century, the resource-less Korean agriculture faced other problems too. Government-supported and protected agriculture could not expect a more subsidy from the government. It has to compete with advanced countries under the WTO system. Now, the agricultural extension service receives many kinds of requests from various clienteles, while its personnel are decreased year by year.

In this aspect, 'Farmer Participation in the Identification of their Technological Needs and Problem Solution' can be a very useful strategy for not only one country, but also for many other countries. In providing this strategy, extension agencies have to identify and review the farmers' technical felt needs, unfelt needs and problems, as well.

It is recommended that to widen the clientele from farmers to consumers, related institutes and all the other areas should be available to collaborate. Based on experiences, farmers may need to co-operate with related institutions and on the contrary the related institutions may need their helping in the near future. Expected to exchange much of mutual interests and each other experiences of APEC member economies.

The Ninth Paper:

AGRICULTURAL EXTENSION IN BRUNEI DARUSSALAM

Haji Anjah Haji Abdul Rahman
(Head Quarter Agriculture Department, Ministry Of Industry and Primary Resources,
Negara Brunei Darussalam)

On the 15th April 1985, the Department of Agriculture launched an agricultural extension system called Training and Visit System (T & V). This system is locally known as “Latihan dan Lawatan” or in short “2L”. In the support of the 2L system, the Department of Agriculture has published a number of pamphlets describing the methods/ technologies of selected agricultural activities. At the same time, the information unit had organized a series of radio and TV programmes.

The integrated approach of the agricultural extension started in 1992 i.e. when R & D was formed. This approach has combined the efforts and capabilities of both research and extension to trigger the pace of agricultural development in the country. The integral part of agriculture extension is the Livestock division, which has contributed a lot in the

development of the livestock farmers. Integrated approach of agricultural extension takes into consideration the "2L" system of training and visit to strengthen the commitment of the extension agents in total agricultural development programmed. The components of the research are combined with all aspects of extension to direct agricultural development. In this manner linkages between research and extension could be strengthened to benefit the farmers.

The commodity approach started soon after the formation of the first three Divisions namely the Agro technology Development Division, Crops Development Division, and Livestock & Veterinary Services Division. Research works are based on commodities such as vegetables, fruits, field crops, livestock etc. In order to establish linkages between the Research group and the Extension group, the District Agricultural Extension also follow the same trend, which reflected directly in its organizational structure. Commodities included in the structure are vegetable, fruit, rice and other crops. Each commodity is headed by a supervisor who is responsible for all aspects of commodity development in the district. He has direct access to all extension workers to implement the farmers' development programmes.

Besides the above mentioned extension systems, there are a few other approaches done by the Government which are considered of equal importance. In 1980's, the Ministry of Education has introduced Agricultural Science subject in a few selected secondary schools. In this connection, Sinaut Agricultural Training Centre (SATC) started it tertiary level of education in 1983 by offering Diploma Course in Agriculture (BNDA). In 1985, SATC has broadened its scope of diploma course by offering BNDA in agricultural engineering (BNDAE). The government departments and private sectors employed graduates of this center. Some of them overseas for further studies and some have started farming. Now the course is taken by Ministry of Education.

In strengthening the capabilities of the farming community in sustainable agricultural production, DoA has conducted training programmes for the personnel and producers. DoA also collaborates with international institutions where in 1999 and 2000; DoA and Commonwealth Fund Training Centre (CFTC) have jointly conducted training on management and production of agriculture. Farmers Resettlement Project was originally known as Young Farmers Project. Participants of this project were the trainees of SATC who successfully completed the two-year course. Each of them were given a 10 acres land to develop. They are the main target of the transfer of technology and their performance are monitored from time to time.

The rural farming communities are recognizing to formulate proper strategies that will contribute significantly to commercial agricultural production. These programs cover development of basic infrastructure like roads, water and electricity, marketing information system, promotion of farmers participating in the marketing if their produce

and product promotion at both domestic and international levels. The collection and dissemination of market information are made available and for the benefit to the farmers, so as to stabilize prices and minimize and spoilage and waste of agricultural produce. However, the success and effectiveness depend much on the system of network with which market information has been collected, analyzed and disseminated to the cooperatives community for production planning.

The development of agricultural industry in 2003 revealed upward trends of production outputs and revenues in all the sub-sectors and food-based primary industry. Both the two main groups of industries, livestock industry and crop industry, have made good inroads in increasing outputs with the active participation of entrepreneurs as well as the assistance from the Department of Agriculture in promoting technology and farming management system, which have brought much improvement to the agricultural industry in this country.

The Tenth Paper:

STRATEGIES TO STRENGTHEN EXTENSION SERVICES FOR AGRICULTURE TECHNOLOGY TRANSFER AND TRAINING: THE PNG EXPERIENCE

Geovaning P. Bilong and Samuel B. Lahis
(Agricultural Extension, Papua New Guinea)

The Government of Papua New Guinea transferred the agricultural extension function, which includes transfer of husbandry skills, knowledge, new or improved technologies and management skills, to the Provincial Government in 1997. Since the transfer, the agricultural extension services have been dysfunctional due to no financial resource support, lack of capacity of personnel as well as institution, low staff morale, poor mobility and poorly coordinated government organizations.

A pilot project named Smallholders Services Pilot Project (SSSPP) was established that was designed to develop an improved extension system that would address three issues: (i) improve delivery system that is flexible to meet the wide range of issues faced by general extension system; (ii) improve the capacity of the extension staff to be able to provide effective extension and (iii) improve productivity and production from smallholder sector. There are four key results of the SSSPP, namely: (i) performance based contract extension delivery system, (ii) farmers actually accessing services, (iii) capacity of extension staff developed and (iv) development of program coordination system.

Some lessons learned are (i) performance based contract extension is an effective way of providing extension, (ii) use of farmer expert is a very cost effective system, and (iii) some technologies may have to be modified to suit the needs before being transferred to farmers. The implication of the SSSPP, therefore, that the contract extension is promoted at national policy as effective way of providing general extension, and the processes in developing needs to be institutionalized.

Field Training and Poster Session

Field Training was arranged during the trips of participants from Jakarta to Bandung via northern route and from Bandung to Jakarta via southern route, and between paper presentation sessions. During the field training, the participants had opportunity to interact, share information and experiences with farmers, including women farmers, entrepreneurs, researchers, extensionists and other interested parties on agricultural technology transfer and training. The objects displayed, observed and discussed during the field training, among others, were:

1. Breeding of crops to have high yielding varieties;
2. Rural industry by women farmers' group;
3. Organic farming managed by women;
4. Floriculture;
5. Farmers Rural Training Center, initiated and managed by farmers' group;
6. Non-conventional agricultural culture such as hydro phonic and aero phonic cultures;
7. Results of partnerships activities between researchers, extensionists, farmers and entrepreneurs in generating as well as adopting technologies.

Posters showing some contributed papers were displayed in the lobby adjacent to the seminar room. Participants discussed the posters during seminar breaks and on the poster session at the end of the seminar sessions. Posters and contributed papers supplement the invited papers and with the following fields: development of integrated crop and resource management, the importance and utilization of agro-ecological zone maps to reduce production inputs, pest- disease and weed control, efficient technology, modeling livestock-crop integration, application of some indigenous bio-pesticides, experience in implementing farmers led extension and market structure on agricultural technology transfer.

Action Plan

The participants of the APEC Training Workshop endorsed the action plan for 2004 – 2006, particularly the plan of 2005 entitle "Seminar on Networking of the

Agricultural Technology Transfer". The participants, however, suggested the following aspects to be considered in the action plans: (1) sharing experiences, information as well as evaluation of the existing networks, in respective member economies, (2) develop data base on ATT & T, (3) include farm machinery, agricultural engineering, post harvest technology in extension, (4) invite NGO to actively participate in the seminar, (5) exchange trainings and visits for farmers among member economies, (6) strengthening cooperation among cooperatives in member economies, (7) elaborate marketing aspects of agribusiness in the village, (8) possible alternatives of the top-down and bottom-up approaches, and (9) intensifying partnerships between farmers and private sector, researchers and extensionists.

Training Workshop Conclusion

The active discussion of the most of the participants and the reaffirmed relevance topic to agricultural technology transfer and training in the APEC member economies indicated and manifested the importance of technical cooperation and communication through the Training Workshop. The Workshop reaffirmed the importance of the strategies for: (i) formulating the efficient agricultural technology and value added agricultural technologies; and (ii) strengthening extension system by intensive involvement of farmers in accelerating technology transfer and improving training.

The Training Workshop gleaned a number of "Lessons Learned" from several program experienced and shared through the Member Economy Presentations and discussion during the Field Training. There were three important topics discussed and agreed:

1. Efficient technology implementation identified:
   h. Cropping system to control plant diseases on vegetables. To address the problems of plant diseases caused by fungi or bacteria, such as clubroot, yellows bacterial, crop rotation with sweet corn, introduction of resistant radish varieties as trap crops or inoculation with endophytes have been applied. Injury caused by nematodes is also a serious problem. Practical methods using antagonistic plants such as marigold have been developed, because only one season is required to introduce these plants with only minor changes in the cropping systems. Selection of crop combinations is essential. Experiences of crop rotations and several cultural practices in high land areas in Indonesia for controlling clubroot and bacterial wilt disease are also reported.Agro-Ecological Approach to generate local specific technology in Indonesia using the expert system. The AEZ approach combined with socio economic factors and transportation and other technologies looks promising to

address various and complex conditions of Indonesia in developing efficient and sustainable agricultural production system.

i. Market demand driven technologies such as hydro-phonic technology to increase quantity and quality of vegetables was shown during field visits.
j. Minimizing production inputs through the Integrated Farming System was observed during field visit.
k. Make use of farmers' experiences as indigenous technology that proofed to be sustainable and economically viable.

2. Role of Women in agricultural production:
   a. Women farmers have more roles on rural industry and non-machinery processing.
   b. Equal diversification of the roles in agricultural activities between men and women.
   c. There is a need to intensify women program in agricultural development.
   d. Women farmers club appear to be potential in intensifying women roles.

3. Transfer of Technology systems and strategies:
   a. Participatory approach in agricultural extension systems to accelerate transfer of technology with focus on satisfying farmers' need.
   b. Research-Extension-Farmers-Private sector spur the transfer of technologies.
   c. Capacity building for extension personnel is needed to improve competencies in order to be able to cope with dynamic needs of farmers as influenced by globalization.
   d. Provide training for young farmers to sustain availability of people to deal with agricultural production and to prevent urbanization.
   e. Training farmers by farmers is potential in increasing farmers' income without any burden additional budget that farmers cannot afford.

Closing Session

Director General, The Indonesian Agency of Agricultural Human Resource Development in his closing remark pointed out that the Training Workshop has achieved the expected benefit of the Workshop by intensive discussion on 10 invited papers with in twice half-days in the classes and two days in the field training during 4 days of the training workshop. In addition several farmers activities that related to the topics being discussed have been visited and we agreed that intensive discussions during the training workshop have enriched the content of the papers and we have gained fruitful result from the workshop and have taken another one step closer to the ultimate goal of "increasing farmers' income and self- reliance"

Annex 1
Report of the Training Workshop 2004.

Action Plan for 2005 and 2006

The suggested Agenda for the future has been discussed and come up with the agreed following Action Plan for 2005 and 2006:

Plan for 2005: Seminar on Networking of the Agricultural Technology Transfer and Training

1. Objective

The objective of the seminar is to exchange information on the implementation of agricultural technology transfer and training among member economies to promote agribusiness in the village, reducing the distance between farmers and consumers and formulating efficient network among research institutions, extension services and farmers' organizations.

2. Methods

In the seminar exchange information, experience, idea and practices is directed to identify:

1. Technological aspect on how to promote agribusiness in the village and how to reduce the distance between farmers and consumers, through:
    a) use of indigenous technology and locally available products in agribusiness;
    b) consider local wisdom in formulating strategies on utilization domestic resources to strengthen its comparative and competitive advantages;
    c) promoting agribusiness in the villages;
    d) post harvest technology such as harvest handling, processing of agricultural products, effective and efficient transportation in order to maintain the quality of agricultural products and meeting the needs of consumers with environmentally concerned.
    e) development of technology and machinery for small-scale agribusiness and post harvest.
    f) developing strategy to reduce distance between farmers and consumers.
2. Technological transfer and training aspect on how to make efficient network among research institutions, extension services, and farmers organization to achieve the increase of farmers' income and promote self-reliance, through:
    a) intensive use of available information technology globally, nationally as well as locally to anticipate unavoidable negative impact of globalization;
    b) making information available on market and price of agricultural products, agricultural production inputs, technology etc necessary for farmers and farmers' organization;
    c) capacity building of trained personnel, particularly women, to handle information technology for efficient networking nationally, provincially and locally, in order to widen access of information needed by farmers and farmers organization;
    d) formulating and developing an efficient network among research institutions, extension services and farmers' organizations in order to increase farmers income and to promote their self reliance;
    e) intensifying the roles of farmers and their organization in providing specific information to the information network directed to increase farmers' income and to promote self-reliance, such as socio-economic cultural conditions of farmers, farmers need and problems.

Plan for 2006: Workshop on the Utilization of the ATT&T Networking System

1. Objective

The objective of the workshop is to exchange information and experiences on the implementation of the utilization of ATT&T Networking System among member economies to accelerate the access of farmers on information on agricultural technology and agribusiness for the purpose of increasing farmers income and self-reliance.

2. Methods

In the workshop exchange of information, experiences, ideas and practices among member economies are directed to identify:

1. The Networking System aspect on the experiences in using the ATT&T Networking System, particularly on:
    a) the strength of the system in channeling information to farmers and other users as well as prospective customers and potential stakeholders
    b) problems encountered in managing the ATT&T Networking System
    c) ideas to improve the system.
2. The farmers access to information through ATT&T Networking System particularly on how the ATT&T Network could provide benefit to the farmers, through:
    a) speedy access of needed information by farmers;
    b) obtaining appropriate markets for farmers' products;
    c) obtaining information on consumers' preferences for agricultural products.
3. The training aspects particularly on how to provide knowledge and skills to the ATT&T Networking System users and operators, such as:
    a) problems in training ATT&T Networking Operators at local level
    b) problems in training farmers and other end-users
    c) new training methods in training ATT&T Networking System operators, farmers and other end users.

Expected specific benefits

- Finding new technologies for the senior government officials and farmer leaders to increase agricultural production, developing agribusiness in village, reducing distance between farmers and consumers, and promote value added agricultural products
- Finding some strategies to meet farmers' needs and solve their problems Influencing specific agricultural technologies
- Finding new system of training opportunities and education for ATT & T by utilizing farmers organization
- Finding new ATT&T Networking System to accelerate farmers' access of information on technology, markets of agricultural products, consumer

behavior and other information from local, national, regional and international information sources in anticipating negative impacts of globalization.

Expected specific beneficiaries

The primary beneficiaries will be the participants of the seminar and the workshop. However since the participants are senior government officials and farmers leaders directly involved in ATT & T of the respective APEC member economies, it is expected that they will make use of the results of discussions and some conclusions for their consideration to formulate the policy on ATT & T to increase farmers income and promote their self reliance.

WELCOMING SPEECH

by :

Dr. Ahmad Dimyati

PROJECT OVERSEER OF AGRICULTURAL TECHNOLOGY TRANSFER AND TRAINING (ATT&T)

Dr. Se-Ik Oh, Lead Sheperd of APEC ATC-WG

Dr. Takeo Makino,Co Sheperd APEC ATT&T

Dr. Achmad Suryana, Director General of IAARD

Distinguished Delegates, Ladies and Gentlemen,

First of all, as the project overseer and the Chairperson of the Organizing Committee of the Training Workshop, I would like to warmly welcome you in this very important occasion. I also would like to take this opportunity to express my deep appreciation to all participants from the APEC member economies to join this gathering, even one of the participants came from very far distance, Chile. Your participation and contribution in this workshop indicate your interest to review, discuss and share experience in the dissemination of technology.

Ladies and gentlemen,

The first seminar on Agricultural Technology Transfer and Training. (ATT&T) was held in Yogyakarta, Indonesia, on 20 -22 February 2001. It focused on farmers' participation in agricultural technology transfer. Several problems behind the lack of participation of farmers were identified, which resulted in little success in improving farmers' income and welfare.

The second Seminar held in Denpasar, Bali on 24 – 26 July 2003, which had successfully identified the important factors in improving farmers income and promoting self reliance welfare such as technology and ATT&T aspects. The second seminar recognized the importance of sharing experiences, methods and strategies on formulating efficient technologies for agricultural production and value added agriculture products, and strengthening farmers led extension system through partnerships among researchers, extension personnel and farmers leaders of APEC member economies.

Distinguished Participants,

To implement the AGENDA, therefore, we conduct the third seminar, that we are about to begin shortly, here in Jakarta and Bandung, from 18 to 22 July 2004. During this seminar we will discuss two groups of topics: (1) Strategies for formulating the efficient agricultural production technology and value added agricultural product and (2) Strategies to strengthen extension services, for agricultural technology transfer and training.

To enrich the Seminar, there will be 9 (nine) seminar papers to be presented by invited speakers from APEC member economies, and poster papers from Indonesia. This Seminar is attended by 22 Delegates from 10 member economies and 29 delegates from 19 Provinces in Indonesia consisting of research and extension institutes, research and assessment institutes, universities and farmers group leader (KTNA).

Distinguished Participants

It is my pleasure to inform you that on the way from Jakarta to Bandung on July 19 we will visit (1) Indonesian Institute for Rice Research (IIRR) at Sukamandi, in which President Megawati Soekarnoputri visited yesterday to commemorate the Grand Opening of National Rice Week as a series of activities and a part of International Year of Rice 2004. (2) Farmers to farmers Agribusiness Development Training Center at Lembang, Farmer Woman Group village agro industry producer, and Organic fertilizer and pesticide technology.

The Training Workshop will discussed 9 papers and will take place in Bandung, West Java, we called Bandung as the Paris of Java on July 20-21. The last day, July 22 on the way back from Bandung to Jakarta, we will visit and meet with Horticulture Farmers and visit Indonesian Ornamental Crops Research Institute (IOCRI) at Segunung, Puncak .

In order to complement the technical and scientific discussion, the workshop will combine class discussion with fields training. After some discussion in the room, the participants will have the opportunity to observe the Indonesian farmers' activities related to the presented topics to supplement and sharpen the discussions. In addition, poster session will present the contributed papers that cannot be presented during plenary sessions. Therefore, during this Training Workshop, you are not only discussing but also observing how Indonesian farmers increase productivity using efficient technology, roles of farmers in organizing training for other farmers, efforts made by women farmers in making use agricultural by products through rural industry, efforts of farmers in getting good price for their agricultural products and other related activities. Through these observations, you will obtain the real picture of the farmers' problems and its solution opportunities. The discussion, therefore, will be based on reality and will not be dominated only by theories.

During the trip, participants and observers will have the opportunity to discuss and exchange views and experiences with local researchers, extension personnel, farmers and farmers' leaders concerning the identification and implementation of suitable local specific technologies and promotion of value added agricultural products as well as the roles of farmers' organization for ATT&T.

Ladies and gentlemen

In this opportunity, I would like to express our sincere appreciation to the Organizing Committee member for the long preparation all supports to this Seminar.

Finally, please accept our apologies for any inconvenience that might arise during this workshop. It is our pleasure to have you here and participate in fruitful discussions. I wish that you all will have a memorable stay in Jakarta and Bandung, Indonesia.

I do believe that your attendance and active participation in the discussions will greatly contribute to achieve the objectives of our Training Workshop. Thank you.

Jakarta, July 18, 2004.

OPENING SPEECH

By :

Dr. Achmad Suryana

THE DIRECTOR GENERAL OF THE INDONESIAN AGENCY FOR AGRICULTURAL RESEARCH AND DEVELOPMENT THE MINISTRY OF AGRICULTURE OF THE REPUBLIC OF INDONESIA

Dr. SE IK OH, Lead Shepard of APEC-ATC Working Group,

Representative of the Ministry of Agriculture, Forestry and Fisheries – Japan, Dr. Takeo Makino

FAO Representative in Indonesia

Representative of National Secretariat - SEKNEG

Representatives of the Provincial Governments

Distinguished Resource Persons and Participants,

Ladies and Gentlemen,

First of all, please allow me, on behalf of the Steering Committee of the APEC Training Workshop on Agricultural Technology Transfer and Training, to express my deep gratitude and sincere thanks for your attendance and participation in the Opening Ceremony of the Training Workshop. It is a great pleasure to welcome you all to this gathering in Jakarta. The training workshop itself as Dr. Ahmad Dimyati mentioned, will be started by field training in Sukamandi, a two-day seminar in Bandung and ended by another field training in Segunung. I hope you will enjoy the entire programs of the workshop until the last day back to Jakarta.

Distinguished Participants

Ladies and Gentlemen,

The APEC Agricultural Technical Cooperation Working Group (APEC-ATCWG) was established in Bogor in 1994. The group shares the view that agricultural technical cooperation, together with the development of agricultural resources will lead to improvements in production capacity, capability, and food variety and quality. The ATCWG initiative provides an opportunity to enhance the ability of agriculture and its related industries to contribute to the region's economic growth and social welfare.

The APEC Agricultural Technology Transfer and Training (APEC ATT&T) is one of seven areas for cooperation among member economies, where Indonesia has been appointed coordinator and Japan as co-coordinator. This area is still very important since the Asia-Pacific region is still facing many difficulties, one being disparities between food supply and demand. To response to some of the challenges, the APEC Food System was launched to focus on the three goals : (a) the development of rural infrastructure, (b) the promotion of trade in food and (c) the dissemination of agricultural technology. I believe that all the APEC member economies agree that the dissemination of technology is especially important.

Ladies and Gentlemen,

We have learnt that food shortage in the world will still be a serious issue in the next decade. The world population is forecasted to reach 8 billion by 2020, far exceeding the food production rate. Centralized top down policy and heavy subsidies implemented by many countries have increased agricultural production, however these have not been sustained. The adoption and implementation of agricultural technology to increase food production is a top priority.

A campaigned for the adoption of new technology has been undertaken intensively, however, farmers as the main actors of agriculture development have not yet benefited of the development in term of family income and standard of living. Therefore, suitable, transferable, sustainable, and acceptable technology that needed by farmers must be identified, formulated, and disseminated to the farmers properly.

One of the most important factors to be considered in order to achieve successful agricultural development in terms of benefiting the farmers is to find out the appropriate technology and extension methodology that can be easily transferred and adopted by farmers as the end users.

The Training workshop in Bandung focusing on two issues: Firstly, Strategy for formulating the efficient agricultural production technology and value added agricultural products, and Secondly, Strategies to strengthen extension system, by intensive involvement of farmers, in accelerating technology transfer and improving training. The purpose of this workshop is to share our experiences on the method and strategy for increasing farmers' income and promoting their self-reliance through efficient technologies for agricultural production and value added agricultural products, and strengthening farmers led extension system. I hope the meeting and the field trip would be beneficial to the participants.

Ladies and Gentlemen,

Further, on behalf of the Steering Committee of the Training Workshop, please accept our apologies for any inconveniences that might arise during your stay in Indonesia. It is our pleasure to have you here with us and hope all participants will enjoy the discussion, exchange of information and experiences as well as observation of farmers' activities and obtain fruitful results from the workshop. I further wish that all of you would have a pleasant and memorable stay in Bandung in particular and in Indonesia in general. It is my fervent hope that your attendance and active participation in the ensuing discussions will greatly contribute to the achievements of the objectives of the Training Workshop.

In this opportunity, I would like to express our sincere appreciation to Dr. Se-Ik Oh, The ATCWG Lead Shepherd; Mr. Takeo Makino Assistant Director Ministry of Agriculture Forestry and Fisheries, Japan; APEC Secretariat; the Local Government and Organizing Committee for their close cooperation in supporting this training workshop.

Last but not least, I wish you all a very fruitful workshop and enjoyable stay in the popular tourist and culturally rich city. With the spirit of the Asia Pacific Economic Cooperation, I now declare the Training Workshop on Agricultural Technology Transfer and Training officially opened.

Thank you.

Director-General of IAARD

Dr.Achmad Suryana

All delegates were taking picture after opening ceremony

Dr. Achmad Suryana. DG of IAARD was delivering opening speech

Some delegates from member economic presented at seminar

Some delegates were observing hydroponic technology while visiting Horticultura Agribusiness Training Center

The delegates were enjoying cultural show “Singa-singaan Dance” at Indonesian Institute for Rice Research

Some delegates were listening seriously the presentation, at the left Dr. Se-IK OH is the leadsheperd of ATCWG

Indonesian delegates were singing together in the informal dinner

Delegates were enjoying the field visit to farmer's farming in Lembang

IMPORTANCE OF CROPPING SYSTEM AS THE BASIC TECHNOLOGY FOR LOW INPUT SUSTAINABLE AGRICULTURE IN INTENSIVE VEGETABLE PRODUCTION

CROP ROTATION AND SEVERAL CULTURAL PRACTICES

Mitate Yamada[1]

ABSTRACT

As vegetables are often grown under continuous cropping in Japan, injury associates with continuous cropping is frequently observed. Although the methods of control are based on the use of chemicals, the importance of promotion sustainable cultivation and environment-friendly technologies is being increasingly recognized. Plant diseases caused by fungi or bacteria, such as clubroot, yellows bacterial wilt are major problems. To address these problems, crop rotation with sweet corn, introduction of resistant radish varieties as trap crops or inoculation with endophytes have been applied. Injury caused by nematodes is also a serious problem. Practical methods using antagonistic plants such as marigold have been developed, because only one season is required to introduce these plants with only minor changes in the cropping systems. Selection of crop combinations is essential. Taro (*Colocasia esculenta* Schott.) is severely damaged by a root lesion nematode (*Pratylenchus coffeae*). By examining the degree of suppression of this nematode by many kinds of crops, determination of crop sequence efficiency became possible for the control of nematodes and offers a wider range of selection of crop combinations. Taro is injured by *P. coffeae* and by the root knot nematode (*Meloidogyne incognita*), while radish (*Raphanus sativus* L.) is attacked by the root lesion nematode (*Pratylenchus penetrans*). The combination of these two vegetable crops with a third one, such as vegetable soybean (*Glycine max*), can minimize the injury caused by these three nematodes.

Experiences of crop rotations and several cultural practices in high land areas in Indonesia for controlling clubroot and bacterial wilt disease are also reported.

Discipline: Horticulture

Additional key words: injury of continuous cropping, crop rotation, trap crop, nematodes, antagonistic plant, clubroot, cabbage, radish, taro

[1] Crop Production and Environment Division, Japan International Research Center for Agricultural Sciences (JIRCAS)

INTRODUCTION

In Japan, vegetables are usually grown under continuous cropping, due to the small scale of land ownership and to promote effective use of fields, machines and markets. Several diseases of vegetables are caused by continuous cropping such as bacterial brown rot, fusarium wilt, clubroot and black rot, yellows in addition to nematode injury. Although the control measures of these diseases are based on the use of chemicals, the importance of promoting sustainable cultivation and environment-friendly technologies is being increasingly recognized. Therefore, crop rotation seems to be a key technology to address these problems. Though crop rotation technology is important, it must be flexible, clearly defined and attractive to the farmers. To control nematodes, practical methods using antagonistic plants such as marigold have been developed. Selection of crop combinations is generally the most efficient measure to control nematodes, but it is difficult to achieve. Several researchers have succeeded in introducing antagonistic plants or crop rotations[4,14]. However, the kinds of antagonistic plant species are limited and the plants usually have no economic value. It is also difficult to identify the optimum rotation in terms of duration and to select the best sequence.

Regarding cropping systems and cultural practices, appropriate systems or practices must be utilized or adjusted to the prevailing natural and economic conditions. Therefore, a large number of methods must be developed and evaluated for the adoption of the best technology. In highland areas in tropical countries, air temperature range is similar to the spring or autumn in Japan throughout the year. It make easer to grow Curusiferae plants, such as cabbage, Chinese cabbagge throughout the year and it lead to sever damage by clubroot. In another hand, effect of crop rotation in these areas might progress more rapidly than in Japan. Adoption of an improved crop rotations is more easier for the farmers in these areas because of short term crop rotation, less limitation by usage of machineries and easy finding of alternative crops. Methods to identify suitable cropping systems or to determine the applicability of technology are also suggested.

CULTIVATION METHOD TO CONTROL PLANT DISEASES

Suppress Cabbage Clubroot Ddisease *(Plasmodiphora brassicae WORONIN)* by Combination with Sweet Corn

Summer in Japan is very hot and humid like in a tropical country and it is very difficult to grow temperate vegetables such as cabbage. In highland areas, farmers are able to produce good quality cabbage and obtain a good income. Therefore, they grow cabbage over wide areas in their farmlands, which results in continuous cropping of cabbage and leads to diseases associated with continuous cropping, for instance clubroot, black rot, etc. To avoid clubroot injury, they apply a large amount of chemicals. In spite of their efforts, the situation is becoming more serious. In one of the highland areas in Gifu Prefecture, where farmers are encountered same problems, cultivation of sweet corn has been increasing and fallow fields were also observed because of the lack of labor. Considering these conditions, Akaike[1] set up 9 plots in the continuous cropping field of cabbage as shown in Table 1.

Table 1. Effects of introduction of sweet corn cultivation

of outbreaks of cabbage clubroot				
Plot	**1988**	**1989**	**1990**	**1991**
1	SC	88	SC	49
2	SC	SC	14	82
3	SC	SC	SC	2
4	FL	95	FL	66
5	FL	FL	30	79
6	FL	FL	FL	15
7	90	100	100	97
8	42+P	50+P	64+P	48+P
9	4+C	12+C	4+C	1+C

Figures show the index of severity of clubroot(0-100).
Figures also show cultivation of cabbage.
SC: Sweet corn CA: Cabbage
FL: Fallow +P: PCNB +C: Chloropicrin

Sweet corn cultivation and fallow was inserted in 3 different frequencies to this continuous cropping field. For the control, plots with continuous cropping of cabbage with or without application of chemicals (PCNB or chloropicrin) were set up.

The results are shown in Table 1. Cultivation of sweet corn during a three-year period suppressed the outbreak of clubroot almost completely and the effect of fallow was rather limited but showed almost the same tendency. Introduction of sweet corn or fallow for 2 years did not enable to control the disease completely but was effective. Rotation of cabbage and sweet corn led to the decrease of the incidence of clubroot disease. Therefore three- or four-years rotation for cabbage cultivation in fields with severe outbreaks can be recommended. Although sweet corn was more effective to suppress the disease but the main effect of sweet corn on the suppression of clubroot was the lack of host plants in the summer season. It should be emphasized that the resting spores of *P. brassicae* survived over a long period of time in the soils but still rather short-term crop rotation can suppress the sever damage.

Radish as a Trap Crops of Clubroot Disease

Clubroot is widely observed in Japan, because not only important vegetables in the Crusiferae family, such as cabbage, Chinese cabbage, radish, cauliflower, broccoli but also many kinds of miner leafy or root vegetables are widely cultivated and most of them are host plants of clubroot. Resting spores are easily activated by root exudates from not only the root of a susceptible plant but also the root of a resistant plant[9], suggesting that the trap effect could be obtained. Recently, it has been reported that clubroot in Chinese cabbage cultivation had been controlled by using trap crops.

At first, Yamada et al.[15] cultivated resistant radish varieties and after harvest they transplanted Chinese cabbage. Clubroot disease spores were activated by radish cultivation but could not multiply in the root of the resistant radish varieties and their number was decreased. To maximize the effect, Chinese cabbage has to be cultivated carefully in many aspects such as planting position of the

seedlings, application of fertilizer and moreover re-use of mulching film to prevent the contamination with polluted soil. When the Chinese cabbage plant was transplanted, addition of 5-7 g calcium cyanamide into the holes was recommended to enhance the effects.

In another report, resistant radish varieties[12)] were grown for 2 months and incorporated into soil. In this study, radish could not be harvested, but many methods of sowing radish including broadcasting were effective. Plowing of radish must be performed one month before transplanting of Chinese cabbage to obtain good results.

Other Environment-friendly Technologies for the Control of Plant Diseases

In Tochigi prefecture, there is a famous and special cultivation of Kanpyou, bottle gourd (*Lagenaria siceraria* STANDLEY *var. hispida* HARA). Farmers traditionally grow bottle gourd with welsh onion (*Allium fistulosum* L.) because they know that damage of fusarium wilt is decreased by mixed cropping. Arie et al[2)] showed the mechanism of this phenomenon as the beneficial effect of endophytes. They showed that *Pseudomonas gladioli* multiplied in the below-ground parts of welsh onion and inhibited fusarium wilt of bottle gourd.

Yellows of Chinese cabbage is a major problem in the largest production area, namely, Ibaraki Prefecture. Watanabe et al.[13)] obtained good results by selecting resistant varieties and combining them with the inoculation of endophytes. This method can be applied in fields with mild or moderate outbreaks. Many attempts to apply these technologies have been done for many kinds of vegetables but as a general method to protect diseases, dissemination is limited because of the unstable results. However as shown in the case of Chinese cabbage, stable results can be obtained by determining the conditions of application.

CROPPING SYSTEMS TO CONTROL HARM OF NEMATODES

Simple Introduction of Antagonistic Plants into Cropping Systems

Antagonistic plants for the control of nematodes are widely used by Japanese farmers because these plants can be introduced in their own cropping systems by a minor change in the systems. For example, for the production of radish in Miura peninsula, marigold (*Tagetes* sp.) is used to avoid injury caused by the root lesion nematodes (*Pratylenchus penetrans*)[5)]. The major crop, radish, is cultivated in the winter season. Although watermelon or other vegetables are also are grown in the summer season, but the importance of these crops is not high for the farmers in aspect of their economy. Marigold can be introduced as an antagonistic plant in the summer season while radish can be continued to grow.

Several nematicidal substances have been isolated from antagonistic plants[3,10,11)]. Some of them are secreted into the surrounding soil, but to achieve a nematical effect, nematodes must be attracted to the roots where nematicidal substances are present. At the same time, other functions to suppress nematodes, such as starvation operate[7)]. Therefore without practical tests, the evaluation of antagonistic plants is difficult.

The major antagonistic plants used in Japan[7)] are listed in Table 2. Antagonistic plants No.1 to No.4 are widely used in Japan. Peanut is also a good antagonistic plant, but it takes a long time to cultivate. Then if peanut is introduced, cropping of main vegetables are limited and more it is losing its economical value due to competition with imported peanuts.

Table 2. Representative antagonistic plants for nematodes and availability in Japan[7)]

No	Plant nama	Scientfile name	Availability					
			Root knot			Root lesion		
			nematodes			Nematodes		
			Mi	Mh	Mj	Pp	Pc	Pv
1	Marigold	*Tagetes erecta*	0			0		0
		T. Patula	0	0	0	0	0	0
2	Guine grass	*Panicum maximum Steud.*	0	0	0			
3	Crotalaria	*Crotalaria spectabbilis*	0	0	0			
		C.juncea	0	0		0		
4	Oat	*Avena sterigosa*		0		0		
5	Glaucous Cassia	*Cassia glauca*		0		0		
6	Peanut	*Arachis hypogea L.*	0		0	0		0

Method to Design the Crop Combinations in the Control of the Injury Caused by Root Lesion Nematodes

Taro is severely damaged by the root lesion nematode (*P. coffeae*) even at a low nematode density. Yahiro[14)] formulated guidelines for selecting crop combinations, sequences and effective use of antagonistic plants in relation to taro cultivation. To avoid the damage caused by this nematode, the density before planting must be controlled almost at 0 level, which implies that the density at the end of the preceding plant cultivation (previous autumn) is less than 3□4 nematodes per 20 g surface soil as shown in Fig. 1.

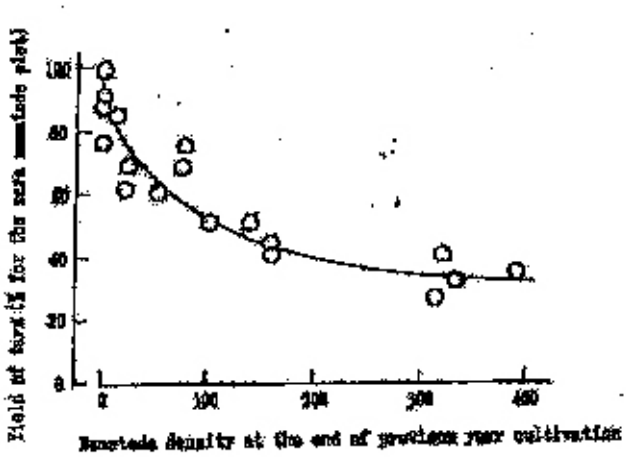


Figure 1. Effect of nematode density on taro yield [14] Unit: Number of nematodes per 20 g soil. Separated by Baermann method

This nematode is widely distributed in Japan and is parasitic on many kinds of vegetables [6]. Marigold (*Tagetes erecta* L., *T. patula* L.) and peanut (*Arachis hypogea* L.) are effective antagonistic plants for the nematode though their economical value is limited. Other plants are somewhat effective. The relationship between the nematode density at the begining of the cultivation, namely end of cultivation of the preceding crops (X-axis) and that at the end of the cultivation year (Y-axis) is shown in Fig. 2, reflecting the effect of plant cultivation on the nematode density. For example, at the end of the cultivation of sweet potato (*Ipomoea batatas* Lam. cv. Shirosatsuma; semi-resistant) there were 100 nematodes while the starting density was 300 nematodes per 20 g soil (arrow in Fig. 2.). This figure also indicates that peanut cultivation leads to a level of about 10 nematodes which may damage taro. Peanut cultivation for a consecutive period of 2 years result in a safe level (first year, from 300 to 10 nematodes; second year, from 10 to about 2 nematodes). Peanut cultivation in the first year can be substituted by the cultivation of Guinea grass (*Panicum maximum* Steud.) (300 to 30 nematodes in the first year by Guinea grass; 30 to 2 nematodes in the second year by peanut).

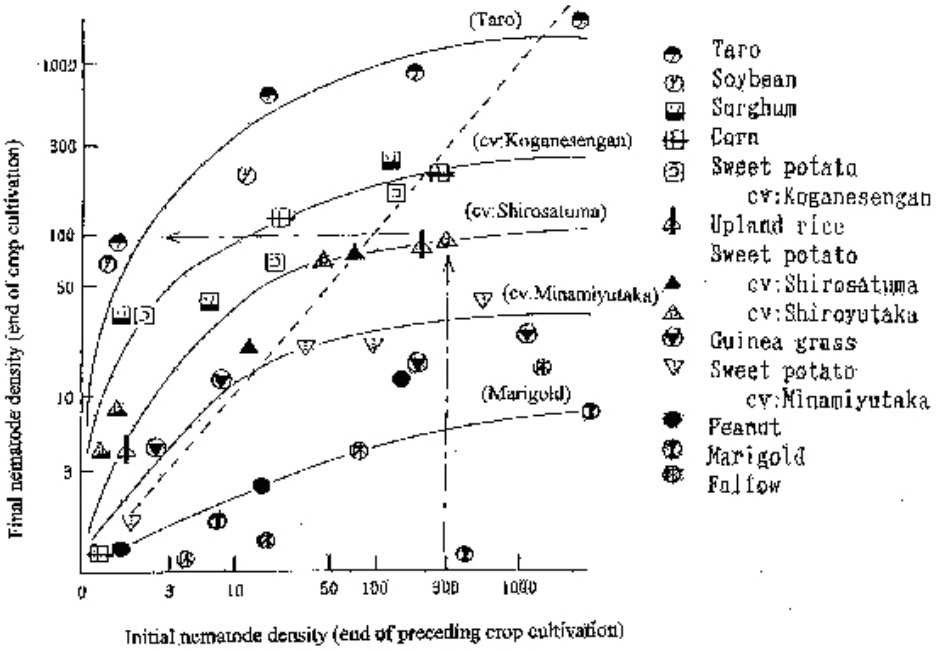


Figure 2. Effect of cultivation of several plants at various initial nematode densities on the nematode density at the end of cultivation [14]. Unit Number of nematodes per 20 g soil. Separated by Baermann method

However, cultivation of Guinea grass for 2 consecutive years may not decrease sufficiently the number of nematodes (300 to 30 in the first year by Guinea grass and 30 to 20 in the second year by Guinea grass). Drastic results can also be obtained by changing the sequence of the 2 plants: peanut - Guinea grass sequence may lead to a high nematode density (300 to 10 in the first year by peanut; 10 to 11 in the second year by Guinea grass). In the meantime, as the maximum nematode density in the given field is around 1,000, the Guinea grass - peanut sequence always leads to a safe nematode density (1,000 to 40 in the first year by Guinea grass; 40 to 3 in the second year by peanut). Almost all the curves in Fig. 2 are crossing with a 45 °line (dotted line) and are located in the upper part of the line in the low X-axis range from 0 to the crossing point. This means if the any plants are introduced at an initial density lower than the crossing point, the cultivation will lead to an increase of the number of nematodes. On the other hand, if plants are grown at a higher density than the point, the cultivation will decrease nematode density. We defined this important density as the "peculiar nematode maintained density" (PNMD). These relationships can be expressed in another way as shown in Fig. 3.

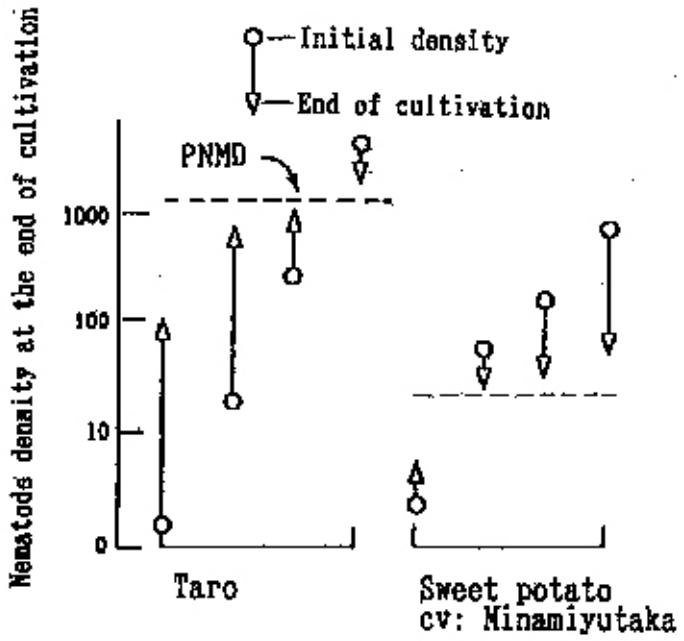


Figure 3. Effect of initial nematode density on the density at the end of cultivation[14)]

The density of nematodes reached by the cultivation of certain plants seems to move toward a certain level that is specific to the plant, hence the adoption of PNMD. If the initial nematode density is higher than the PNMD, even a plant which is usually a good host of the nematode, will decrease the density. Though the sweet potato cultivars can not suppress the nematodes completely, resistant sweet potato cultivars, such as Shiroyutaka and Minamiyutaka can be used in the combination with strong antagonistic plants. With this formula, we can estimate the results and can find the more good combination or a wider range of selection of crop species for the crop combinations.

Control of Multiple Sspecies of Nematodes by Combination of Three Host Crops

Taro is injured by root lesion nematodes as shown in Fig. 4 and the root knot nematode (*M. incognita*) while radish is attacked by the root lesion nematode (*P. penetrans*). The injury on the radish root surface decreases its marketable value, as shown in Fig. 5. Soybean is also attacked by a cyst nematode (*Heterodera glycines*) and root lesion nematode (*P. penetrans*). As a result, nematode densities were very high in every continuous cropping plot corresponding but differ the species of the nematodes to the host-parasite relation as shown in Fig. 6. Chikaoka[4)] reported that taro was not a good host of *P. penetrans* and recently Shimizu[8)] has observed that taro suppressed this nematode as strongly as fallow.

Figure.4. Injury of taro attacked by nematodes(P. coffiae)

Figure. 5. Injury of radish attacked by root lesion nematodes (P. penetrans)

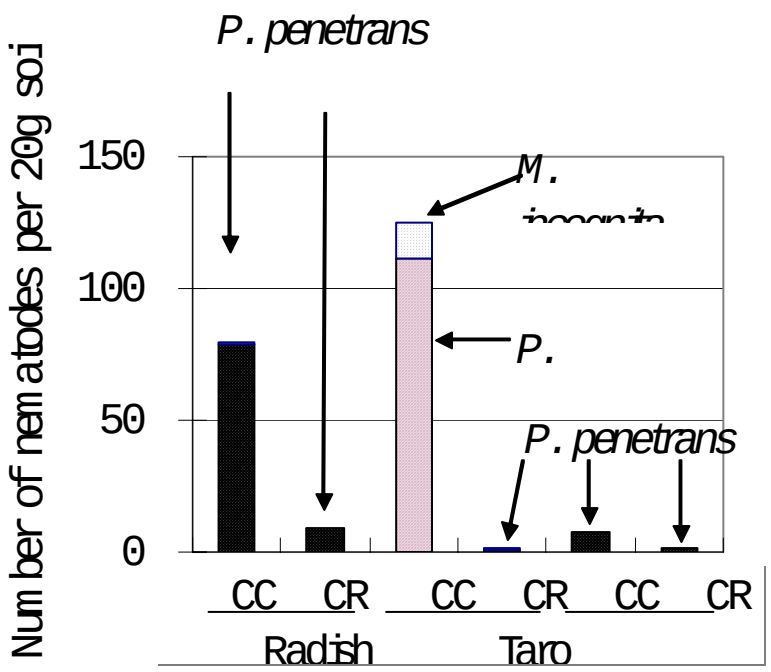


Fig. 6. Species and density of nematodes affected by crop rotation[16)]

In the crop rotation plot there was no *P. penetrans* at the end of taro cultivation[16)]. These results indicate that both soybean and radish increase the incidence of *P. penetrans*, while taro can suppress this nematode almost to a 0 level in crop rotation. For *P. coffeae*, radish is not a good host nor is soybean in the Kanto area, in the central part of Japan. As a result, a low density of both nematode species was observed in the rotation plots while a high nematode density was observed in the plot with continuous cropping. If we focus on the injury of radish and taro, a radish - taro rotation may also be effective. On the other hand, the root knot nematode of taro (*M. incognita*) does not injure severely taro, but has a very wide host range and injures tomato, melon, carrot, etc. Since it is preferable to keep the nematode density of a low level, a 3 years crop rotation is more effective. Regarding the sequence of crop rotation, the taro - radish - soybean rotation is more suitable than the radish - taro – soybean rotation, because radish is more sensitive to *P. penetrans* than soybean and the density directly after taro cultivation is the lowest. Soybean is also attacked by a cyst nematode (*Heterodera*

glycines) and the longevity of the cyst exceeds 3 years. To solve this problem, new methods have to be added.

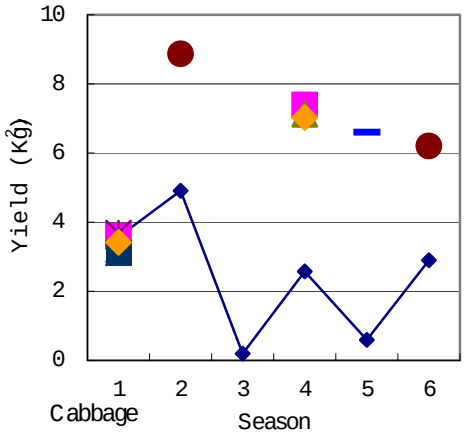
Control of Clubroot by Short Term Crop Rotation in West Java Highland

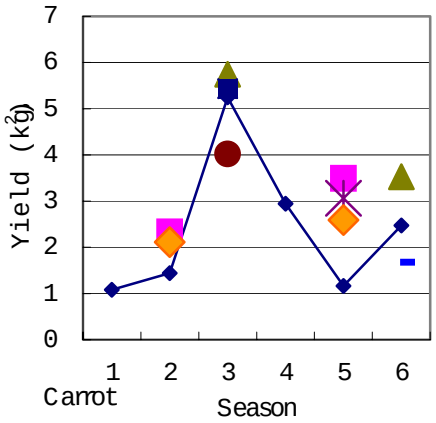
Indonesia is one of the typical tropical island countries with many mountains and volcanoes. This geographical condition is suited for temperate vegetable cultivation throughout a year, which leads to continuous or highly frequent cropping of cabbage or other Culciferae family plants such as cabbage, Chinese cabbage and so on especially in the areas close to big cities, resulting in the sever incidence of clubroot damage. To solve the clubroot problem in the cabbage production, short-term crop rotation systems, namely three crops rotation cycles within a year, were designed and investigated in field condition. The combined vegetable crops were selected from carrot and potato that are widely produced in the highland. As control, continuous cropping (C) of those vegetables was designed and two crop sequences in those crop combination (R and R2) were set up. The insertion of fallow for one cropping season (RF) was also tested because in many places cropping is limited by insufficient water supply during the dry season. Effect of insertion of corn cultivation (RC) and rotation with mixed cropping (RM) was also investigated. For the abbreviation, R stands for rotation, RC for rotation inserted with corn after every rotation of R, and R2 is rotation but in a different order of R. Consequently RC and RC2 became two-years crop rotation.

The yield trend of the continuous cropping of cabbage is shown in Fig. 7. Data connected with lines show yields of the continuous cropping (C) plots. In the first season, yields in all the cabbage plants were rather low because of improper insect management especially for control of diamondback moth but were almost the same without severe damage symptoms by the clubroot disease. From the second season until the sixth season, yields in the continuous cropping plots showed a large fluctuation but were always lower than those of the crop rotation plots or non-continuous cropping plots.

Results from the cropping systems with all combinations of rotation showed some beneficial effect on cabbage cultivation, but for evaluation of the system as a whole results from carrot and potato cultivation that were inserted as rotation should be considered. The yield trend of carrot in the continuous cropping is shown in the middle of Fig. 7. No severe damage by pests was observed. As a result, no bad effect even by continuous cropping was observed. In the 5th season, the yield of C plots was low because of the damage by cutworm, but this was observed in newly planted plots in the 6th season, indicating unpredictable occurrence.

In case of potato, wilting and dying of the top part were observed in the early stage in the C plots from the second planting and the phenomenon became more severe intensity with advance of planting. The yield of potato in the C plots was severely reduced as shown in Fig. 7. Because of growth reduction of the top part in the early stage in the C plots, tubers became smaller and the number of rotten tubers increased. As a result, weight of tubers in the C plots was almost only 1/3 of those in rotation plots in the 3rd season. The sequence of rotation did not affect to recovering of the damage in the same way as in the case of cabbage plants.


10
8
6
4
2
0
Yield (kg)
1
2
3
4
5
6
Cabbage
Season


7
6
5
4
3
2
1
0
Yield (kg)
1
2
3
4
5
6
Carrot
Season

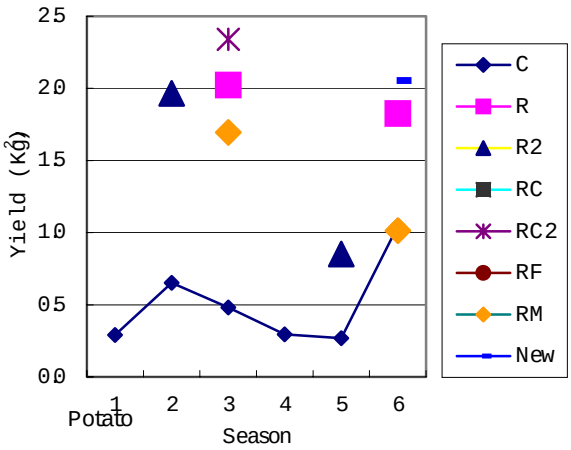


Figure. 7 Effect of crop rotation on preventing the injury of continuous cropping

FUTURE PERSPECTIVE

As mentioned above, although many environment-friendly technologies have been developed, there application in farmers' fields is not common. As a selection of cropping is decided or strongly affected by economical aspect such as price of vegetables, available capital, land ownership, labors and agricultural machineries, improved cropping systems are often conflict with framers' selection. Moreover, cropping systems are usually specific or adapted to the environment tested and difficult to generalize. So, to meke increse the range of a crop selection more wider and to make clear the process of finding proper cropping systems and the expected effects are important for adoption of these technologies. But it is very important for preventing sever outbreak of known or unknown pests and for prevention of excess use of agro chemicals and for basis of environmentally friendly agricultural technology to utilize the effects of crop combinations. Development of new technologies that are compatible with the economic and natural conditions of a certain environment is very important. In this regard, a participatory approach involving a close collaboration between researchers and farmers should be promoted to identify the most suitable technologies for specific systems.

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LESS INPUTS OF PRODUCTION TECHNOLOGY THROUGH OPTIMIZATION OF AGRO-ECOLOGICAL ZONE APPROACH IN INDONESIA (CASE STUDY IN NORTH SUMATRA PROVINCE)

Hasil Sembiring, Endang Romjali, M.A. Girsang, Darwin Harahap and Timbul Marbun

ABSTRACT

AEZ approach has been used widely in Indonesia in generating local specific technologies. This approach was used because every province in Indonesia has complex biophysical and social characteristics from one location to the other. The objective of this paper was to elaborate the experience of using the AEZ approach in North Sumatra province. This approach has been started since 1997 and the improvement on the methodology has been also made. The main factors of AEZ approach were climate, land physiographic and humidity regime. The results indicated that North Sumatra consisted of 6 zones, 11 sub zones. From the commodity zoning, it was established land suitability for certain crops and their distribution. Additional information of the zone such as P and K status for irrigated rice was made. The uses of AEZ approach in North Sumatra were as guidance for agricultural planning, intervention needed for the zone, research and dissemination plans. Another advantage of this approach was that transferring the technologies is easier because each AEZ has uniform characteristics; therefore, technology transfer should be cheaper and easier. Some of the stakeholders have allocated their own budget to follow up these works by making crop suitability maps in bigger scale. For P and K status map, it has been proven that this info could save a lot of money compared to normal recommendation.

INTRODUCTION

Agriculture production System in the future must be efficient and sustainable in order to be able to compete in the global market. In order to achieve that condition, technology used must be developed based on local resources. However, natural resources in Indonesia is various and complex from one location to the other. For example, North Sumatra province has 162 islands with various biophysical, cultures, social, ethnic, and economic conditions (BPS, 2002). Therefore, appropriate approach is needed to simplify the variation for generating local specific technology with less inputs of production technology.

Agro ecological approach (AEZ) has been developed to generate local specific technology in Indonesia using the expert system (Amien, 1992 and 1997). The AEZ is an alternative to develop an agriculture production system based on existing local resources and to formulate an efficient program formulation on research, assessment and development of the region. The main principle was to match between climate factor and land characteristics with crop requirement. The main components of AEZ were climate, physiographic or land form and soil. Since, climate is not able to change then it was used as a dominant factor (Abdurachman et. al., 1998). In addition, social economic factor and transportation and other technologies were also included in developing the agriculture production system.

The natural resources can be used as efficiently by the compatibility land analysis through agro-ecological zone. Considering of agro-ecological condition, the use of land as production system and chosen of plant can be decided in order to minimize of risk and efficiency of input. North Sumatra AIAT has implemented this approach since 1997 in designing the program and implementing research, assessment and dissemination. Therefore, the objective of this paper is to share the experience of using AEZ approach in formulating assessment program and formulating technology for agriculture system development in North Sumatra as a sample for Indonesia.

AEZ IN NORTH SUMATRA

Study of AEZ in North Sumatra has been started since 1997 and the results have been disseminated to stakeholders. In 1997, AEZ with 1:250.000 scales has been made and available for North Sumatra Province. This map was consisted of several regencies. In 2002-2003, commodity zoning has been done to compliment the previous AEZ work. Dissemination has been conducted to all regencies in North Sumatra and some regency is interested in following up the results.

The methodology of the AEZ was improved by time. At the beginning, expert system developed by Amien (1996) was used. Later, ALES (Automatic Land Evaluation System) was used to find out the suitability of crops and its distribution. These methods were still considered expensive and the improvement is being developed by Center for Soil and Agro-climate Research. The main improvement of data validation was done using aerial photo interpretation than manually ground check.

Zoning of North Sumatra

Based on these studies, North Sumatra has been divided into 6 zones (Table 1 and Figure 1) and 11 sub-zones (Table 2 and Figure 2). The information was presented in AEZ map (1:250,000 scale) for 10 regencies. In addition, agriculture is divided into low and dry land based on terrain information and land information such as texture, acidity and drainage. These maps were used as guidance for agricultural production system and commodities chosen for each production system.

Suitable crops in each zone and sub zone were also presented by the AEZ (expert system). These commodity alternatives of each production system were mainly determined by climate condition such as temperature regime and humidity regime which could be expected by elevation and rainfall distribution. In general, production system was considered of ecological preservation, biodiversity and sustainable of

the farming system, which constantly maintenance of the conservation, zone hydrologic and input of energy needed. Currently, the scale of the AEZ maps has been increased to 1:50000 in order to get better results and to be more accurate.

The map can be used as guidance to determine the suitability of the agriculture commodities by considering to other information such as market and labor availability to seek superiority of the commodities. Currently, improvement methodology has been made by using ALES (Automatic Land Evaluation System) software to find out the suitability of selected crops for a particular AEZ. This additional info combined with AEZ information was used to determine a business plan for the particular AEZ.

In the field, the use of land was not always similar to the AEZ map recommended. By comparing between the exiting land uses with the result of agro-ecological approach, the intervention can be formulated by improving of cultivation technique namely variety, plantings, fertilizer system, integrating pest management, post harvest technology and marketing system. There were two possibilities of land utility which are not recommended. The first was over utilization of land, for example the use of land which must be provided for perennial crops were used for seasonal crops. Model of intervention could be done by rehabilitation through land conservation. Intervention for land improvement can be done by the improving of irrigation system. The second was under utilization of land such as the use of land provided for intensive agriculture but it was used for forestry. The intervention model for extensively production system was done through changing of land utilization for the other utility such as for infrastructure of roads.

The AEZ map of North Sumatra available was on 1:250,000 scale, it means that 1 cm^2 of area in the map represents 625 ha of areas in the field. Currently, this scale is being used for agricultural planning guidance. This map was also used by decision makers and agriculture practices. This scale was considered to be too small for operational purposes; therefore, it was suggested to use the 1: 50,000 scale. Financial supports from local governments are needed to produce 1:50000 scale map of AEZ (Figure 3 and 4). Some local governments have collaborated with North Sumatra AIAT to provide especially financial support to make this scale map. Through agro-ecological approach using detail map, the land utilization should be more efficient.

Agro-ecological zone approach helps to select suitable commodity and technology based on local resources and make it easier to transfer the technology with the same agro ecological zone. Using similar agro-ecological zone, agricultural research could be more effective and efficient, thus the technology adoption at suitable areas can be faster.

Table 1. Land classification of North Sumatra according to AEZ (Ibrahim et.al., 1998)

Zones	Biophysics Parameter							Analysis	
	Elevation	Tempe-rature	Physiogra-phic	Parent material	Slope	Soil type	Drai-nage	system	commodities
I	50-2000 m asl	Hot	Mountain/ Hill	Volcanic ash	>40 %	Udult Udant Tropept	good	Protected forest	Natural vegetation
IIa	40-750 m asl	Hot	Mountain/ Hill/ plain	Volcanic ash	16-40 %	Udult Udant Tropept	good	Perennial crops cultivation	Cacao, oil palm, rubber, etc.
IIb	750–2000 m asl	Cool	Plain Wavy	Acid Tuff Toba Tuff	16-40 %	Udult Udant Tropept	good	Perennial crops cultivation	Coffee, citrus laces
IIIa	50-750 m asl	Hot	plain	Acid Tuff	8-15 %	Udult Udant Tropept	good	agro forestry	coffee, lanseh maize, upland rice, horti
IIIb	750-2000 m asl	Cool	plain	Acid Tuff	8-15 %	Udult Udant Tropept	good	agro forestry	coffee, lanseh maize, upland rice, horti
IVa1	0-750 m dpl	Hot	Marine Terrace	Toba Tuff	< 8 %	Aquents Aquepts Aquuands	poor	Lowland	Food crops and horti
IVb1	750-2000 m asl	Cool	Marine Terrace	Toba Tuff	< 8 %	Aquents Aquepts Aquuands	poor	Lowland	Food crops and horti
IVa2	0-750 m asl	Hot	River and marine Terrace	Acid Tuff Toba Tuff	< 8 %	Udults Udands Tropepts	good	upland	Food crops and horti
IVb2	750-2000 m asl	Cool	River and marine Terrace	Acid Tuff Toba Tuff	< 8 %	Udults Udands Tropepts	good	upland	Food crops and horti
V	0-50 m asl	Hot	marine		< 3 %	swamp	poor	buffer	Mangrove Brackish pond
VI	vary	vary	Mud hole peat	Organic	< 3 %	Saprist Hemists	poor	forestry	Natural vegetable

According to Table 1, the land utility for food crop agricultural are present in IVa1, IVa2, IVb1 and IVb2 zones, however in IIIa and IIIb zones are still possible. In general, soil parent material in North Sumatra was composed from acid tuff and toba tuff materials with poor nutrient contain. Sub zone IIIa and IIIb with elevation 8-16 % are soil erosion critical soil type. Agricultural food crop in those zones could be utilized for area conservation. Generally the soil acidity (pH) was the most constrain beside CEC value and low soil organic contain.

Table 2. Intervention recommended for each zones (Amien et. al., 1996)

Dominance Sub-zone	Agricultural system & commodities alternative recommendation	Existing Agricultural systems	Intervention recommended
I	Natural Forestry	Forestry	= carrying capacity (conservation)
IIa	Plantations & perennial crops (cacao, coconut, oil palm, rubber, rambutan, banana, jack fruit, papaya, snake fruit, mangoes teen, durian, lanseh tree and livestock)	Forestry Plantations upland	< carrying capacity (extensification) = carrying capacity (intensification) > carrying capacity (diversification)
IIb	Plantations (tea, lengkeng, kemiri, orange)	Upland	> carrying capacity (rehabilitation / diversification)
IIIa	Agro-forestry (cacao, coffee, mangoes teen, lanseh tree, food crops)	Plantations	> carrying capacity (rehabilitation/ diversification)
IIIb	Agro-forestry (Lengkeng, orange, candlenut three, garlic, tomato, carrot)	Forestry	< carrying capacity (diversification)
IVa1	Low land (rice, maize, soybean, peanut, mungebean)	Low land rice	= carrying capacity (intensification / diversification)
IVa2	upland (upland rice, maize, soybean, peanut, chili , pineapple, livestock)	Plantations Upland Low land rice	< carrying capacity (diversification) = carrying capacity (intensification) < carrying capacity (diversification)
IVb1	Low land (low land rice, tomato, carrot)	Low land rice	= carrying capacity (intensification / diversification)
IVb2	upland (potato, celery, garlic, carrot)	Forestry upland Low land rice	< carrying capacity (diversification) = carrying capacity (intensification) < carrying capacity (diversification
V	buffer (mangrove, brackish)	Forestry Plantations Upland	= carrying capacity (intensification) > carrying capacity (rehabilitation) > carrying capacity (rehabilitation)
VI	Primary forest (natural vegetations)	Plantations	> carrying capacity (rehabilitation)

Agricultural Commodity Zoning

The commodity zoning was one of thematic maps resulting from agro-ecological data with similar scale. Study of commodities zoning in North Sumatra was conducted from 2002 to 2003. The results are land suitability maps (1: 250,000 scale) of priority commodities for each regency in North Sumatra. This map was useful to predict the total development areas that can be used both for establish the agribusiness and its allocation, especially for perennial crops (Figure 4).

Land suitability of agricultural commodities (1:250,000 scale) based on land evaluation from tabular and spatial data of several agricultural commodities. Land evaluation based on land characteristics that contain land unit map (soil, climate) and socioeconomic data. The results of land evaluation presented on spatial view or maps through imported tabulation data from the ALES to GIS form. Land suitability map was presented by Arc View soft ware. The potential area map resulting from overlay of land suitability map with administrative map. Selected commodity will be developed in

some areas according to land suitability class, priority commodities, labor availability, market opportunity and accessibility.

Land evaluation result was present the suitability class for selected commodities. Each land unit may suitable for more than one commodity. Land quality and characteristic used in land suitability analysis are presented in Table 3. Three land suitability classes for each commodity of each land unit was made such as suitable (S), conditionally suitable (CS) and Not Suitable (N). Complexity of soil map unit including 2 to 3 different classes of land suitability which are needed to simplified (Table 4)

Table 3. Quality and characteristic used in land suitability analysis (Djaenuddin, 2000)

No.	Land Quality	Land Characteristic
1	Water availability (wa)	Agro-climate zone
2	Rooting condition (rc)	Soil texture, effective depth
3	Oxygen availability (oa)	Drainage
4	Nutrient retention (nr)	pH reaction, CEC
5	Nutrient availability (na)	Level of K_2O and P_2O_5
6	Land preparation (lp)	Topography

Table 4. Class Simplification criteria of land suitability (Djaenuddin, 2000)

Class	Explanation
Suitable land (S)	
S	>75% suitable land
C/S	50-75% suitable and 25-50% Conditionally suitable
Conditionally Suitable (CS)	
CS	>75% Conditionally suitable
CS/N	50-75% Conditionally suitable and 25-50% not suitable
Not Suitable (N)	
N	>75% not suitable
N/CS	50-75% not suitable and 25-50% Conditionally suitable

APPLICATION AEZ IN NORTH SUMATRA

There are three main uses of AEZ approach in North Sumatra AIAT namely for planning purposes, develop local specific technologies for selected sub zone (IVa1 and IVa2) such as developing fertilizer recommendation based on P and K status and dissemination strategic for the target area (expansion). The response of stakeholders on AEZ program in North Sumatra is also reported.

Planning Purposes

The limitation of the sources especially budget, staff and facilities, assessment was established on certain AEZ (Table 5). The regencies for the center of assessment were established by considering distance from the main office, local government response and support, farmer response and the size of the area. The output of the assessment was disseminated to other locations within the same zone using several methods such as VCD, poster, dialog with the policy makers and seminars. The priority of research activities were accordance to the regional development priority.

Table 5. Priority AEZ and commodity selected in North Sumatra (Ibrahim et al, 1999)

No	Agro ecology zone	Regency		Intervention
		Assessment sites	Expansion Area	
1	Irrigated Rice land (IVa1 and IVb1)	Simalungun and Asahan	Deli Serdang, Serdang Bedagai, Madina, Tapsel, Labuhan Batu, Taput, Tobasa, Humbas, and Karo	ICM of Rice
2	Highland (IIIb)	Karo,	Simalungun, Taput, Tapsel, Tobasa, Humbas and Dairi	Orange, Maize
3	Upland (IVa2)	Deli Serdang	Madina, Langkat, Labuhan Batu, Tebing Tinggi, Asahan	Beef cattle production
4	Rain fed low land (IVa2)	Langkat	Deli Serdang, Labuhan Batu, Dairi and Humbas	Rice and sheep
5	Swamp and peat (IVa1 and IVb1)	Langkat	Deli Serdang, Asahan and Labuhan Batu, Humbas,	Rice
6	Coastal (V)	Langkat	Deli Serdang, Tapteng, Sibolga	Fishery

Status of P and K Soil in Irrigated Wetland (IVa1 and IVb1)

P and K fertilizers are the most expensive input in rice production system and need to make it more efficient by using the status of P and K maps. Rational and balancing fertilizer use is the main key factor continuous intensification program for 20-30 years period resulted unbalanced nutrient contain in the soil as a result of accumulation of intensive fertilization. In that condition use map of P & K status (1:50,000 scale) could be used as a base for recommendation fertilizing of local specific condition both for district and regional levels. Through the map of P & K status (1:50,000) approach nutrient critical level or nutrient available in the soil can be determined. Fertilizer recommendation for P & K fertilizing for irrigated rice was done based the soil status (Figure 5 and 6)

Mapping for P & K status of lowland paddy were done by North Sumatra AIAT for six regions in North Sumatra province such as Deli Serdang, Simalungun, Taput, Madina, Tobasa and Asahan regencies. The retrenchment of fertilizing cost by using P & K recommendation map was presented in Table 5.

Table 6.Cost and fertilizer retrenchment using P & K map recommendation (Jamil et al, 1999, 2000, 2001, 2002)

No.	Regencies	Total area (Ha)	Fertilizer retrenchment (t/MT)		Cost retrenchment (Rp.) / Season	
			SP36	KCl	SP36	KCl
1	Tapsel	46.296	1024,79	4.172,95	2,1 M	8,4 M
2	Madina	18.965	443,16	1.840,35	0,9 M	3,7 M
3	Simalungun	47.058	616,98	4.705,86	1,2 M	11,8 M

4	Deli Serdang	89.657	862,46	6.723,37	1,7 M	13,5 M
5	Asahan	52.402	1.109, 1	5.194,8	2,2 M	10,4 M
6	Tobasa	24.806	1.022,7	2.480,6	2,1 M	4,9 M

Stakeholder Response and Comments

AEZ program was responded differently from one regency to the others. Some regencies have allocated some budgets to follow up the results. Summary of the collaboration was presented in Table 7.

Table 7. Adoption of AEZ by local government in North Sumatra

No.	Regencies	AEZ	Funding
1	Taput	Commodity zoning 1:100,000 scale	Local government (1998; 1999; 2000)
2	Asahan	Mapping of P & K lowland rice for each district (1:50,000 scale) Horticulture commodity zoning (1:50,000 scale)	Local government (2002; 2003) Local government (2003)
3	Tapsel	Agricultural commodity zoning (1:50,000 scale)	Local government (2003)
4	Dairi, Tobasa and Taput	P and K status map	Province Government (2002)

CONCLUSION

Using the AEZ and commodities zoning maps approach provided some benefits, such as the information of land suitability, simpler research and assessment activities; therefore research and dissemination activities became more efficient. By choosing the suitable commodity in the certain zone; therefore the competitiveness of the crops increases. Also, it made easier for decision makers to plan and to established other infrastructures such as roads, storage industry processing and market opportunity. Some local governments adopt the AEZ approach indicated by providing some budgets to follow up the activities.

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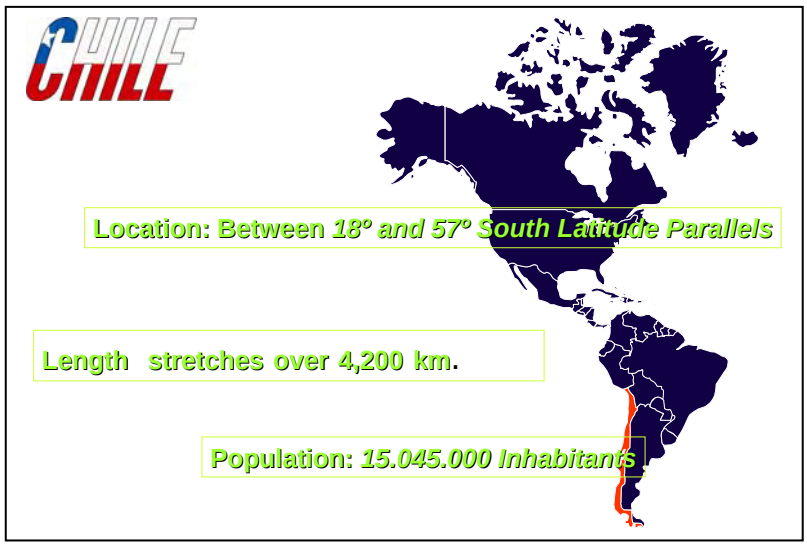
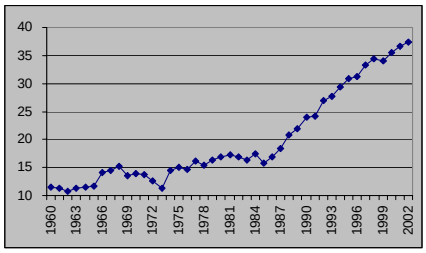
INTENSIFYING THE ROLES OF WOMEN IN AGRICULTURAL PRODUCTION AND IN INCREASING ADDED VALUE TO AGRICULTURAL PRODUCTS IN CHILE

Cecilia Rojas L

ODEPA



Evolution of GDP
billions of 1996 pesos

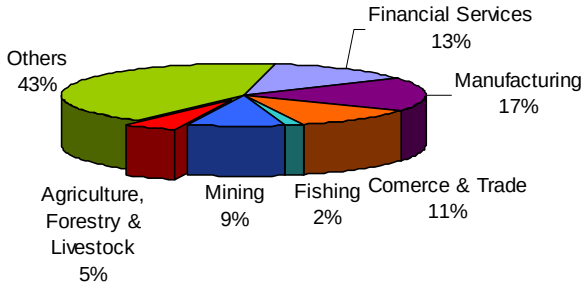


GDP percentage variation

1960 – 1975	2.0
1975 – 1990	4.6
1990 – 2003	5.5

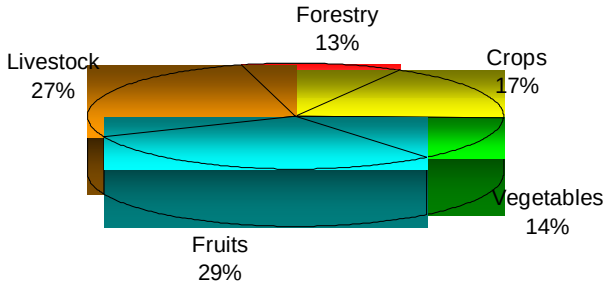
- In the year 2003 the Chilean GDP was approximately US$ 71,400 millions and per capita GDP US$ 4,670.
- Measured at parity purchase power it is placed in US$ 10,373 (The

Gross Domestic Product. 2002



The Ministry of Agriculture range of operation is restricted to Agriculture, Livestock and Forestry, excluding Fishing. The three areas that compose the Ministry's activities, including related productive chains, account for 16% of GDP.

Agricultural, Livestock anf Forestry Production Value (1990-1997 Average)



*** Gross production value of fruit sector is the biggest one. From the total commercial production of fruits, 50% is exported as fresh fruit. As to processed fruit, it is estimated that the total volume corresponds to 25% to 30% of production.**

Agricultural Land

With 75.6 millions of hectares of continental land, only one third has some agriculture and forestry potential.

Those 25 millions of hectares are divided as follows:

11.6 : forestry potential

8.5 : livestock breeding aptitude

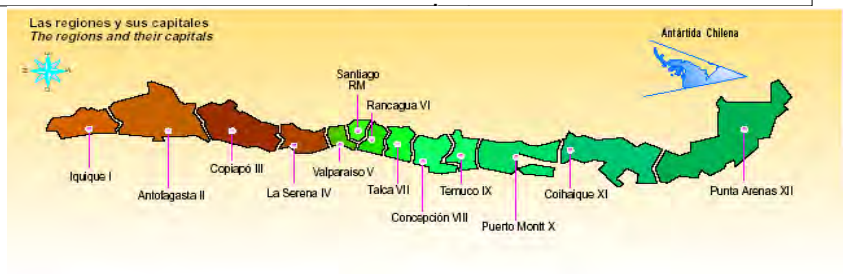
- **5.1 : tillable land**
  - **-1.8 of irrigated soil**
  - **-1.3 of soil with irrigation possibilities**
  - **-2.0 of dry land**

Agriculture through the country

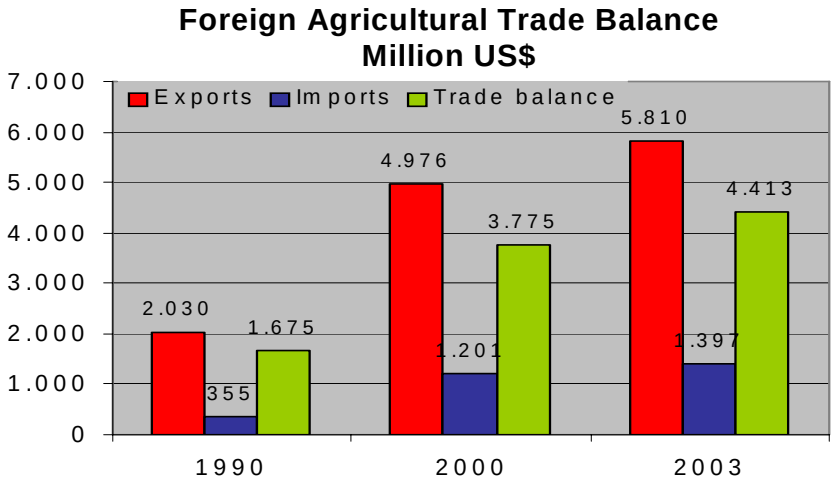
Northern agriculture production in Regions I to III is not as important as mining.

Central Chilean agriculture (from Regions IV to VII) usually relies on artificial irrigation and has horticulture and fruit production, activities strongly export-oriented.

Southern Chile (Regions VIII to XII): cattle farming and annual crops, cater mostly for the domestic



International trade is relevant for Chilean development, due to the small size of its economy.



THE LAST AGRICULTURAL CENSUS DATES FROM 1997 AND IT IS THE FIRST AGRICULTURAL CENSUS THAT INCORPORATES A GENRE ANALYSIS OF DATA GATHERED.

THE REASON IS BECAUSE GENRE VARIABLE HAS BECOME CURRENTLY SIGNIFICANT.

NUMBER OF PRODUCERS

Total producers	290.986
Women	63.671
Men	227.315

Source: ODEPA; National Agricultural Census from INE

FARMS ACCORDING SIZE AND GENRE

Type of farm	Number of producers			Women producers
	Women	Men	Total	%
Big farms	710	4.910	5.620	12,6
Medium farms	1.892	11.564	13.456	14,1
Small entrepreneurial	29.229	126.615	155.844	18,8
Small of subsistence	26.491	68.957	95.448	27,8
Without clasification and without exploitation	5.349	15.269	20.618	25,9
Total	63.671	227.315	290.986	21,9

Source: ODEPA; VIth National Agricultural Census from INE

AREA CULTIVATED BY INDIVIDUAL PRODUCERS, MEN AND WOMEN, ACCORDING KIND OF CULTURE (HA)

Culture	Women	Men	Total	Women %
Annual crops	89.730	676.382	766.112	11,7
Vineyards	8.955	39.128	48.083	18,6
Fruit orchards	21.284	103.161	124.445	17,1
Forestry	81.792	514.450	596.242	13,7
Pastures	1.150.180	5.695.883	6.846.063	16,8
Vegetables	10.188	77.494	87.682	11,6
Total	1.362.129	7.106.498	8.468.627	16,1

Source: ODEPA; INE

SHARE OF WOMEN PRODUCERS BY CULTURE AND REGION (%)

Region	Annual crops	Vineyards	Vegetables	Fruit orchards	Forest plantations	Pastures	Total
I	13	32	23	27	-	29	22
II	34	-	31	50	9	34	25
III	15	16	8	15	30	26	18
IV	10	16	12	22	8	30	23
V	15	32	13	17	22	18	15
VI	8	15	8	14	19	23	16
VII	12	18	9	16	12	13	11
VIII	13	22	16	16	14	17	14
IX	11	-	17	20	12	14	12
X	15	-	24	22	14	18	15
XI	-	-	19	11	2	13	12
XII	19	-	14	30	-	13	12
RM	12	9	7	17	10	17	13
Total	**12**	**19**	**12**	**17**	**14**	**17**	**14**

Source: prepared by ODEPA. VI National Agriculture Census, INE 1997.

LIVESTOCK AND POULTRY STOCKS IN INDIVIDUAL PRODUCER FARMERS, BY SEX

Livestock and poultry	Women´s farms	Men´s farms	Women participation %
Cattle	458.510	2.732.024	14,4
Sheep	390.938	2.081.925	15,8
Goats	185.235	878.018	17,4
Pigs	87.076	456.435	16,0
Poultry	1.093807	7.683.235	12,5

Source: prepared by ODEPA; VI National Agriculture Census, INE 1997.

AGRICULTURAL LABOR FORCE BY CATEGORY

Category	Total farms	Individual producer farms	Individual producers/total (%)
Remunerated permanent workers	538.308	409.849	76,1
Non-remunerated permanent workers	153.787	143.834	93,5
Temporary workers	280.662	176.587	62,9
Total	**972.757**	**730.270**	**75.1**

Source: prepared by ODEPA; VI National Agriculture Census, INE 1997.

AGRICULTURAL LABOR FORCE BY SEX

Sex	Total farms	Individual producer farms	Individual producers/total (%)
Women	219.443	163.126	74,3
Men	753.314	567.144	75,3
Total	**972.757**	**730.270**	**75,1**

Source: prepared by ODEPA; VI National Agriculture Census, INE 1997.

- AGRICULTURAL LABOR FORCE TENDS TO DECREASE ALONG TIME, WITH ANNUALLY FLUCTUATIONS.

NUMBER OF AGRICULTURAL WORKERS ACCORDING SEX

	Years				
	1990	1992	1994	1996	1998
Total	770.028	798.657	732.201	806.242	733.630
Women	73.608	98.527	85.819	110.954	103.855
Men	696.420	700.130	646.382	695.288	629.755

Source: MIDEPLAN, CASEN Survey

AGRICULTURAL LABOR FORCE: RELATION WITH TOTAL AND COMPOSITION ACCORDING SEX

	Years				
	1990	**1992**	**1994**	**1996**	**1998**
Agricultural labor force as percentage of total labor force	17,5	16,4	14,5	15,3	13,9
Composition according sex					
Total %	100	100	100	100	100
Women %	9,6	12,3	11,7	13,8	14,2
Men %	90,4	87,7	88,3	86,2	85,8

Source: MIDEPLAN, CASEN Survey

Fruit and flower production
Women participation

- VIth Region is the most important one in terms of fruit production and as well in terms of temporary workers (about 86.000) from which approximately 50% corresponds to women. Their participation is very significant in packing plants, especially referred to pomes, major regional production, where they carry out post-harvest handling, thus contributing to add value to agricultural products.
- Temporary work is likely to be the main labor option of women in this Region, as involves a greater percentage of occupied women (60%) than other remunerative activity (for example services, commerce, etc.). Women temporary workers, unlike men, tend to come more from urban than rural areas.
- In relation to segmentation of tasks according sex, different studies agree that, in fruit orchards, about 60% to 70% of day's work are occupied by men, as in packing about 75% are occupied by women.
- Another agricultural activity, in which participation of women is very significant, is flower culture.
- There is an interesting experience in relation to carnation culture in the Vth Region, where a category of small women entrepreneurs has emerged. Carnation is a labor intensive culture and responds very well to delicate and meticulous work, in which women have especial abilities.
- Flower culture has a great potential, mainly based upon women producers.

National seed sub-sector. Direct labor force employed (number of persons)					
Institution	**Women**	**Men**	**Total**	**Share %**	
				Women	Men
Seed production field	4.986	2.670	7.655	65	35
Seed production enterprises	242	594	836	29	71
ANPROS	5	10	15	33	67
INIA	6	28	34	18	82
INIA (Bank of germplasma)	5	2	7	71	29
SAG (Seed Dept., Laboratory)	19	16	35	54	46
SAG (Inspection)	19	45	64	30	70
SAG (Lo Aguirre Laboratory)	4	2	6	67	33
ODEPA	2		2	100	
TOTAL	5.288	3.367	8.654	61	39

Source: Prepared by ODEPA with its own information and information from INIA, SAG, ANPROS and seed production enterprises.

Direct labor force employed in seed production fields 2002/2003 season								
Species	**Area**	Day's work		Number of persons			Share %	
	(ha)	Day's work/ha	Total	Women	Men	Total	Women	Men
Corn (H)	12.419,9	56,0	695.512	1.636	1.091	2.727	60	40
Tomato (MH) 2/	137,9	3.625,0	499.960	1.627	333	1.961	83	17
Cucumber (MH) 3/	133,8	1.800,0	240.840	567	378	944	60	40
Pepper (MH) 3/	95,3	2.000,0	190.560	546	202	747	73	27
Melon (MH) 3/	166,3	400,0	66.520	209	52	261	80	20
Watermelon (MH) 3/	208,2	300,0	62.460	196	49	245	80	20
Sunflower (H)	2.369,4	34,0	80.560	158	158	316	50	50
Cauliflower 2/	131,4	150,0	19.710	26	52	77	33	67
Sugar-beet	226,2	40,0	9.049	10	26	36	28	73
Potato (MH) 4/	1,0	2.700,0	2.700	10	1	11	90	10
Pea 1/	7,0	58,9	413	1	1	2	40	60
Lupine	40,0	16,0	640	1	2	3	25	75
Radish 1/	2,7	150,0	400	1	1	2	33	67
Elephant Garlic	1,0	230,0	222	0	0	1	50	50
Wheat	2.996,3	12,5	37.454		147	147		100
Potato	403,8	60,3	24.344		95	95		100
Red clover	341,0	13,6	4.638		18	18		100
Barley	410,5	10,0	4.097		16	16		100
Rice	225,4	12,0	2.704		11	11		100
Rapeseed	153,8	15,0	2.307		9	9		100
White wheat	183,9	12,5	2.299		9	9		100
Alfalfa 1/	162,0	13,9	2.252		9	9		100
Oat	131,3	7,6	998		4	4		100
Crimson clover	45,0	14,0	630		2	2		100
Ballica sp.	17,6	22,2	391		2	2		100
Triticale	25,5	12,5	319		1	1		100
Beans	4,0	60,0	240		0	0		100
Sorghum	15,0	11,7	176		0	0		100
Orchard grass	0,7	22,2	15		0	0		100
Soja bean 1/	12,7	7,0	89		0	0		100
TOTAL	**21.068,5**	**395,6**	**1.952.496**	**4.986**	**2.670**	**7.655**	**65**	**35**

Source: Prepared by ODEPA with its own information, from seed production enterprises, INIA, SAG, INE and Chile Foundation. 1/ Area under certification, SAG, average 2000-2003.
2/ VIth National Agricultural Census, INE, 1997. 3/ (MH) manual hybrids, estimate according INE area, 1997. 4/ INIA estimate, Remehue.

CHILE: PARTICIPATION OF WOMEN IN MINISTRY OF AGRICULTURE SUPPORT INSTRUMENTS

SUPPORT INSTRUMENTS TO INVESTMENT	Women Beneficiaries (Nr)	Share (%)
1. INDAP ORDINARY PROGRAMS		
TECHNICAL ADVISORY SERVICES		
* Informal Groups	1.729	19
* Individual	117	11
ON-FARM ADVISORY SERVICE	6.214	22
PROJECT ADVISORY SERVICE	198	14
LIVESTOCK MODERNIZATION		
MANAGEMENT CENTRES	363	15
RURAL TOURISM PROGRAMME	111	54
RURAL YOUNG SERVICE	77	31

Source: INDAP

SUPPORT INSTRUMENTS TO COMMERCIALIZATION	Women Beneficiaries	Share (%)
NETWORKS FOR SPECIFIC AGRICULTURAL PRODUCTS	256	29
RURAL WORLD SHOW	148	33
COUNTRYSIDE TASTES	56	66

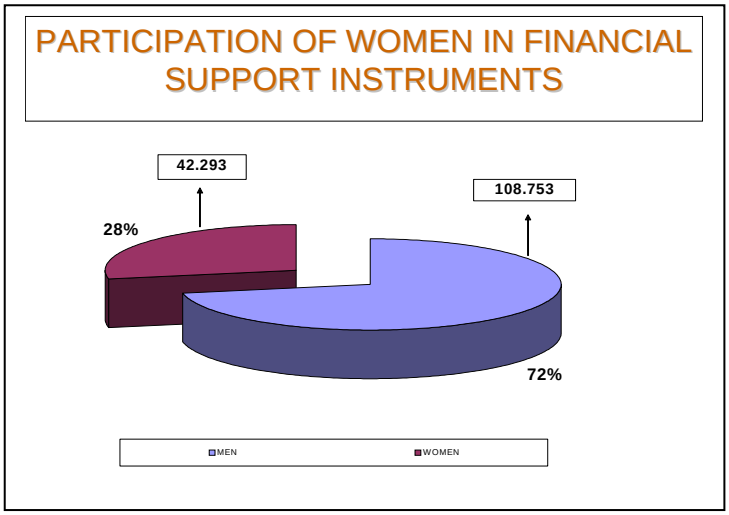
Source: INDAP

INVESTMENT FINANCING INSTRUMENTS	Women beneficiaries (Nr)	Share (%)
1. SPECIAL FOR WOMEN		
PRODUCTIVE PROJECTS CONTEST	12.321	100
INDAP-PRODEMU AGREEMENT	1.344	100
PRODUCTIVE PROJECTS FUND	410	100
2. INDAP ORDINARY INSTRUMENTS		
AGRICULTURAL MODERNIZATION	893	44
LIVESTOCK MODERNIZATION	657	26
SIRSD	6.372	22
INDIVIDUAL IRRIGATION	251	31
ASSOCIATIVE IRRIGATION	600	21
INDIVIDUAL PDI	27	24
AGRICULTURAL MODERNIZATION PDI	21	49
LIVESTOCK MODERNIZATION PDI	34	24

Source: INDAP

SUPPORT INSTRUMENTS TO SPECIAL PROGRAMMES	Women beneficiaries	Share (%)
RURAL WOMAN EDUCATION AND TRAINING	**3.900**	**100**
ORIGIN PROGRAMME	**2.137**	**37**
PRODESAL	**9.215**	**37**

Source: INDAP



OTHER AVAILABLE TRAINING MECHANISMS:

In the year 2003, the Ministry of Agriculture created a training programme directed towards peasant labour force, aimed to foster the use of tax exemption in virtue of a specific Act (Act Nr 19.518).

Said initiative seeks to improve the quality and quantity of agricultural, livestock and forestry products, as well as to improve standard of life of rural sector inhabitants.

A further training campaign will be launched by the Ministry of Agriculture from second semester 2004, which intends to ensure continuity to the 2003 implemented one and to increase in 20% the number of workers trained.

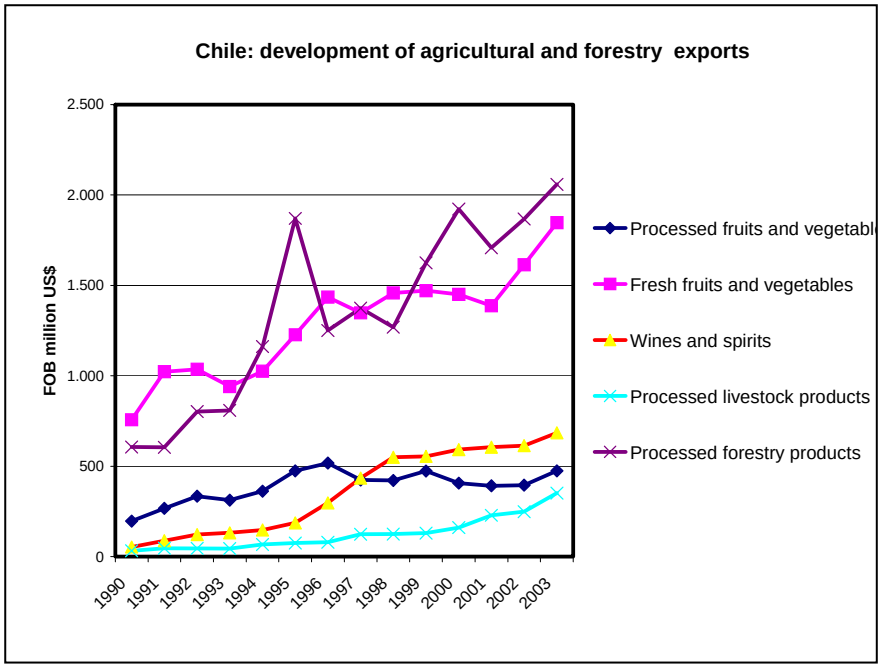
Main topics to be considered are:

- Management Centres
- Labour Competence Certification
- Professionalism of labour force
- Leaders Training
- Training on new technologies
- Tax aspects

To implement these actions, the Ministry of Agriculture works jointly with the National Training and Employment Agency (SENCE), whose mission is to contribute to the improvement of national productivity through occupational training both for companies and individuals, focusing on those within the lower earning brackets. Its operations are carried out through the administration of tax incentives that the State offers to companies which opt for the training of their staff.

Enterprises may:

- Train directly
- Hire a recognised Training Organization (OTEC)
- Support one or various Training Intermediate Organization (OTIC)


Chile: development of agricultural and forestry exports
FOB million US$
2.500
2.000
1.500
1.000
500
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Processed fruits and vegetabl
Fresh fruits and vegetables
Wines and spirits
Processed livestock products
Processed forestry products

POST HARVEST TECHNOLOGY FOR SMALL FARMERS PRODUCTION AREA, INCLUDING THE ROLES OF WOMEN, IN THAILAND

Dares Kittiyopas[1]

POST HARVEST TECHNOLOGY FOR SMALL FARMERS PRODUCTION AREA

Approximately 41 percent of the total area of the Kingdom, 514,000 sq.km., is under agriculture. Main crops of the country are paddy, maize, cassava, sugarcane and fruit.

Post harvest technology use in Thailand keeps rolling forward due to agricultural purpose changes from domestic consumption to competitive business, post-harvest, food-loss reduction and improvement of quality must be implemented. However, level of utilization still differs by crop and land condition, socioeconomic and other constrains. That had concluded as follow:

Paddy

In step of harvesting, it is about 35 percent operated by combine harvesting machine. Paddy combine harvester has been rapid expanding. There are about 3,000 local combine harvesters being use for custom hire service in central plain, lower part of northern and western region. In small field area, there are still harvested by labor while paddy threshers are mainly use in step of threshing about 88 percent in hire service. For drying operation, sun drying is the most generally practice for farmers, to keep for consumption and seed reserved. But for high moisture paddy, it is transported from farm to paddy market, agriculture cooperation or rice factory to be operated with large scale dryer, which involves a lot of investment and operational cost. Table 1 shown level of post harvest practice for paddy in crop operations.

Table 1. Post harvest practice for paddy

Operations	Labor (%)	Equipment (%)
Harvesting	57.24	42.76
Threshing	11.67	88.34
Drying	10.00	90.00

However, using of high-yielding seed and appropriate harvesting period are promoted to farmers for improve of production efficiency and keep excessive losses in both quantity and quality.

Field Crop

Field crop harvesting is mostly done by labor. There are a few level of the use of harvester for cassava, soybean, sugarcane and maize, about 28, 5, 4, 3 percent, respectively. These are due to the local harvesters for field crop have not developed efficiently and practically, and the exporting machines are too much expensive. Moreover, there are many constrains such as planting system, field

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and crop condition for machinery use. For threshing, grain crops as maize and soybean are operate by shelling machines, which keeps expanding. For drying, the sun drying is the generally practice for farmers, big dryers are use in the large-scale feed stock industry or the big market for Aflatoxin prevention. Small dryers are not much use; due to the investment cost is too high related to sun drying. Table 2 shown level of post harvest practice by crops and crop operations.

Table 2. Post harvest practice for field crops.

Type	Harvesting		Threshing		Drying	
	Labor	Equipment	Labor	Equipment	Labor	Equipment
Maize	96.49	3.51	-	100	75.0	25.0
Sugarcane	95.89	4.11	-	-	-	-
Cassava	71.87	28.12	-	-	100.0	-
Soybean	95.00	5.00	-	100	100.0	-

Fruits

Fruits is necessary to select the ripening of fruit in harvesting step, control quality as insect and fungi damage and perishing in sorting and packing step, which need to implement by skill labor. Therefore, there is very rare to use equipment in post harvest process for this fresh crop. But storage technology, such as cold room, cleaning and waxing machine can be seen in commercialize scale, to be the pay-service for farmer. However in 6-7 year past, according to value added of preserve fruit products had promoted to farmers, so fruit dryers were developed and has use for processing in main variety of fruit as Lychee and Logan.

ROLE OF THAI WOMEN

About 27.7 million of Thai or 44 percent of total population are engaged in farming. Women constitute about 51.6 percent of the agricultural labors force in the country.

Post harvest operations are almost always the responsibility of farmwomen, but no research study has been done to identify their exact rule in the post harvest system. On the other hand, the Kasetsart University has shown productivity are performed by women in harvesting, threshing and marketing about 50, 45 and 100 percent, respectively.

Despite the fact that the responsibilities of Thai farmwomen in post harvest activities are obvious, but they are usually excluded in most farmer project activities. The agricultural extension service programs mostly focus on the male farmers. Women have been found to assume a major role as well in food production and preserve processing. Therefore the Department of Agricultural Extension has encouraged farm women into “Farm Women’s Clubs” to play active role on income-generating activities and improvement of the quality of life for the benefit of their family members, disseminates technology on farm home improvement for promotion of food and nonfood processing and related activities in pursuit of future tiny agro-industry. At the present, there are 758 farmwomen’s clubs settlements, which is about 60 percent of farm women’s clubs are in good tiny business activity level. Since the year 2003, farm women’s clubs promotion program has been assigned to improve production process by General Principles of Food Hygiene, that known as Good Manufacturing Practice (GMP), to develop farmwomen’s products to reach the food safety product standard, while the Food Safety is one of the Present Government Policy of Thailand. The program is doing by encourage and inerrancy of appropriate equipments and structure plants.

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PARTICIPATORY EXTENSION APPROACH; INDONESIAN EXPERIENCE (A CASE ON MP3 MODEL)

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INTRODUCTION

Being the world's largest archipelago, Indonesia possesses the biggest number of island in any one country. Its approximately 14,000 islands, Kalimantan, Sumatra, Sulawesi, Papua and Java are the five big one, making Indonesia's natural resources is the richest in the world. The population of Indonesia is 220 million of which more than 80% are Moslem. About 80 million or 24 million households are farmers who live in the rural areas. Consequently agriculture is predominant sector for life. The Agricultural sector became a "back bone" in Indonesia national development.

The agricultural sector has successfully performed a major role in developing the Indonesia economy during 32 years. Agriculture has significantly contributed to the national economic development by providing employment, food, and raw material for industry and devise from export.

In 1984 agricultural sector noted a big success. After decades of being the world's largest rice importer, Indonesia transformed to rice self-sufficiency. An accomplishment praised through out the world and awarded by the FAO.

Unfortunately after years of being successful in the Asians largest economic growth and medium rich class country, Indonesia slid down to the smallest economic growth and became classified as a poor country, due to serious impact of world's economic crisis in 1997. It is noticed that income per capita dropped from more than US $ 1.200 to less than US $ 500. In fact unemployment increase sharply from 5 million to 32 million and the number of poor people increase fantastically from 17 million to 38 million. More than three fourths of them live in rural areas who depend on agricultural sector. Around 25 million poor people are farmers live in the rural areas. Consequently agricultural development becomes the leading sector of in the national development.

Development is defined as a process through which the quality of life of the people seen both in terms of material and spiritual aspects is improved. It means an increasing attainment of community's own quality of life. Hence, the physical development is not the real output of development process. It is realized that the road, the building, the irrigation canal, the mosque to be built are **not** the precise indicators for measuring the success of development process.

Development is not something which can be given; it is too acquired and worked for by those who are to benefit from it. The objectives of development must have to match to the priorities; and how the resources should be used to achieve these objectives.

The concept of development regards to a human enterprise. This conceptualization emphasizes the following notations. First, the development is a process, not a state. Secondly, that process ultimately refers to quality of life of the people, and third to those of the people who are involved in the process. Among the elements to increase the quality of the people life, the following have been stressed in another form, as follows:

1. More and better life-sustaining goods for all.
2. No poverty
3. No unemployment

4. Better community

For the above reasons it means that development process of poverty alleviation and unemployment reduction. Development is a **battle** against **poverty** and **unemployment.** Development is a war on poverty and unemployment to be fought and war on the **rural area**. The front of the battle is in the rural area. The motor of the battle is **agricultural development**. Consequently agricultural development will be the motor of national development, through which poverty is alleviated, and unemployment is alleviated.

AGRICULTURAL DEVELOPMENT

Indonesia has strong comparative advantage in agricultural resources that should play the role as the fundamental of the Indonesia's economy. The resources comparative advantage should be further utilized and developed into a strong competitive one. In this way Indonesia's economy has strong domestic resource base and competitive strength.

Learning from the past experiences, to effectively change the comparative advantage into competitive one it is necessary to change the format of agricultural development from production based into agribusiness based. In this way the focus of agricultural development in not only on the on farm development, but also on the upstream off farm development as well as downstream off farm development, harmoniously and simultaneously. Agribusiness development encourages small and medium scale farming and industries as well as marketing done by the farmers. It also establishes farmer's group enterprises, cooperatives and corporations.

As mentioned before, recently Indonesia faces two main problems namely: (1) poverty and, (2) unemployment. To overcome these problems Indonesia must have to develop competitive strength in agribusiness and people oriented agribusiness, beside sustainability agribusiness and decentralization of agribusiness.

Competitive strength agribusiness is indicated by market orientation. The agribusiness products must be the best in quality but the cheapest in term of price. So that it will be able to compete in the market including local market, national market, and global market. By promoting competitive strength in agribusiness, directly impact will increase the farmer's income and poverty alleviation.

People oriented agribusiness is indicated by the establishment of small and medium scale agribusiness done by the farmers in the rural areas. The farmers act as the prime actor of agribusiness development. They are employed in their own agribusiness. They do not necessary urbanize to the town or migrant to other countries (ex. Malaysia, Arab, and Hongkong, Korea). This agribusiness development will cope with the problem of unemployment in the rural areas.

Thus agribusiness development has a strategic position in national development of Indonesia, mainly to improve the quality of life of the farmers, through poverty alleviation and increased employment.

AGRICULTURAL EXTENSION

In Indonesia agricultural extension is often the **non-formal education** interface between rural people and government agricultural organizations. The function is to enhance learning among farmers. It is to communicate agricultural research findings and recommendations to farmers. It is to bring farmers into contact with sources of practical and useful information through organized group action. Agricultural extension is commonly identified with activities whereby Agricultural Extension Workers interact with and teach farmers improved farming practices, new techniques, and more efficient technologies or packages of technologies. Larger numbers of these Agricultural Extension Workers

are organized into an agricultural extension system which provides them with a constant supply of useful messages (including crop and livestock production, processing and marketing, as well as rural development), technical and administrative supervision, and logistical support.

Thus agricultural extension is a service which assists farmers, through educational procedures, in improving farming methods and techniques, increasing production efficiency and income, bettering their levels of living, and lifting the social and economical standards of rural life.

Farmers are commonly rural people live in family groups, and the work of agriculture to be shared among men, women, and children. In words the farmers in Indonesia is commonly to refer to women farmers (Tani Wanita), to young farmers (Taruna Tani)), and to men farmers (Tani Dewasa).

Before 1999 the Indonesian agricultural extension system was **centrally directed** and controlled by Ministry of Agriculture. But after 1999 under the Law No. 22 Indonesian agricultural extension system becomes **de-centrally directed** and controlled by District Government.

THE ROLE OF AGRICULTURAL EXTENSION IN AGRICULTURAL DEVELOPMENT

To support agricultural development, agricultural extension is the most crucial element. Through agricultural extension the quality of farmers as agribusiness human resources are increased in term of competencies including competencies in: (1) technology. (2) entrepreneurship, (3) managerial, (4) team work, and (5) organization. These competencies are needed to develop agribusiness. Therefore, the role of the farmer is an actor of agribusiness development.

Being a non educational system, agricultural extension helps farmer to acquire competencies needed as an actor of agribusiness development, agricultural extension primarily empowering farmers to become subject in the agricultural development process. Agricultural Extension Workers facilitates learning process as an active learning process as well as self discovery learning process rather than passive or non participatory one. Therefore, an appropriate agricultural extension approach must be selected to meet to this need. Basically full participation by the farmers is needed.

The approach is the essence of an agricultural extension system. The approach is the style of action within a system. The approach embodies the philosophy of the system. It is like the beat of a drummer which sets the pace for all of the activity of the system. It informs, stimulates and guides such aspects of the system as its structure, its programme, its resources and its linkages, each approach was conceived as appropriate in particular circumstances, and each has its own advantages and disadvantages.

When the farmers are organized for their own benefit, much can be achieved if the participatory approach to agricultural extension takes advantage of this intention. It is significant participation by those who are to be involved in the agricultural extension system. This includes participation by personnel of agricultural research and service organization, as well as farmers.

PARTICIPATORY AGRICULTURAL EXTENSION APPROACH

The government of Japan learned this participatory agricultural extension approach in the early 1870s, after an abortive attempt to have outsiders provide agricultural extension education to Japanese farmers. In 1875 the Meiji government introduced a method of using veteran farmers for extension work. The central government selected several experienced farmers to take part in planning and improving the agricultural technology. In 1878 these “veteran” become part of the Agricultural Correspondence System. From this beginning, Japan moved to increasing participation by farmers in the agricultural extension approach.

The **purpose** of agricultural extension with the participatory approach is to increase the productivity of farmers and to enhance their quality of life. By farmers participation the relevance of extension messages to farmers needs will increase; the learning process by clientele through purposeful participation and group pressure will enhance; the appropriate recommendations from agricultural researchers through participatory feed back from farmers to researchers will secure; in adjusting inputs of supplies, credit, and marketing to farmers needs will assist; and because of all these, the efficiency and effectiveness of agricultural extension will increase.

Within the farmer participation approach, program planning is **controlled** locally, often by such groups as farmer's associations. Participation by representatives of agricultural research and service organizations contributes significantly to success, but it is the decentralization of programming control which allows priorities to very greatly from place to place within a country, and the program can shift on a timely basic when local situations change.

Because of local control of program, the **content** tends to feature information, which fits the needs and interests of local people. For example when an insect pest attacks farmer's crops, they will demand information on control of the pest, but when dry whether makes cropping difficult, farmers will ask for information on irrigation. In an area where most of the farmers are women, they will influence the program so that women's concern is addressed in the extension program such as backyard intensification. And if agriculturalists in a research organization recommend heavy doses of mineral fertilizer, when farmers control extension program, they may ask the extension staff to do Benefit/Cost Ratio and analysis (B/C ratio), to discover whether the increases cost and yields they may get will also be more profitable. This participatory agricultural extension approach features relevance to local needs and interest as its hallmark.

Implementation of this participatory agricultural extension approach tends to feature many meetings. Small farmers group will meet from time to time to discuss their problems, to explore solutions with extension officers, and to urge extension officers to go "outside" to seek help for them when they need it.

This participation enhances the **learning process** of the beneficiaries. And the group pressure, which it generates encourages cooperation by clientele in "trying" recommended innovation. To the extent that those who supply inputs to farmers, and those who market farmer's outputs are also **participants** in the approach, the feasibility of following the recommendations increases. For example, farmers are more likely to use a fertilizer, if it is available from local suppliers in a timely manner and at an affordable price.

In addition to meetings, demonstrations techniques are also a typical feature with this approach, as are individual travels and group travels. Members of farmers group or farmers associations, or other groups organized by extension personnel visit each other's from lands and livestock. They also organize tours to distant places where they have heard of new and successful practices of horticulture, marketing or other activities.

This approach requires extension workers who are not only non-formal agricultural educators, but also **local volunteers** (Penyuluh Swakarsa)**.** Their task is to stimulate farmers to organize group effort, and this requires special skill, so that needs a special training for local agricultural extension volunteers. But once such organization has been discovered or created, local volunteers became the key field personnel of the extension organization.

This tends to **reduce** the total cost of the extension system, since such local volunteers are rewarded in other ways for they services to the community.

This strategy can overcome the problem of density by having larger number of extension volunteers whose background is appropriate to local needs.

Investment in their **further training** can focus on appropriate technology, communication methods, group building and maintenance, since they are already well acquainted with local conditions.

The **success** of the participatory agricultural extension is measured through continuity of local extension organizations and the benefits to the community of extension activities. Success is also measured by the extend to which agricultural research personnel, and others involved in input supply and marketing, actually participate in both program planning and program implementation.

When extension groups dissolve after a few months, or rarely last up to a year, the approach is considered not very successful. But where groups have been together for ten to fifteen years, for example, there has been a high level of success. The cohesiveness of such groups contributes to the effectiveness of group's pressure in enhancing the agricultural extension achievements.

Since extension programs are planned locally, the extent to which programs goals and objectives are achieved is also a measure of success. When local people evaluate their own programs they change them if they are not working well, and strengthen them where they are effective. They also generate a voice to influence the agenda of agricultural research organizations, as well as those who supply farm inputs and farm output market.

There are many **advantages** of participation by farmers, research works, input suppliers, and output marketers in agricultural extension. A key strength is the relevance or fitness of the program. When these people participate in deciding what the program goals as well as in what methods will be used, the chance is great that the extension program will fit their needs and interests. And when they decide what kind of activities the extension staff will conduct, they are highly likely to attend. The double benefit, then, is in relevance of either the messages, or the "content" of agricultural extension program, and of the methods and communication program, and of the methods and communication channels used by extension staff.

Another benefit often found with high levels of participation is **the mutually supportive relationship**, which develops among the participants. This is in evidence between first line extension personnel and the rural people they serve; between agricultural credit and other input suppliers and both farmers and extensions; as well as among others. Each can learn from others how to do his or her own job more effectively.

There is also a tendency for highly participatory approaches **to cost less**. That is because farmers groups or farmers organization as well as association of local people facilitate communication and the whole system is more efficient. At a lower total national cost, more farmers are likely to adopt more improved practices, because they will be practices which fit their farms, and because inputs may be readily available. This approach also stimulates increased **confidence, awareness,** and **activity** among farmers. It caters to the "human" side of the extension promise, as well as the technical side.

One of the **disadvantages**, from the perspective of central government, is that there is a lack of control of the program from the center. It may also be more difficult to manage central reporting and accounting for participatory approach, since program shifts from time to time as local conditions change. Also, to the extent that participating local people actually influence personnel management, decisions, like selection, transfer and promotion of Extension Field Workers, central government may see this as a problem.

MP3 MODEL OF PARTICIPATORY AGRICULTURAL EXTENSION APPROACH

Ministry of Agriculture of the Government of Indonesia has been striving to promote further development in agricultural sector with utmost emphasis of agribusiness. In 1999, the Indonesian government has introduced **decentralization policy** and this has brought some changes in agricultural

supporting system such as an extension service. The Agency of Agricultural Human Resources Development (AAHRD), Ministry of Agriculture, has reviewed the role of agricultural extension services and determined it improve capabilities of extension officers and services to farmers, in additional to extension service system itself.

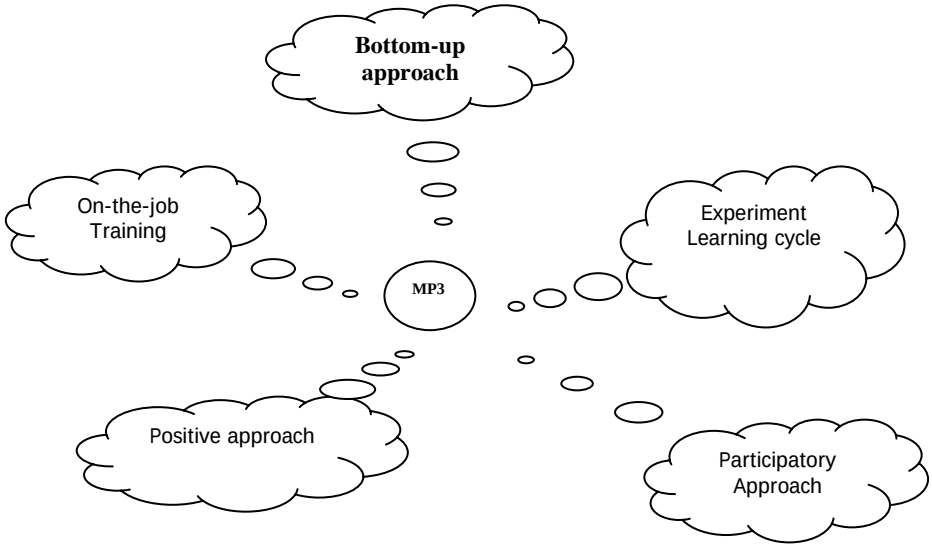
Meanwhile, all kinds of development works must be participated by all stakeholders of various levels and this has been a worldwide requisite for the success of the development programs and projects.

Under these circumstances, AAHRD in collaboration with Japan International Cooperation Agency (JICA) of the Government of Japan, implemented a project for 3 years from 1999, and has successfully developed a unique and valuable participatory agriculture extension approach called **MP3** (*Metodologi Penyuluhan Pertanian Partisipatif: Participatory Agricultural Extension Method*). In January 2004, AAHRD and JICA have agreed and started another project to further improve the MP3 and disseminate the MP3 through Rural Extension Center nationwide.

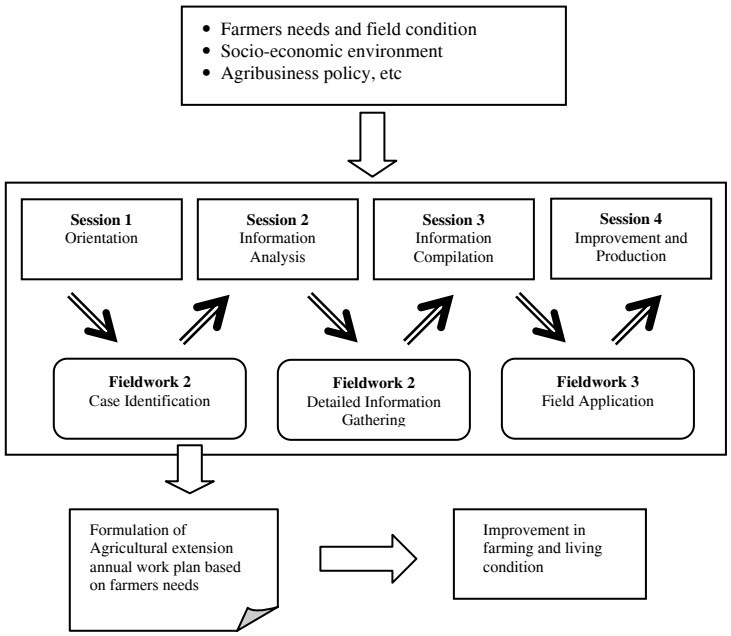
The MP3 has originally been developed as a training method for extension officers but functions as a tool for extension services, an empowerment practice for farmers and stakeholders as well as a rural development method. Keywords such as "Participatory approach", "Bottom-up approach", "On-the-Job", "Positive approach" and "Experiment Learning Cycle" well characterize the MP3.

The MP3 pursues "advanced and/or outstanding cases (*positive approach*)" being practiced in actual farming, such as innovative marketing, well-managed farmers" organization and environmentally sound farming, and further disseminates the cases to farmers as keys to a profitable and successful farming in diversified rural communities. The participants of the training identify and compile cases in their fields of assignment through observation and discussion with farmers (*bottom-up* and *participatory approach*). They learn advanced and outstanding cases through their experiences at fields and deep analysis among the participants (*experiment learning cycle*).

The MP3 is including a training for extension officers works as useful extension service as it is an *"Ón-the-Job Training (OJT)"*.



The MP3 model consists of 4 sessions of training and 3 field works, each field work is in between the two sessions. The session and field works are about 15 weeks respectively and scheduled alternatively as shown below.

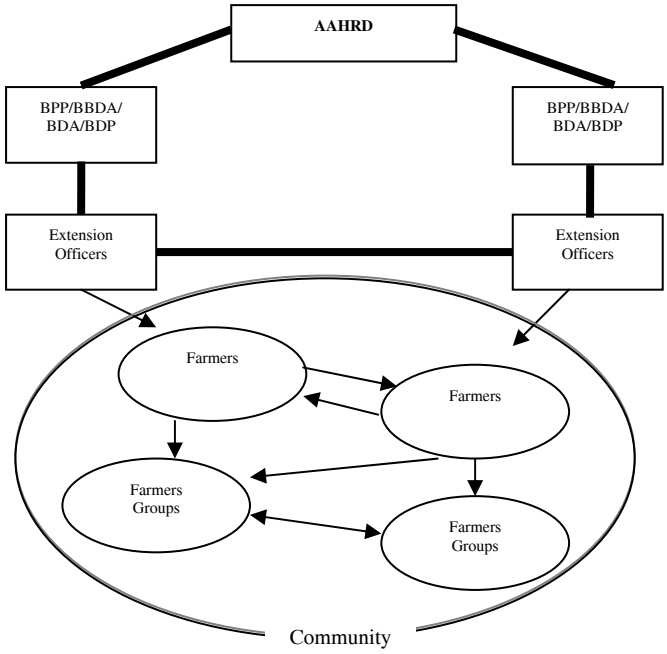


The table shows key points and duration of these sessions and fieldworks

	Period	Points
Session 1	6 days	Program orientation Briefing on MP3
Fieldwork 1	6 weeks	Case identification at fields
Session 2	4 days	Group analysis of identified cases
Fieldwork 2	3 weeks	Detailed information gathering of the cases
Session 3	3 days	Compilation of Information and
Fieldwork 3	4 weeks	Application of cases
Session 4	3 days	Improvement and material production

The MP3 encourages participants to keep seeking and disseminating those advanced and outstanding cases during their daily extension activities. There more cases would surely assist extension officers to offer better choices for farmers to select and adopt.

The AAHRD and Rural Extension Centers as well as Agricultural Training Centers are compiling these cases from nationwide into a database so that the extension officers have quick access to the information.



CONCLUSION

Agricultural extension with participatory approach is the most crucial element to support agricultural development in Indonesia to develop competitive strength agribusiness, people oriented agribusiness, sustainability agribusiness and decentralization agribusiness, mainly to improve the quality of life of the farmers through poverty reduction and increase rural employment.

Being a non-educational system, through participatory approach, agricultural extension help farmer to acquire competencies needed as an actor of agribusiness development, to become subject of development and to do an active learning process as well as self discovery learning process.

With the participatory agricultural extension approach agricultural extension program planning could be controlled locally, the content fixes the needs and interest of farmers, enhances the learning process of the beneficiaries, reduce the total cost of the extension system, and stimulants increased confidence, awareness, and activity among farmers and other beneficiaries.

Since 1999 Indonesia has successfully implemented MP3 model of participatory agricultural extension approach through a join project between AAHRD (Agency of Agricultural Human Resources Development) Ministry of Agriculture Republic of Indonesia and Japan International Agency (JICA) of the Government of Japan.

The success of MP3 model to increase participation among farmers and another extension beneficiary is characterized by five keywords such as: (1) participatory approach, (2) bottom up approach, (3) on the job, (4) positive approach, and (5) experiential learning cycle.

Through 5 sessions of training and 3 field works, during 15 weeks, the MP3 model pursues advanced and/or outstanding cases being practiced in actual agribusiness such as innovative marketing, processing and input supply, well management farmers organization and environmentally sound farming, and further disseminates the cases to farmers as keys to a profitable and successful farming in diversified rural communities.

FARMER-DRIVEN TRANSFORMATION OF AGRICULTURAL EXTENSION

Salmon Padmanagara

THE PROBLEM AND ITS SOLUTION

Adoption and Implementation of agricultural technology to increase food production is a top priority. Centralized top-down policy and subsidy have increased agricultural production, but is not sustainable. A campaign for the adoption of new technology has been undertaken. As a result, productivity and production of agricultural products have increased and its quality has also improved. However, farmers have not fully enjoyed the benefits of those results. They are still left behind in terms of their income improvement.

The issues of increasing food production, higher income for farmers and improving the welfare of farmers have been sustained for more than fifty years since the early nine-teen fifties. In spite of the introduction of new production technologies and efforts to motivate farmers to adopt it, the issues still persist. Technologies are very important as is also the participation of farmers and their training.

It seems that an important and crucial factor has been overlooked, neglected and not recognized, which is the farmer as the subject of development. His role and his welfare should be the focus of agricultural development and not the physical target of increasing food production.

Consequently Agriculture Extension should not be used as the vehicle to increase production, but is the educational system to empower farmers. Agricultural Extension is not an institution for the purpose of transferring technologies, but is the educational system in which farmers learn by doing, by experiencing and above all by discovering.

Educated and empowered farmers are able to verify the suitability of technologies coming from sources outside their environment. The have the capability for generating and developing technologies suitable for and directly applicable in their local specific agro-ecosystem (agro-ecosystem based crop production, IPM) and for maximizing the productivity of their farming system (Agro-forestry based farming system).

Farmers should be given the opportunity and trust to become the subject of development and to decide what is best and appropriate for improving their income and welfare.

The farmer is not stupid, he is intelligent. He has aspirations, he wants to improve himself, he wants to be able to do better farming and better business and he wants to live better in a prosperous community and in healthier environment.

The approach of the extension worker should be changed from the conventional education approach to that of a liberating education approach. His role becomes that of a facilitator trying to create opportunities for the learner (farmer) to learn and discover by himself.

Farmers First and Last should be consistently considered and adopted as the guiding principle for activities to be undertaken by all stakeholders of agriculture development in their decision-making program planning and implementation.

A political will is needed to implement the Farmers First and Last principle and strategy in overhauling the Agricultural Extension.

THE CONCEPT OF DECENTRALIZED AGRICULTUTRAL AND FORESTRY EXTENSION (DAFE)

The central part of the concept is the farmer and his family, his farmers group and his village community. Their feelings and aspirations, their needs and wants, their potentials and capabilities are the basis for planning and programming of training/education activities and farm-business plans.

The aim is the development of a behavior of self-reliance and self-confidence. The creation of a favorable condition for learning and the application of participatory approaches in the learning process is the essence of the new extension education.

The target is a prosperous rural area sustained by a productive market-oriented farming system. Income generating on-farm and off-farm activities, a rational land-use plan, consideration for the local ecosystem/environment, taking notes, filing, and bookkeeping, are subjects and topics for training, studies, experiments and learning in support of the development of modern farm management capabilities.

The concept also included gender awareness building, development of agro forestry-based farming systems, and building a decentralized management structure of extension. The strengthening of relation between farmers with partners from different functional groups and their involvement in extension activities and business arrangements are important elements for the development of an improved and profitable farm business.

The whole concept is transforming the traditional and conventional extension system into a modern system that will become the system of the future. I t contains the essential elements of a democratic, participatory institution.

Even at this early stage of implementation farmers already are in favor of and receptive towards the introduction of the new extension concept. A stronger and more serious support from all stakeholders will further strengthen the initial achievements and results of the project.

APPROACHES AND METHODS

Agricultural extension used to be, and still is, practiced in a top-down manner, in a non-democratic style. It is more concerned with sub-sector topics, concern more with things rather than with people.

The new concept of DAFE is bottom-up, its concern is people. The process is participatory, which proofs to be well suited for empowering people (IPM-FFS, PROSPEK, and others). This is the more reason to secure the implementation of DAFE principles in other *District* by having a strong National Policy on Agricultural Extension.

The participatory approach of DAFE emphasized decentralized decision-making. Farmers are trained in decision-making by participatory methods. It should be kept in mind that the implementation of the participatory principle should be consistent in all parts, in all aspects, and in all levels throughout the whole agricultural extension system. Otherwise it will create tensions and problems in the running and management of activities. If PPL's apply participatory methods in working with farmers, then as a consequence relations between PPL's and Extension Office Managers should also be participatory in style up to the and in the National level. The PPL's should participate in determining their interest and contribution in the organization, administration and management of their institution concerning rules of employment, personnel policy, handling of funds. Attitudes at all levels should be consistent with the participatory approach implemented in working with farmers.

Participatory approach implies joint learning processes. That is why it is demanded that PPL must change his role of teacher to that of facilitator and become a learning partner of the farmer.

We do not need to create new learning methods in agricultural extension. The need is to skillfully handle the use of those methods in the spirit and in the style of participatory approach, since the orientation is towards process and action. An entirely new concept of PPL training will be needed (diploma as well as on-the-job training). Thus by adopting the participatory approach we should underline the importance of changes in behavior/attitudes, reversal of roles and re-orientation of institutions.

We should be aware that the DAFEP is an effort, a tool of transforming the existing organization, institution, system of agricultural extension. Meaning that during and even after the project the learning process should continue.

One important and basic method implemented by DAFEP is the Participatory Rural Appraisal (PRA). The concern of PRA is exactly people and process. Therefore, it is the key to decentralized decision-making and bottom-up planning. Its demand driven and its accountability are downwards, not upwards. PRA admittedly is difficult to do at the very beginning but with better facilitators become a joyful exercise of village people. PRA, Action Research Facility (ARF, as it was developed by the IPM project) and Village Level Planning are the three leading learning approaches of bottom-up approach of empowerment.

A case worth mentioning here is the "Apa itu?" method of learning from the IPM-FFS. This participatory method was used by a farmer trainer, an alumni of IPM-FFS and vegetable expert, from *Pengalengan Sub-District in Bandung District* to help the farmers in *Seloprojo village, Ngablak Sub-District, Magelang District* (a DAFEP village) in overcoming a disease destroying their cabbage crops for years and was the reason for their impoverished situation; at one time a prosperous village. In just 3 days of intensive inter-active learning process he succeeded in convincing the farmers that they are able and have the means and skills to overcome their problems. There are many cases of this kind of farmer to farmer extension activities in DAFEP areas which deserve support and encouragement.

DECENTRALIZATION

Agricultural Extension is an out-of school system of education. As such it is a Human Resource development activity, an Agricultural Human Resources Development System Program.

UU no.22/1999 Article 7 section 2 mentioned that Human Resources Developments is the responsibility of the central government. Therefore decentralization of Agriculture Extension should be in the sense of transfer of management and not transfer of power, and therefore the Minister of Agriculture has the power to arrange and organize the Agricultural Extension Institutions (offices) at the District / *District and Sub-District/ Sub district* level as seen fit. A decree should be issued for a uniform organization and structure of the agricultural extension office at the District level to avoid troubles and misunderstandings concerning the role, position, and responsibility of the office and to provide working security for the Field Extension Agents (PPL). All that in harmony with principles of DAFE.

A grant in aid policy is also recommended to all districts to support extension activities by ensuring matching funds allocated by the APBD *District*. In addition National allocations for Agricultural sector through DAU should be specifically mentioned for the purpose of agriculture extension activities, if that is the purpose.

Agricultural Extension needs a strong legal base to ensure pureness of philosophy and principles, to ensure the continuous flow of needed funds for its operational activities and working security for its

personnel, and to guarantee the implementation of the principle of transfer of management of the decentralization policy.

The decentralization policy of the planning, programming and implementing of agricultural extension activities, including evaluation, to the village level (to the farmers and village community) is very conducive for empowering village people to achieve the aim of transforming the status of farmers from that of object to subject of agricultural development. This policy is very important and very sound for the purposes of the implementation of the principles of participation, partnership, democracy and for developing the spirit of self-reliance (*swadaya-swadana*) leading to Farmers Owned and Managed Agricultural Extension System. The National Decentralized Agricultural and Forestry Extension System should be built on a network of these farmers institutions and accountable to them. The basic principles here is that farmers have the ability and the power to mandating government institutions and non-government institutions (economic, social, educational) for carrying out farmers-driven extension needs and programs. This is the bottom-up system of extension planning and programming.

The other system is the at-the-bottom system of extension planning and programming, which is 100% planned, financed, and managed by farmers.

INTEGRATION

In 1973 an effort was made to establish an integrated (unified) National Agricultural Extension Service within the newly organized Ministry of Agriculture. A special agency was created to execute this policy with the support of a World Bank Project. All extension personnel, facilities and activities were to be integrated into the new AETE.

It did not work. Right at the very beginning a proposed Agricultural Extension Project with World Bank loan financing was to be handed over to the DG of food crops. A few years later all DG's were allowed to create their own extension directorates.

In the minds of many people (including officials) agricultural extension was always a kind of information service for the purpose of disseminating subsectoral topics of interest to their respective subsectoral clients. The focus is the sub sector, food crops, animal husbandry, fisheries, forestry, not the farmers and their farming systems. It has always been an inward looking attitude of self interest. The farmer (people) does not come into the picture; hence the essence of education is lost. The term *Penyuluhan Pertanian* is derived or is a translation from the Dutch word *"Landbouw Voorlichting"*. *Voorlichting* means Information.

DAFE is on the right track with its one unified extension institution at the *District* level, with the creation of an agricultural extension committee, with the establishment of the Sub district Field Extension Team with the UPKG and FMA at the villages with their farmer's facilitators. This concept which has been proven to be applicable and workable even at this early stage of DAFE implementation should be immediately followed by the issuance of a strong policy statement by the Ministry to be implemented gradually throughout the country.

This unified National Agricultural Extension Institution (structure) will meet with satisfactory approval from the farmers. The farmers are the unifying force or motive for the integration of agricultural extension into one strong, efficient, effective system. Socialization for this concept is a must.

Integration of agricultural extension and forestry extension into one unified extension system at the district level (field level) is a sound policy. It should be supported and backed-up by a strong policy statement concerning the integration, signed by both the Minister of Agriculture and the Minister of Forestry to secure the sustainability of its implementation. This is the first time in the

history of agriculture extension in Indonesia that Agriculture and Forestry are joined by DAFEP and through the development of the Agro forestry-based farming system in one extension institution to serve their common clientele, the farmer in the rural area.

PARTICIPATION

Agricultural Extension is an educational activity of the extension worker aiming at transforming farmers' needs into farmers' wants. For that purpose it is the extension agent who did the farmers needs survey and the rural appraisal. The extension agent formulates the content of what to teach and how to teach. He tries to persuade and to convince farmers to adopt new or better technologies or to change to other more profitable crops. He is trying to produce desired changes in farmers' behavior. He organized weekly courses, demonstration, and method as well as result demonstration, followed by field days. Excursion tours or study tours, or look and learn visits as it is called sometimes today were also part of the extension activities.

Farmers are objects of extension. When active they are actively looking, listening and trying to implement guidelines or instructions as given and or recommended by extension agents. Their participation is by becoming followers of the extension agent, their teacher.

This style and methodology of extension it must be said resulted in better yields, due to the application of modern inputs, implementation of new farming skills and the introduction of credit schemes. The farmers however, become used to the state of being told what to do and even develop the attitude of expecting to be helped, expecting support from others and depending on others (outsiders, government). To pray is often regarded as the solution for addressing problems.

Through DAFE this attitude is being transformed from the lowest grade of participation (by just being present and just following) to the highest form of participation, which is ownership of activities, being the decision makers and implementers of felt needed extension activities. The key to this sudden change in attitudes is by the implementation of PRA which awaken potentials. A good PRA is the fundamental start of a process leading to RKDD and to Proposal. The PRA should also provide the basis for village monograph, which in turn should become the basis for *Sub district monograph* leading to *District monograph.* These monographs are very important for the implementation of bottom-up Agricultural Extension Planning and Programming in which the farmers' participation element is guaranteed from the very beginning. In this case the farmers then are in a position of mandating the LSM or government (PPL) to participate by mobilizing needed resources (expertise, funds) and facilitating the extension process further, with the UPKG still managing the activities. This bottom-up process of planning and programming and executing at the bottom can also be used for channeling programs which have community wide (national, District) importance and implications like land and water conservation, erosion control, poverty elevation.

The UPKG and the village facilitators are executing the extension activities in collaboration with government or with NGO and other interested parties. In the case of business plans, the farmers themselves are individually responsible for the execution or their respective farmers groups, depending on the nature of the business activity.

Thus in this model outsiders are participating. Outsiders and farmers become partners in agricultural extension or in agribusiness development.

The other model, which also has its beginning in PRA and subsequent activities leading to RKPD, is purely owned, lead, manage, funded and executed by farmers through their village extension organization (UPKG, village facilitators, farmer leaders). This is the case when resources and expertise are locally available. With experiences gained by the follow-up activities of the IPM-FFS alumni, and by the PROSPEK trial project in South-East Sulawesi and other local projects, DAFE has

a good prospect of success in establishing the above model to become the National Agricultural Extension System based on partnership and in which participation has the meaning of cooperation, working together as equals. In this context DAFE should at least be given two more years to consolidate achievements in the 16 *District* and prepare replications in other selected *District* and to prepare a National Agricultural Extension Law. The House of Representatives is already positive in agreeing and facilitating to that end. Meanwhile, a strong National Policy should be issued as follow up.

RESEARCH-EXTENSION-FARMERS

Research and Extension linkages have always been of interest to or rather a concern for some people for sometime. Extension has been pictured as the bridge linking Research to Farming. Research is the source of goods (technologies, etc) which have to be transported to Farmers (as consumers of the goods). This is the classic paradigm of Research-Extension-Farming.

This picture neglects the reality that Research (and the Research Institute) is not the only source of knowledge, skills, and technologies for farmers. Farmer's sources of those goods are multiple, including their own experiences and those inherited from their ancestors, and also their parents.

It is not a daily event that Research produces new or better goods for the farmers, besides is not always farmer driven research. It is a good policy to have a formal relationship, an agreement or a working mechanism between research institution and extension organization.

The farmer in his daily farming activities is always confronted by facts of ever changing situations in the fields. He should always be alert to face sudden problems and be ready and able to overcome them. He cannot wait for solutions to come, he must act. Therefore, concerning research and extension we should look at it from the farmer's angle and his needs. DAFE is conducive to accommodate this.

What farmers needs is not the Research Institution with their longer term basic solutions. He needs instant solutions in the field. Meaning that knowledge, skills, technologies, and solutions or experiences should be within his grasp when he needs it. Meaning that carriers of those goods (people) should be in his neighborhood, should be closed to his farm, and should be in his environment. Those people maybe his fellow farmers, the PPL, the researchers, or any people with the needed expertise.

We need to look at research and extension not as formal government/private institutions but as an activity of the farmer, an activity in the field. A cooperation of people, with diverse background, working together in the field, directly solving problems or seeking better or new practices and production inputs. There are many farmers doing studies in their field, seeking answers for question or problems. The Action Research Facility (ARF) organized by the former IPM program/project meets this need of farmer. For the farmer Research and Extension should become one terminology not two different separate things. The proposed village training center of DAFE is a good start to begin with, managed by the UPKG.

The BPTP has already a connection with the DAFE by being a member of the District extension committee and has assigned a liaison officer at the District Extension Office. The BPTP should take the lead in organizing ARF units in the villages in the middle of the farming community/environment. These units should be run and managed together by farmers and BPTP personnel, who should live in the villages for a certain period among the farmers. The person seconded to the ARF units will become researcher-extensions or extensions-researcher. BPTP personnel will take turns to do their assignment in the villages (ARF unit). By building this ARF unit research-extension linkages is secured; research is at the bottom, at the farmers' field; is a cooperatively integrated activity/action between farmers and technicians/ professionals. This should become the Research-Extension-Farming

integrated/unified model at the bottom. A promising action by BPTP is the organizing of "Agriculture Clinic" at the Sub district level managed by BPTP personnel. Farmers are invited to visit the clinic for consultation concerning production technologies or solutions for solving problems.

ACTION RESEARCH FACILITIES (ARF)

The ARF concept is an approach to the old problem of "getting research to the field". It was successfully implemented within the context of the Farmers Field School (FFS) during the implementation of the World Bank supported IMP TRAINING PROJECT (1990-2000).

It provides a flexible response model for agricultural research that creates a more ecologically based research program, and ties this together with farmer training by tying together researchers with trainers (farmer trainers and extension officers).

In general, the ARF should be a flexible "tool" that requires no permanent physical structure to be built, but rather is able to be moved from one location to the next in response to specific problems, or to investigate new habitats.

The first task of the ARF should be to develop a database for the local are by employing a general background study, which will provide the ecological and sociological context for future work. The result of the studies will help support the other activities and resource-development center for extension workers and farmer-trainers, and a field laboratory to help researchers to access farmers and to become familiar with local farmer conditions and problems.

The field research laboratory will be the location where researchers and experts can get a clear picture of conditions in the field. Here they can work together with farmer groups and trainers to focus efforts and attention on problems more closely related to the farmer's needs.

The requirement for researcher participation in an ARF should be that researcher must observe and participate in a farmer field school (FFS) for one season, and they must develop a training exercise-in consultation with extension officers-including a simple experiment that will be carried out as a "special topic" during a farmer field school.

FARMER FIELD SCHOOL (FFS)

For a FFS, a group of 25 farmers from one location meets once a week during each rice season (or ten to twelve times) for half a day. A FFS has its own teaching-field in part of which conventional pest management practices are applied and IPM practices are followed in the other part. In every session these fields are closely observed by groups of five participants. They examine the rice plants, count pests and beneficiaries, and collect unknown insects and other specimens for further discussion.

These observations are assembled in a large drawing showing a rice plant, pests on one side and beneficial insects on the other side. The process of drawing not only fosters close collaborations but also serves as an opportunity for the exchange of information and experience among the group members. Based on the observations the groups come up with a recommendation concerning pest management. The drawing and each group's recommendation are presented to the plenary session and then thoroughly discussed. That is usually followed by a group dynamics exercise for relaxation but also to promote social competence and group cohesiveness. Eventually the FFS deals with a special topic as dictated by actual needs and selected by the participants (for example, joint rodent control). The FFSs are supplemented by a number of simple applied experiments like an insect zoo, herbivore-predator trials in cages, defoliation experiments etc.

AGROFORESTRY

Small farmers and sustainable agriculture are topics which have gotten much attention in circles who are concerned about the sustainability of agricultural development. What can be offered to improve small farmers farming system in order to increase productivity and income, to conserve soil fertility and water availability, and to maintain an ecology and environment. How to help farmers help themselves developing an outlook and a behavior conducive for appreciating, adopting, and implementing better, improved or new technologies, farming systems and management skills. Efforts towards those ends should be done with attention to the small farmers' condition, meaning the use of low-external inputs.

Agro forestry and DAFE are suitable for accommodating the two above mentioned questions of what and how. Agro forestry is the technical economic input system and DAFE is the social community education system. Agro forestry combines agriculture and forestry practices in an Agro forestry- based Farming System suitable for implementation for small farmers under different physical conditions (climate, ecology). This Agro forestry-based Farming System provides the farmers not only with food crops, cash crops, but also with forest products like wood for the household and industrial activities and also fruits for consumption or for sale.

Low external inputs for introducing and implementing Agro forestry-based Farming Systems for instance consist of providing seeds or seedlings for three planting (fruits, wood) and activities starting with PRA and subsequent planning exercises (which they can do using their own resources) and DAFEP funded training activities like seed selection, grafting, preparing *bokashi*, the use of green manure, etc.

The DAFEP educational principles and processes are already supported by the implementation of farmer-led research and extension activities like for instance in Labuan Batu, Maros, Bima and Kolaka districts, as reported by the Agro forestry Specialist. Those activities consist of trial plots, comparative studies, training sessions, field school, etc. in a wide variety of plant production and product processing.

FARMERS TO FARMERS EXTENSION

Since 1950 the idea of farmer teaching farmer or farmer learning from fellow farmer was already being experimented with, in some areas in Java. Those farmer teachers are called *Kader Tani* and organized into *Ikatan Kader Tani* (IKT). The *Kader Tani* was the forerunner of the current *Kontak Tani* (contact farmer). This contact farmer was meant to be elected by a farmer group to become its group leader/group chairman and at the same time functioning as its trainer and as liaison for the Extension Institution. The farmers group (Kelompok Tani) serves as the receiving part for the dominant delivery part of the existing extension organization.

National *Kontak Tani* was already involved in activities outside their own locality. A vegetable master farmer form Cisarua/Bandung district was a consultant employed by GTZ in East Kalimantan. An inland fisheries master farmer from Cinagara/Bogor district was invited to Malaysia for consultation and for advising and planning fisheries projects. A horticulture master farmer from Selecta/Malang district trained farmers and students in fruit production. In agribusiness master farmer from Lawang/Malang district is engaged in training people in processing techniques and business activities of farm products. He also collaborates with Magelang district KIPPK in developing village agribusiness center.

Those people have their own training centers, the so-called P4S, run and managed by them besides running their own farm enterprise. The above examples only show that farmers are capable of doing extension work, are capable of organizing and managing training for their fellow farmers.

Another example is the association of alumni of IPM-FFS (IPPHTI). The former farmer trainers of the IPM project are sustaining derivates of IPM training project, organizing IPM-FFS, Field studies, Field experiments and training farmers in technical subjects like soil conservation, organic farming, etc., provide consulting services and collaborate with international donors.

The above examples are a development from the simple farmer to farmer extension at the village level. The farmer to farmer extension approach is a sound approach and should be further strongly supported. Farmer trainers with experience from other non DAFEP *District* should be invited to participate in the development of their fellow farmer trainers in DAFEP *Districts.*

FARMERS MANAGED EXTENSION ACTIVITIES (FMA)

The changing position of the farmer from passive recipient to active initiator of activities is the most important and fundamental educational activity of DAFEP. This reversal of role can only be attained by introducing role reversal throughout the entire extension system, including institution building, development of appropriate approaches and methods/techniques and training manuals to be used by the extension worker. A socialization campaign is needed to familiarize people (officials and farmers) with the new extension paradigm.

The focus of the new paradigm is from and by the farmer. The farmer is appraising, analyzing, deciding, planning, implementing, evaluating. The family business plan is the basis for the preparation of the village extension plan, which will be executed under the guidance of or facilitated by the Farmer-Facilitators. These Farmer-Facilitators are members of the UPKG board (the management unit for extension activities) of the village.

Programs of National importance, like the welfare of people and the concern for the environment for instance will also become part of the village extension program after due consideration and sanctions given by the village community. The whole process (known as PROSPEK) needs intensive training activities, especially for field extension workers who have the duty of facilitating the introduction to and adoption by farmers and the village community. The farmers need several exercises during several planting seasons before the process becomes a habit.

Serious attention should be given to this habit building, since this is the essence of FMA. Exercises should be organized for repeating the PRA and the subsequent formulation of plans for activities. At present the spirit of farmers for FMA is good and it will be a pity if this spirit is weakened by for instance delays in release of DAFEP funds for training or a lack of seriousness from the part of government officials, including PPL.

FIELD EXTENSION TEAM (FET)

The FET serves a dual function. It is the implementation arm for the National Agricultural Extension System and at the same time the support team for the Rural Agricultural Extension System (PROSPEK concept).

Programs of National importance are developed at the National level and managed through the *District* Extension Institution to be processed and implemented as one of the *Sub district* Extension Program after due consultations, and discussions with farmers and the village community and obtaining their approval and support for implementation. Such a program may be like the Poverty Elevation Program or a Flood Control Prevention Program, Conservation Program, etc.

Programs developed by the farmers and the village community which have their origin in the PRA and the RUK and need partial outside expertise for implementation will become also a *Sub district* Extension Program.

The PPL coordinator as the Chairman of the FET should have a farmer trainer as vice chairman to be elected by the *Sub district* group of farmer trainers for a certain period of service to secure legitimacy and support from the farmers and the village community.

Needless to say the need for an intensive retraining program for the PPL, PKL, PHP to be able to serve as members in their respective sub teams, concerning agricultural and business subject matters as well as concerning methods and techniques of their reversed roles as facilitator and learning partners of farmers.

At present the FETs are still in the formation and developing stage and their members are still adjusting to their new roles and situations.

To prevent recurrence of past experiences of being neglected and the current fact that there are still PPLs without their functional status as extensions, it is urgently recommended that PPLs be installed again as national employees.

This national status of PPls is critical for the success of introducing this new FET approach and its sustainability thereafter.

While each sub team or individual team member is required to visit farmers and facilitate training etc, it should be stressed that those activities should be in accordance with the *Sub district* extension programs, meaning mandated by the farmers and accountable to farmers. It should not become a mechanical /robot-like visit like past experiences.

DISTRICT EXTENSION COMMITTEE (DEC)

During the New Order Regime (*Orde Baru*) a consultative forum (*Mimbar Sarasehan*) was formed for the purpose of bringing together Agricultural Officers (including extension) from various sub sectors and Contact Farmers (*Kontak Tani*) at the Provincial and District level. Dialogues and consultations were held periodically to exchange views and find solutions for problems encountered in the implementation of the Bimas Rice Intensification Program. Problems encountered were usually in the field of pest and diseases, inputs supply, credit facilitation. The duty of extension at that time was to facilitate the success of the overriding importance of the Rice Self-Sufficiently Program. It has nothing to do with farmers-driven programs or bottom-up planning activities.

In DAFEP concept a consultative forum is also organized, namely the District Extension Committee (DEC). The position and role of DEC, however, are entirely different. The *Mimbar Sarasehan* is a loose organization whereas the DEC, established by *SK Bupati*, is an institutionalized organization existing beside the District Extension Office.

The role of DEC is that of a coordinating forum for the implementation of agricultural and forestry extension activities. Its membership consists of people from various functional groups in the district, who have a stake in extension, whereas the *Mimbar Sarasehan* consist only of subsectoral *Dinas* officers and contact farmers.

The DEC's function is that of providing inputs and advice for the formation of policies and operational plans in extension based on farmers' needs and potentials. Its function is also to mobilize funding sources and to evaluate the extension activities. In both organizations the farmers have contacts and interactions with government officials, although of a different nature and based entirely on different approaches of extension.

Of interest to extension educators are the needed desired changes in behavior of both officials as well as farmers to make the different roles in the new extension paradigm works. For the other stakeholders it is a new experience to participate in extension activities. That is why the DEC needs

some time to function as designed. At present it is still trying to find its own style in the discharge of its duties.

Efforts should be intensified to secure the understanding of the members concerning what and how of agriculture extension. It is recommendable to assign a farmer as vice chairman of DEC and to change periodically the membership to avoid bureaucratization.

THE INDONESIAN IPM FARMERS' ASSOCIATION (IPPHTI)

IPPHTI is a national level network of IPM farmers established and declared through the Indonesian IPM Farmer Congress on July 20, 1999, by all of the participants of the congress (461 IPM farmers from 11 provinces involved in the implementation of the Indonesian National IPM program).

It was the first time they have a national-level network, by forming a coordinator board, which function as working committee with the task to guide the follow-up plan of the National Congress. The board was represented by coordinators from 27 provinces (2 farmers from each province). District and sub district level coordinators were elected during local congress.

IPPHT was born to meet the need of IPM farmers to build a network for facilitating their efforts to empower IPM farmers' role. They are aware that farmers face many problems due to the fact that many institutions and organizations regard and treat farmers as "object".

The visions of IPPHT are Farmer's role empowerment and ecological balance. Farmers as the biggest group of the community is always considered and treated as low class and marginal citizen and has almost no say in the community. Farmers are always dominated by others and only trained to implement technology packages and to passively accept other things imposed on them by others in the name of developments. IPM farmers' concern for the ecology and the environment is very serious and therefore they are trying hard to develop and implement farming practices that are environmental friendly leading to a situation of environment balance sustainability.

The program of work consists of:

1. Network Development Program
2. Farmers' Science Development Program
3. Fund Raising Program
4. Secretarial Program
5. Advocacy Program
6. Gender

HISTORICAL OVERVIEW OF THE CHANGING AGRICULTURAL EXTENSION IN INDONESIA

The position of farmers in the conventional agricultural extension system in Indonesia is that of passive receivers of messages coming from experiment stations and delivered by the Agricultural Extension worker. Those messages contain recommendations on the use of improved production technologies and better production inputs, like seeds and chemical fertilizers.

The position of the extension worker is that of middlemen between the experiment station and the farmer. The extension worker is also the teacher of the farmer. He persuades farmers to adopt the recommended practices. He organizes farmer courses, method and result demonstration, fieldtrip, field days, and farm broadcasting programs. He also distributes leaflets, posters. He is supported by audio-visual performances.

The persuasive one-way approach easily becomes a compulsory approach. By the end of the 1950's the overriding priority program, the rice intensification program, was announced. Agriculture Extension became the tool and the channel for achieving targets of the program. For instance row planting was compulsory, chemical fertilizers use was compulsory.

Farmers and agricultural extension workers alike were in no position to reject the program or to alter the approach. The overriding rice intensification program practically neglected extension work in other farm products. However, it should be acknowledged that farmers continues activities serving their own needs as they seen fit, like producing commodities for the local markets.

During the *Bimas Rice Intensification Program* (started in 1969) the focus was on achieving rice production targets. The TV approach of the *Bimas* period did not alter the position of farmers as well as the relationship between extension worker and farmer. The *Bimas Program* with TV extension approach and with its technology and input package succeeded in increasing substantially the rice production, even at one time (1984) a rice self-sufficiency was achieved. Farmers became familiar with modern rice production technologies and with the use of chemicals (fertilizers as well as pesticides).

In spite of all the achievement in rice farming, the farmers are still passive receivers of messages and programs coming from outside or from others (government). They are deprived from opportunities for self-development as farmers, from taking intelligent decisions and initiatives on improving their own farm business, from expressing their needs and wants in the process of agricultural development planning and programming.

Those conditions reflect also the still existing feudalistic structure of rural society and paternalistic behavior within the village community. The farmers live and belief in those traditional social relationships. In this condition changes will take place very slow. Interventions from outside is needed to speed up the process of desired changes in social relations of the rural area.

During the persuasive extension approach in the 1950's, and at later period, Senior Agriculture Officers were already thinking educating farmers to educate themselves and farmers to become the subject of development. The compulsory approach in support of rice production program however pushed that idea into the background although not entirely. Farmer-trainers were already active. They were called Farmer Cadres (Kader Tani), later to become Contact Farmers (Kontak Tani), the elected leader-trainer of the farmer group.

Agriculture Extension operates in the rural area (villages). It has relations and come in contact with farmers (village people) and influences farmers in their behavior, in adopting technologies. Agricultural Extension is an ideal entry point for also introducing new social relations in the villages and new relations between farmers and extension workers.

Prior to DAFEP (Decentralized Agricultural and Forestry Extension Project) in selected parts of Indonesia several projects have been already carried out (IPM, KUF, Delivery, and PROSPEK). Those projects introduced new concept in implementing agricultural development, rural development, and community development. The Agricultural Extension approach of those development activities is the participatory approach. The results were satisfactory. The farmers responded positively to the new roles offered to them, which are as participant of activities and or partners in activities. The right approach, method and techniques plus the already changing times (reformation, globalization) are conducive for the change to take place, that is the position of farmers from object to subject of development. This new position of farmers is the main factor, the main basis for the sustainability of programs dealing with agricultural development and farmers.

DAFEP comes into the picture at the right time as follow up to the previous projects and at a time when the reformation fever is still warm. Farmers response in DAFEP villages is positive. They

consider DAFEP as useful in helping them to acquire new knowledge and skills, in improving their understanding that management, planning and bookkeeping is important for the progress of their farm business.

DAFEP recognizes the existence of master-farmers (petani ahli) in the villages and their capabilities for training other farmers. DAFEP is also instrumental in bringing farmers closer to each other through meetings, training activities, and planning exercises, etc.

Farmers feel that they are being treated as human beings. This is the main reason for their positive response to DAFEP. Their latent energies, suppressed for a long time, found an outlet opened up by DAFEP principles. Dormant farmer groups are awakening and become active in planning and training exercises. In a relative short time DAFEP proves to be applicable as an extension concept and as an operational organization for empowering farmers.

Farmers representatives are already members of the District Extension Committee (DEC) and farmer trainers are members of the sub-district Field Extension Team (FET). In the villages farmers have already elected their UPKG (Village Activities implementation unit) officers. Proposals for villages extension and training activities were submitted for approval to the FET and for funding by the District Extension Office (DAFEP funds) and implemented in the villages facilitated by extension workers and farmer trainers. An important exercise is the PRA that leads to the formulation of village extension activities plan. Some are farming plans submitted to the *Bupati* for funding and some activities are implemented using village sources (*swadana*). Many farmers have already their own family enterprise plan, which is a good practice and very important for self-improving adjustments of their enterprise. Some farmers are convinced that their income will increase since they have already start bookkeeping they said. However, the results of technology training at this time in terms of increased incomes are not yet available.

All those activities and exercises need to be established as a habit. The yearly or seasonal activities need to be repeated several times, i.e. the intervention of DAFEP project to consolidate the achievement of the capacity building of farmers need to be extended for at least two more years after the closing date of the project.

The above situations are the result of the extension workers (PPL) and related colleagues working in the villages in their new roles of facilitators. It can be imagined the difficulties of changing roles, from that of telling farmers what to do and how to do, to that of listening and being partners in learning activities. Good extension workers should have no problems in applying participatory techniques to the implementation of extension methods they already know. PRA, planning processes (RUK to RKPD), gender mainstreaming, are new subjects they should master, as well as additional commodity production techniques as needed by farmers. He should also familiarize himself with facilitating farmers' activities doing experiments and verification studies. It is also imperative for the extension worker to make facilitating a habit in order to match the developing active role of farmers as subject of development.

It is worthwhile considering the possibilities of re-installing extension workers as national employees to secure their position and careers as functional extension officers and their mobility for transfer to other areas where they are needed. They should be seconded to the district extension office and report to its chief without jeopardizing their accountability to the farmers.

A strong continuous training program and a HRD plan for those extension workers should be further developed to strengthen their position as partners of village farmer trainer and facilitators of farmers' activities. Their training should also include the facilitation of collaboration and partnership building of farmers with the business community and the banking institutions. The apparent success at this early stage of the duet of farmers and extension workers is a firm foundation for the continued

implementation of DAFEP principles. Continued support from the District Extension Office will further strengthen this foundation, especially by an attitude with the spirit of DAFE.

There is a need for improving the understanding of district officials and district parliament members. They should grasp the importance and the strategic position of agriculture extension as an investment for the development of agribusiness leading to increased economic activities and higher incomes of the rural communities. They should understand that a prosperous rural community will contribute substantially to the district PAD (District Treasury) and therefore the provision of funds for extension activities and for the running of the district extension office should be improved and sustained.

A continuous effort should be made to build a spirit of solidarity and understanding from other *Dinas*/Institutions at the district as well as at the national level. The long history of independent sub-sector chauvinism and quarrel about a unified or a diversified extension organization could be overcome by a strong ministerial policy statement and its strong implementation, that DAFE is the National Agricultural and Forestry Extension System. In this connection the promulgation of National Extension Law is urgently needed. Measures to that effect have already been taken by the agency for agricultural HR development and parliament is favorably cooperative toward that end.

The need of sub-sector institutions for personnel in their discharge of their duties in rural area can be overcome by strengthening the sub-district agricultural office with the appointment of agricultural officers. Their duties would be in the service and regulatory function of Agriculture Administration. The common practice of using extension workers for service and regulating functions should not be allowed to happen again. The creation of PPL (agricultural extension worker) in the early 1970's separated from the post of sub-district agriculture officer is for the sole purpose of educating farmers.

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IMPLEMENTING AGRICULTURAL TECHNOLOGY PROMOTION AND TRANSFER PROGRAMME: THE MALAYSIAN EXPERIENCE

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SUMMARY

This paper outlines the implementation of MARDI's (Malaysian Agricultural Research and Development Institute) agricultural technology promotion and transfer plan. Aggressive measures have been taken to establish linkages with the various Federal and State agencies entrusted with the extension and the overall development of agriculture. The plan involves development, promotion and transfer of technology and focuses on commodities such as tropical fruits, rice, livestock and poultry, and entrepreneurship development in the food processing industry. A model of a successful technology transfer mechanism involving the new pineapple hybrid Josapine is highlighted. Josapine is a cross between the local Sarawak and Johor varieties and has gained wide market acceptance. It has benefited farmers and large scale entrepreneurs through implementation of the technology promotion and transfer programmes via the extension agencies, and direct commercialization of the crop.

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INTRODUCTION

Agricultural technology transfer and extension for farmers in Malaysia have been implemented through various approaches by relevant agencies under the Ministry of Agriculture and Agro-Based Industry (MoA)

The Malaysian Agricultural Research and Development Institute (MARDI) has been entrusted with R&D, promotion and transfer of technology (TOT) while the Department of Agriculture (DOA) is responsible for carrying out extension and regulatory services.

Other agencies are also involved through the MoA Inc. concept whereby the various agencies work together towards achieving a specific goal. This helps to facilitate and enhance the delivery of support services to the farmers, fishermen and private sector enterprises.

An effective agricultural technology transfer and training (ATT&T) or extension programme must be able to increase farmers' productivity. It can be done by offering technology, advice and help to farmers to enable them analyse and identify problems and opportunities.

This paper discusses the implementation of promotion and the agricultural technology transfer with special reference to the TOT Mechanism for Josapine pineapple.

AGRICULTURAL RESEARCH AND DEVELOPMENT

MARDI was set up by an Act of Parliament in 1969 to provide technological support for agricultural advancement of the country. Over the last 30 years MARDI has contributed significantly in terms of research and technology development.

With the challenges and demand of ASEAN Free Trade Area (AFTA) and World Trade Organization (WTO), new approaches would be needed to ensure that MARDI continues to be relevant in the country's main thrust and development.

MARDI has since redefined its role to provide the following core functions:

- Generate (leading edge) technology
- Transfer of technology (TOT) for public good and social economic consideration
- Commercialise technology & IPR for wealth generation
- Technical, scientific and expert service provision
- Leading towards K-economy entrepreneur with a K-intensive HRD

To facilitate the formulation of local specific technologies and improve linkages with the various agencies, farmers, and entrepreneurs, MARDI has reorganized its structure. The TOT programmes in MARDI were strengthened with the establishment of a TOT centre, with a Director in each of the 13 States.

MARDI's R&D stations were also reassigned to perform the above core functions. Three categories have been identified; namely TOT, R&D and specialise stations. TOT stations coordinate the promotion and ATT&T as well as the commercialisation in the State.

Complementing TOT stations are the Business Development Unit (BDU), the Planting Material, Seed and Livestock Breed Production Unit and the various research centres. Included among these research centres are Horticulture Research Centre, Strategic Livestock Research Centre, Food Technology Research Centre, Economy and Technology Management Research Centre, Strategic Resource Research Centre and the Biotechnology Research Centre. At the research centre level, research officers are also expected to contribute some 30% of their time to TOT activities.

MISSION, OBJECTIVE AND STRATEGY

Mission

To develop and transfer technologies needed in the Government's efforts to transform agriculture into a modern, commercial, innovative and competitive sector.

Target Group

MARDI's ATT&T and commercialisation programme is focused towards the implementation of successful technological and business innovation at three main target groups:

1 Smallholders/traditional producers (through extension and rural development agencies)

2 Food and agro-based SMEs (investment between RM0.25 – RM10.0 million)

3 Private/corporate sector (through JVs, licensing, consultancy and technology incubator programme)

Objective

The main objectives of MARDI's TOT programmes are:

1 To enhance and accelerate the application of new technologies by smallholders and traditional producers.

2 To develop technology-based SMEs in food and agro-based industries in the State

3 To enhance and accelerate technology commercialisation by the corporate/private companies.

Strategy

MARDI adopts three main strategies to ensure the effectiveness of its programme. They are:

1 Aggressive `Industry Linkages and Technology Promotion' to the target groups.

2 Conduct `Technology Development, Transfer and Commercialisation' projects based on the developed technology, with active participation of the target groups

3 Provide quality `Technical Support Services' to the target groups

PROGRAMME AND ACTIVITY

The TOT programmes and activities for the State are summarised as follows:

Programme	Activity	Target
Strategy 1: Industry Linkages and Technology Promotion	a) Business Forum	- Client interaction through business forum.
(i) Client Interaction	b) Dialogue with entrepreneur	- Dialogue and SMEs clinic on food processing.
	c) Clients Open Day	- Held every Saturday fourth week of the month
	d) Visit to farmers' farms	- Visit by MARDI officers to farmers farm/SMEs premise as a follow up to clients open day. Farmers/SMEs visit to selected MARDI's Stations/ Lab.
(ii) Technology Promotion	a) Seminar	- Seminar on food technology and industry development.
	b) Exhibitions	- State level exhibitions, including S&T Expo - radio air-time
	c) Publicity	Articles on rice, fruit growing and food processing.
	d) Technology Info Centre(TIC)	- info at TIC
	e) Model Farm	- Demonstration plots.
(iii) Industry linkages	a) Bilateral with other agricultural development agencies.	- Bilateral meetings with MADA, KADA, DOA, FAO, FAMA and SEDC.

Strategy 2: Technology, Development, Transfer and Commercialisation (i) On-farm trials	a) Pilot project b) Technology up-scaling	- Pilot projects on fruit production, paddy precision farming, fertigation, will be conducted to demonstrate new technology. - Upscaling to determine their commercial viability for State TKPM
Programme	**Activity**	**Target**
(ii) Area development	a) Area development/ crop and animal zoning	- Formulation of commodity development plans.
(iii) Bilateral projects	a) Bilateral with KADA/ KESEDAR/ RISDA / FELCRA	- Collaborative projects under TWGs to address crop, animal and food production programme
(iv) Entrepreneurs development	a) Technology and business development support b) SMEs incubator c) Adoption system	- Collaborative projects with food based SMEs to support the Halal Hub - Nurture development of new SMEs. - Special development programme for new industries.
v) Technology commercialisation	a) Equity J-V b) Licensing c) Consultancy d) Technology incubator	- Commercialisation with private sector involvement.

Strategy 3 Technical Support Services	a) Technical training	- Technical courses to staff of agricultural development agencies and private companies
(i)Technical Services	a) Technical advisory	- Visiting agents to MoA Inc. projects, advisory and trouble shooting, laboratory analyses and quality assurance services
	b) Technical publication	- Manual and brochures
(ii) Planting Material Production	a) Planting materials	
	b) Tissue culture	- Seeds and planting materials

IMPLEMENTATION PLAN

Aggressive measures are being undertaken by MARDI to establish linkages with the various State and Federal agencies entrusted with agricultural development. Close link are maintained with the DOA, DVS, FAO, FAMA, FOs, KADA and MADA in the form of MoA Inc. bilateral programmes and TWGs between MARDI and these agencies are very important as these agencies are directly involved with the farmers.

Extensive vetting must be done before promoting the technology to the farmers and entrepreneurs because in some cases the so-called technologies are mere research findings, incomplete and not likely to result in marketable output.

The ATT&T implementation plan focuses on rice and tropical fruits commodities such as pineapple, papaya, jackfruit, carambola, mango, citrus, banana, watermelon, rambutan and durian. These fruit types are in big demand both locally and in overseas market. Vegetables such as tomatoes and chillies are also given emphasis in projects involving the active participation of farmers and extension agencies.

Entrepreneurship development programme in food processing is also given emphasis. Focus is on 13 clusters of food products that have high demand, availability of raw materials and technology (Embi and Seterfarzi 2003). The existing food entrepreneurs would also be given training and advice to help them improve the quality of their products through Good Manufacturing Practices (GMP).

One of the most recent successful technology transfer mechanisms involves the hybrid pineapple Josapine.

TRANSFER OF TECHNOLOGY FOR JOSAPINE PINEAPPLE

Title of Technology

Fresh pineapple production of Josapine cultivar for domestic and international market.

Scenario

Malaysia, comprising Peninsular Malaysia and the states of Sabah and Sarawak, is located 7 degrees north of the Equator. To the north lies Thailand and to the south Singapore. Peninsular Malaysia is separated from the states of Sabah and Sarawak by the South China Sea. There is great potential for the expansion of pineapple industry in Malaysia. Malaysia's pineapple industry is unique because nearly 90% of the crop is planted on peat soil, which is considered marginal for most other agricultural crops (Mohammed Selamat 2002).

The current technology for cultivation of pineapple cv. Josapine on peat appears adequate although the inability to mechanise on this type of soil is a severe disadvantage in the face of labour shortage and rising input costs. There is an emerging interest in planting fresh fruit cultivars especially for Josapine on mineral soil to obtain better quality produce. In the existing cultivated area on inland soils, where pineapples are grown commercially, a variety of soil series of mineral soils are often available. It ranges from a very clayey to very sandy soils. However, a very low plant population of less than 10,000 plants per hectare is generally used. Consequently, low yield is often harvested. Since its release in 1996, Josapine, a table-pineapple hybrid cultivar, has been extensively grown on peat soils and to a certain extent on mineral soils. A study was conducted to determine the performance of the cultivar on a sandy mineral soil.

Currently, Malaysia is a net exporter of pineapple mainly canned products. The Balance of Trade Plan (DOA 2003) indicates that in the year 2010, there will be no import of pineapple but an export surplus. The per capita consumption is also expected to increase from 9.5 to 15 kg per person.

Fresh pineapple production in Malaysia currently involves only the smallholders with a combined plantation area of about 4,000 ha, fairly evenly distributed in Peninsular Malaysia, Sabah and Sarawak. Currently export of fresh pineapple is mainly to Singapore. There is scope for expansion of export to other Asian and Middle East countries.

With the new MARDI pineapple hybrid 'Josapine', the prospects for expanding the domestic market as well as increasing export of pineapple are good. This cultivar bears fruits early and the fruits are very sweet and aromatic with deep golden yellow flesh (Chan and Lee 1996). The fruit has good shelf-life and resistant to black heart disorder caused by low temperature storage. This is a distinct advantage that allows Josapine fruits to be shipped for export in refrigerated containers.

From the list of technologies available for commercialisation, Josapine has a good potential for promotion. Currently the adoption rate for Josapine pineapple is fairly good as indicated in the impact studies on MARDI's technology 2002. Complete package of technology is available at MARDI.

Background of Project

Josapine pineapple is suitable to be planted on peat and a wide range of other soil types. The transfer of technology project was conducted in the States of Kelantan and Johor over a period from 1999 to 2003. Currently, the total hectarage for pineapple in Kelantan is about 250 ha which is mainly planted with Sarawak variety. However, Sarawak variety has limited market. Johor on the other hand is the major pineapple growing area with hectarage exceeding 4,000 ha. Varieties grown include Morris, Gandul, N 36 and Josapine.

Although farmers have been planting pineapples in Kelantan for a long time, new technologies in terms of varieties, hormoning for uniform fruit bearing, post harvest technique and quartering technique for planting material production are not practised or adopted widely.

Problems and Constraints

- Farmer acceptance of new cultivar Josapine

  The farmers in Kelantan are used to planting Sarawak and therefore the introduction of new varieties requires monitored ways of transferring the technology

- Supply of quality suckers as planting material

  At the moment suckers are only obtainable from Johor farms and they are costly (RM0.40–RM0.60 per sucker).

- Minimum farm size

  For viable commercial fresh pineapple production, the minimum farm size is 50 ha (MARDI 2003). It requires an initial investment of RM1.85 million for a 50 ha production. However, the payback period is 4.5 years and Internal Rate of Return (IRR) is 20%.

- Marketing constraint

  Although there is a good demand for fresh pineapple, with Josapine selling at retail price of RM0.80–RM2.00/kg and at RM2.99/kg in Kuala Lumpur hypermarkets, the ex-farm price is extremely low. Currently FAMA buys at ex-farm price of between RM0.40–RM0.90/kg according to grades (grade C, size <0.9 kg, grade B, size 0.9–1.1 kg and grade A, size >1.0 kg). Private marketers buy at an ex-farm price of RM0.70/kg irrespective of grade. Furthermore, the logistics involved in bringing choice quality Josapine from Kelantan to Kuala Lumpur have not been fully organized yet.

Objectives: Promotion, ATT&T and Commercialisation

- New pineapple variety Josapine for fresh consumption
- Quartering technique for planting material production
- Hormoning technique
- Value added food processing from pineapple

Target Group

- Farmers
- Private Entrepreneurs
- Agencies (DOA, FAMA, RISDA, FELDA, FELCRA, SEDC)

Work Plan

- Endorsement by review committee
- Technology promotion to relevant farmers and agencies includes awareness on the merits of the new varieties and its potential in both domestic and export market.
- Training of implementers and farmers

- Pilot project by farmer through development agencies like DOA and FAO.
- Impact assessment
- Technology commercialisation (50 ha farm) by entrepreneur
- Farm accreditation (SALM) by DOA
- Malaysia Best certification by FAMA

Programme Implementation

The detail programme implementation and activities for 3 years period is as shown in Table 1.

Table 1: Implementation Programme and Activities

Programme	Activity	2001	2002	2003
(i) Industry linkages	a) Business Forum for interaction with client	X X		X X
	b) Dialogue with producers	X X		
	c) Clients Open Day	X X X X	X X X X	X X X X
	Visit to farmers' farms (follow-up to Client's Open Day)	X X X X	X X X X	X X X X

(ii) Technology Promotion	a) Seminar on technology and industry development	X	X	X
	b) Exhibitions -State level	X	X	X
	c) Mass media publicity - Radio & TV air-time. Article in local press & VIP visit to MARDI Stations	X X	X X	X X
	d) Technology Info Centre	X X X X	X X X X	X X X X
(iii) Agency linkages	a) Bilateral meeting with FAMA / DOA /FOA	X X	X X	XX
	b) Bilateral meeting RISDA / FELCRA	X X	X X	X X
(iv) On-farm trials	Pilot project 2 ha	X		
	4 ha		X	
	16 ha			X
(v) MoA Inc. Project Meeting	a) Technology support for TWGs	X X	X X	X X
(vi) Impact study and technology auditing	a) Clientele adoption			X
	b) Feedback	X	X	X
	c) Profit and loss - comparison between estimated cost / return	X	X	X
(vii) Technology commercialisation (50 ha) (selected entrepreneur)	a) Advisory and Consultancy			X X X X

Programme	**Activity**	**2001**	**2002**	**2003**
(viii) Technical Support Services	a) Technical training	X X X X	X X X X	X X X X
	b) Technical advisory	X X X X	X X X X	X X X X
(ix) Planting Material Production (on farm)	a) Quartering	X X X X	X X X X	X X X X

The work plan and implementation programme is summarised in the flow-chart (Figure 1)

Most of the TOT activities carried out by the agronomist concerned were the training for the trainers, that is the transfer of technologies to the extension agents involved in the pineapple industries and also other interested parties. These are evident from the extensive list of papers presented in the seminars, some of which are listed in the bibliography. Some of the training sessions are listed below:

- Pineapple production (MARDI Pontian, May, 1995)
- Pineapple production (IADP Samarahan July, 1995)
- Pineapple production (FAO Selama Kedah, August 1995)
- Pineapple production (MPIB, 1996)
- Pineapple production (DOA, 1997)
- Pineapple production (MPIB, 1997)
- Pineapple production (MPIB, 1998)
- Pineapple production (MPIB, 1999)
- Pineapple production (MARDI, 2000)
- Pineapple production (FAMA, 2001)
- Pineapple production (FAMA, 2001)
- Pineapple, Banana and Melon production for KEJORA (MARDI, June 2002)
- Pineapple, Banana and Melon production for KESEDAR (MARDI, August 2002)
- Pineapple production (DOA and MARDI Terengganu, August 2002)
- Pineapple production (IADP Kalaka Saribas, 2003)

Impact Assessment

This has been conducted in the year 2002 to evaluate the following aspect:

- Clientele adoption
- Feedback
- Profit and loss - comparison between cost/return

CONCLUSION

Aggressive measures are being undertaken by MARDI to establish linkages with the various State and Federal agencies entrusted with agricultural development. Close link is maintained with the DOA, DVS, FAO, FAMA, FOs, JPS, KADA and MADA in the form of MoA Inc. Bilateral programmes and TWGs between MARDI and theses agencies are very important as these agencies are directly involved with the farmers.

An example of a successful ATT&T and commercialisation programme is that of a package technology for the new pineapple hybrid Josapine.

The mechanism involved includes training, technical advisory services, upscaling, pilot project implementation and large scale commercialisation.

The success of the project highlights the importance of Research – Extension – Farmers – Private – Sector linkage on ATT&T and commercialisation.

It also illustrates the importance of public-led ATT&T in determining the success of agricultural development.

The continued active participation of the private sector is also essential for the successful implementation of ATT&T and commercialisation in line with the Third National Agricultural Policy (NAP3).

The public sector will facilitate and enhance the delivery of support services to farmers and private sector enterprises to achieve their income and business objectives.

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GLOSSARY OF ACRONYMS

AFTA	-	ASEAN Free Trade Area
ATT&T	-	Agricultural Technology Transfer and Training
BPM	-	Bank Pertanian / Agriculture Bank
DOA	-	Department of Agriculture
DVS	-	Department of Veterinary Services
FAMA	-	Federal Agricultural Marketing Authority
FAO	-	Food and Agriculture Organization
FELCRA	-	Federal Land Consolidation and Rehabilitation Authority
FOs	-	Farmers' Organizations
GAP	-	Good Agricultural Practices
GMP	-	Good Manufacturing Practices
HRD	-	Human Resources Development
IADP	-	Integrated Agricultural Development Project
IPM	-	Integrated Pest Management
JPS	-	Jabatan Pengairan & Saliran /Department of Drainage and Irrigation
KADA	-	Kemubu Agricultural Development Authority
KEJORA	-	Lembaga Kemajuan Johor Tenggara /Johor Development Authority
KESEDAR	-	Lembaga Kemajuan Kelantan Selatan / South Kelantan Development Authority
LPNM	-	Lembaga Perindustrian Nenas Malaysia / Malaysian Pineapple Industry Board
MARDI	-	Malaysian Agricultural Research and Development Institute
MoA	-	Ministry of Agriculture and Agro-Based Industry
MoA Inc.	-	Ministry of Agriculture Incorporated
MPIB	-	Malaysian Pineapple Industry Board

NAP3	-	Third National Agricultural Policy
QAP	-	Quality Assurance Programmes
R&D	-	Research and Development
RISDA	-	Rubber Industry Smallholder Development Authority
RM	-	Ringgit Malaysia / Malaysian Ringgit
SEDC	-	State Economic Development Corporation
S&T	-	Science and Technology
TKPM	-	Taman Kekal Pengeluaran Makanan / Permanent Food Park
TOT	-	Transfer of Technology
TWGs	-	Technical Working Groups
WTO	-	World Trade Organization

FARMERS' PARTICIPATION, INCLUDING WOMEN AND YOUTH FARMERS, IN THE IDENTIFICATION OF FARMERS' TECHNOLOGICAL NEEDS AND PROBLEM SOLUTION IN KOREA.

Dr. Woo Gun Lee

BRIEF HISTORY OF AGRICULTURAL EXTENSION SERVICES

In 1906, the Agricultural Demonstration Station was established for primitive agricultural experiment and research in Korea.

After the national independence(1948), the Korean War (1950~3), and the passing of the Agricultural Extension Law (1957), a modern type national agricultural extension service system was developed as a post-war rehabilitation. In that time, there were overlapping and competition between the agricultural extension and community development.

Thus, in 1962, agricultural and community development and other related functions of various organizations were integrated under the Rural Development Administration (RDA).

Major Achievements of the Extension Program

- After Korean War, Korea faced by problem of starvation. The RDA researchers developed a high-yielding rice varieties ("Tong-il" etc.) with International cooperation, and well-educated extension workers disseminated the research results to the farmers by training, visiting and demonstrating methods.
- From the 1970's Korea achieved self-sufficiency in rice the main food of Korean people(called as a green revolution in Korea).
- Korea has four different seasons characterized by the monsoon weather. Crops could be grown during the warmer period (April~October).
- But from 1980's farmers could produce the fresh vegetables in any season by utilization of transparent vinyl house technology(a white revolution).

MISSION AND GOALS OF AGRICULTURAL EXTENSION

Korean agriculture faced a historic challenge due to the globalization, decentralization, consumers' various demand with farm-labor shortage. That made the extension function weaker and harder comparatively.

The Mission of RDA

The "Rural Development Law" describes objective of the organizations as to contribute to the development of farmers' welfare through;

- **Research** agricultural technologies
- **Transferring** scientific technologies and knowledge
- **Training** agriculture related people

The Goals of Agricultural Extension

All the Korean extension activities for agro-technology transfer are based on;

- Efficient farm management to meet the competitive agriculture,

- Substantial increase in the farmers' income and,
- Healthy people and healthy rural area.

To accomplish the above objectives, the area-specific model projects for higher income and new technologies are implemented at the national or regional level.

NATIONAL AND LOCAL EXTENSION ORGANIZATION

National Extension Related Organization

Korean agricultural extension organizations are well organized hierarchically to collect the farmers' technological needs and problems.

Rural Development Administration (RDA) is an outside arm of the Ministry of Agriculture and Forestry (MAF), and assists the MAF on matters of technical and extension work problems at the nation's rural development policy.

There are Research Bureau and Extension Service Bureau in RDA. And the Extension Service Bureau has 4 divisions in it.

The Extension Planning Division is responsible for budgeting, personnel management and the support national integrated community-based rural development, while Home Economics Division is in charge of rural welfare. Other divisions, which is staffed with production-oriented specialists has 2 subject-matter divisions namely Food Crops Division, Horticulture and Livestock Division.

Technical Training Division which was removed to the National Agricultural College of the RDA in 1999 is responsible for training farmers' and extension workers throughout the country.

The Farm Management Office is to support both parts of the research and the extension on farm management and computing services with its 2 divisions.

The Communication & Media Center, popularly known as "Agricultural Information Center", is responsible for all the information services of RDA.

Local Extension Systems

There are 9 Provincial RDAs (PRDA) under the 9 Provincial Governors.

The 157 City/County Agricultural Extension Centers are outside arms of and considerably dependent on the City/County Governments including financing.

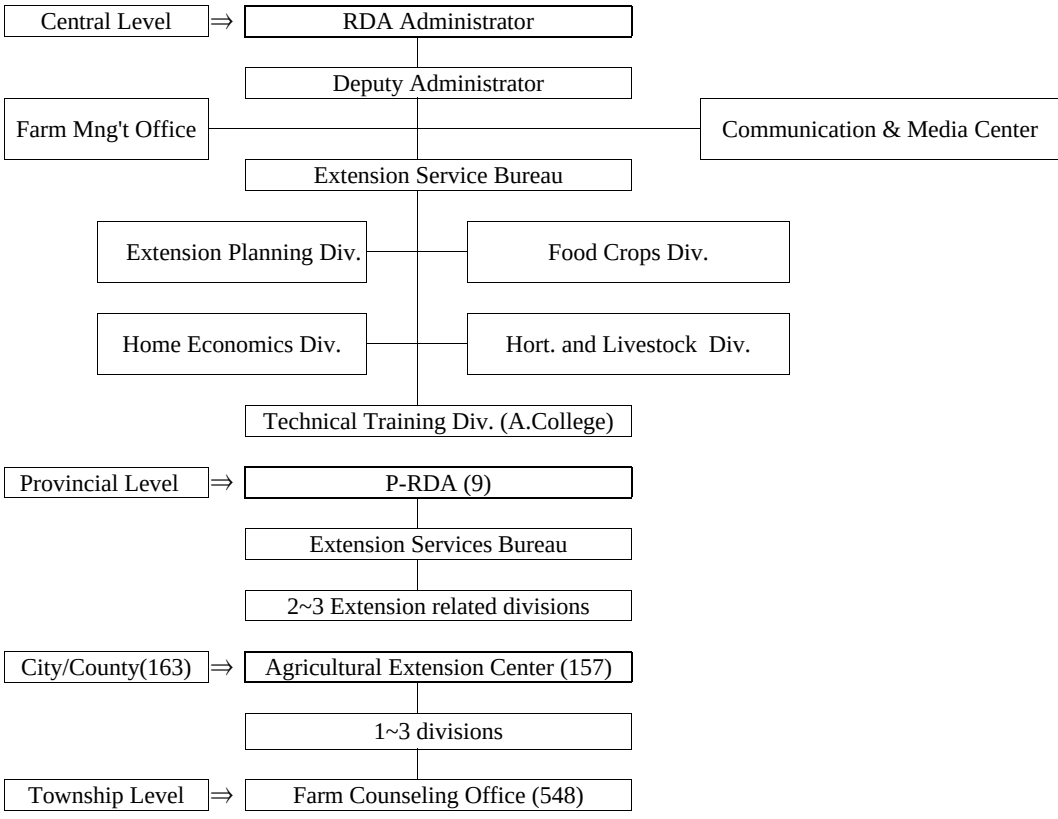

Figure 1. National and Local Extension Related Organizations

Finally, there are the real grass-root extension organizations under the jurisdiction of the County Extension Centers, which are named "Farm Counseling Office" totaling 548 across the nation at the township level. Each office is geographically responsible for extension programs.

These local extension offices make plan and carry out localized programs, and execute national extension programs financed by the national government.

Extension Personnel

In 1958, the Institute of Agriculture worked with 944 extension personnel but the number has steadily increased to a total of 7,979 through the end of 1990.

About 1,000 extension workers were changed into researchers (1992, 1994), and before decentralization, RDA had taken charge of all the extension personnel administration, directly or indirectly including appointment, positioning and promotion. However, since 1997, most of the field extension personnel has changed from central to local governors.

By 2003, there are 4,724 extension officials throughout the country. 71 at RDA, and 227 extension agents at the 9 provincial RDAs. About 94% (4,426) of the total extension personnel are working directly with rural people, stationed at the local level of either city/county extension centers (157) or their branch offices.

On the average, one extension field agent covers 8 villages (35,679) with 289 farm households (1.28 mil) and 421 hectares of farm land (1.86mil).

Extension Budget

- Extension budget comes from dual sources. One from central government and the other does local government.
- Under the matching fund system, the budget for field demonstration project is shared 50% each by both central and local government.
- Extension budget was steadily increased year by year. However, this has been decreased since 1998 because of the economic crisis(IMF management). After this crisis, the extension budget was increased again to vitalize the extension activities.

Table 1. The number of the extension personnel (July 2003)

Regional	Total			Rural Extension			Home Extension		
Level	Total	Senior	Junior	Total	Senior	Junior	Total	Senior	Junior
Total	4,724	445	4,279	4,145	427	3,718	579	18	561
RDA	71	32	39	61	27	34	10	5	5
Province	227	40	187	180	33	147	47	7	40
City/County	4,426	373	4,053	3,904	367	3,537	522	6	516

Table 2. Yearly Budget for Extension *(Unit: million won)*

Fiscal Year	Total Amount	Fund Source			
		Central Government		Local Government	
		Amount	Ratio(%)	Amount	Ratio(%)
1963	190	190	100	-	-
1970	1,671	593	35.5	1,078	64.5
1980	13,661	2,913	21.3	10,748	78.7
1990	89,183	8,797	9.9	80,386	90.1
1998	263,918	82,177	31.1	181,741	68.9
2000	240,878	85,260	35.4	155,618	64.6

1US is equivalent of 1,300 won (June 1, 2001)

Clientele of Agricultural Extension in Korea

Farmers including women and rural youths are the main clientele of agricultural extension services. They can participate in various agricultural extension programs.

Along to the shortage of labor, well trained farmers' are needed. So, RDA provide fostering of the future farmers by training and supporting the farmers' learning group activities. They discuss on their mutual concerns by themselves.

Table 3. Farmers' Learning Groups

Name of Group	4-H	future farmer	rural leader	women leader	Commodity producer
No. groups	2,394	5(17years)	1,670	172	-
No. members	62,414	120,294	77,860	97,340	94,240

There are 77,860 members in 1,670 of rural leaders' group, and 97,340 members in 172 of rural women leaders' group.

Korean government has supported 120,294 members of future younger farmers during the 17 years since 1981.

2,394 of 4-H groups consisted with 75% of student 4-H members (46,872) and 25% of farming 4-H members (15,542). To lead the farming 4-H members RDA plans investing with 700million won (US$ 583,000), and 600 million won (US$ 583,000) for the student 4-H members in every years. If they want to be a future younger farmer, Korean Government will support 200 million won (US$ 166,000) for each member for farm management.

By this step, some of 4-H members can become the future farmers, followed by to be rural leaders or Commodity producers.

Sometimes other clienteles of agriculture as representatives of consumers, local governments (even another extension agents) or international organizations(or foreign trainees) can also participate in this technology transfer and feedback system directly or indirectly.

All of them can participate in various agricultural extension programs and give us somewhat useful information.

They can meet an extension agent on their farm, Demonstration field or in the office. They can take part in several training or workshops as they want.

IDENTIFICATION OF THE FARMER'S NEED FOR R & E

The following chart shows the extension organizations at various administrative level and technology transfer & feedback system in Korea. Technologies are transferred by various extension methods

During the whole extension activities, all the extension organizations observe and collect the farmers' technological needs and problems. Sometimes those needs can be included not only agri-

techniques but also their economic and/or non agri-income jobs or individual consumer or other client's demand.

Major Extension Strategies

Achieving self-sufficiency in rice, and according to the economic growth, the extension programs in Korea had to be changed from the food crop-centered to the income crop-centered. Thus, The RDA has organized the diversified extension subjects which form specialized techniques and skills for crops to meet the needs of specified farming actively.

Farmers including women and 4-H members can be participated in local or national level various extension methods. The participatory & experiential learning are regarded as a very important ones.

Open forum, group discussion in solving problems, demonstration, practice, benchmarking through comparative observation trips, participants' presentation, and sharing of experiences are introduced to enhance the extension effects.

Most of all the training, meetings give them evaluative questionnaires to collect their technological needs and farming problems. From all kinds of the activities, extension agents can collect and analyze not only farmers' felt needs but also their unfelt needs as well. Those unfelt needs can be gathered on the spot of demonstration plot.

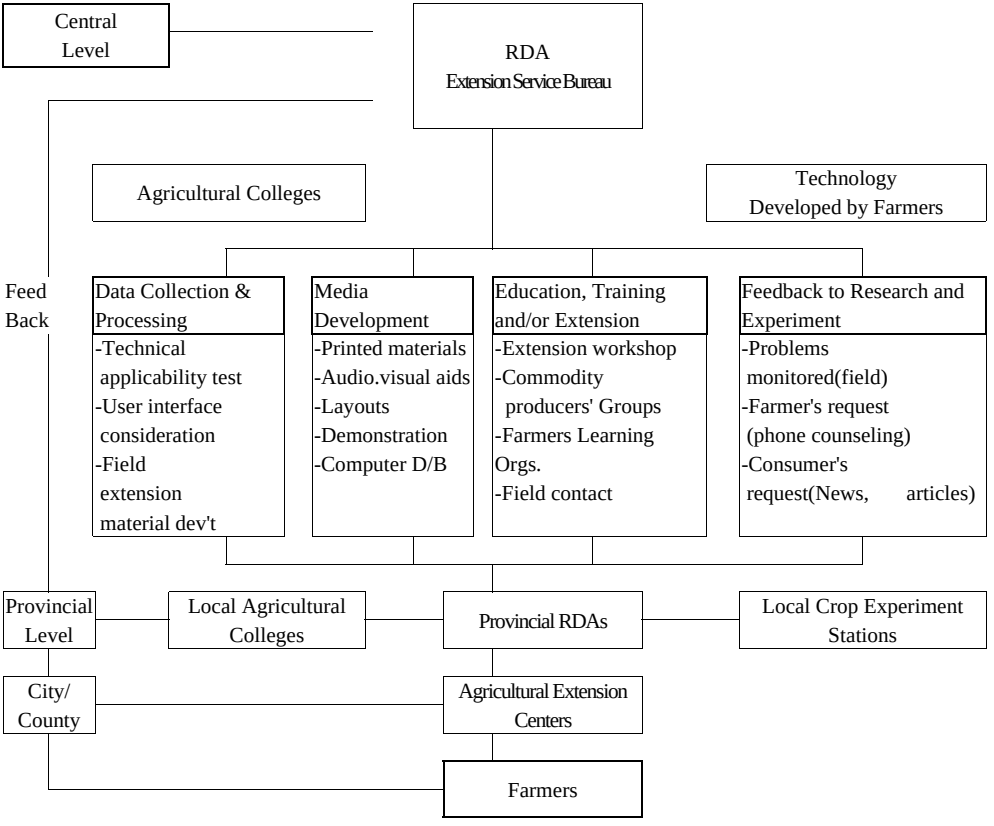

Figure 2. Technology Transfer & Feedback System in Korea

Farmers' Participation in Extension Methods

Through popular mass communication media, such as radio, TV, newspapers and other printed matters, informations are available for rapid dissemination of farm techniques. Counseling with direct telephone and internet systems are used by the farmers and urban consumers.

Classroom lecture	Teaching technical principles
Producers' Group participatory learning	Group discussions and presentation of practical cases

Field teaching	On-the-field training, field observation and experiences
Audio-visual aids	Slides, Films, VCRs, Telephone Counseling
Cyber approach	Self-directed learning or counseling Based on PC(CD-ROM, Internet Home)

Figure 3. Many kinds of Extension Methods

Extension Personnel Training

With the competitive marketing environment and growing of adventured farming, farmers' technological needs and farming problems are more various.

So extension workers must have highly specialized knowledge, newly developed techniques and experiences. Through continual professional training, they must be able to carry out more effective and productive extension services for farmers. And they must collect and analyze farmers' technological needs and farming problems.

Therefore, in spite of localization with most of extension agents, RDA has rendered constant effort through in-service training, professional workshops at the national or overseas level advanced training institutes and pilot farms for extension agents. And local extension offices will perform 78 experimental research in 2004 with problems monitored from demonstrative plots or farmers' fields. These research experiences could help the farmers and extension agents solving their regional problems by themselves directly.

Table 4. Training for Extension Related Agents 2001

Course	Duration	people	Target Participants
Total		3,508	
< Extension officials >		< 2,088 >	57 courses
Short term training	4~10 d	2,013	Those Who applied (48 courses)
Long term training	10 wk	25	Those who applied (4 courses)
Self-direct farming	4 wk	50	Those who applied (5 courses)
< Related organizations>		< 1,420 >	
Farm techniques training	5 d	250	Staff of agricultural cooperatives
Farm machinery training	3~10 d	1,170	College students, teachers Staff of farm machinery repair service center

Farmers' Training Program

Various year-round training program at national, provincial and county levels are furnished to farmers to improve their farm management and production skills including commodity-specific

technologies and machine operation. Intensive rural education on a nationwide scale is delivered during the winter season of January and February which is nor a busy time for farmers, whereas during summer regular technical lectures on region-specific commodities are organized jointly by RDA and the Korean Broadcasting System (KBS).

The Korea National Agricultural College of the RDA has provided the 3-year specialization course to the future elite farmers since 1997.

Specialized income crops training (RDA)

Income crops training program is organized at the national level for those volunteered participants with advanced knowledge on the topic. They are selected from among successful farmers and senior members of the 4-H clubs. The main purpose of this program is to train the program participants on specialized knowledge and techniques various crops for them to become farmer technicians on respective subject-matter fields.

The courses of the specialized technical training are classified into fields such as fruit farming, vegetables, flowers, livestock, special crops, and others.

The training field is divided into specified courses according to the crops or cultivation patterns of each crop, etc. For example, the fruit farming training field is organized for specified training courses for specific crops like apple, pear, peach, vinyl cultivation of grapes, among others.

Regional specialized crops training (PRDA)

Throughout the country, various "main production areas" for different agricultural products are designated in accordance with the different physical and economic environmental characteristics.

The provincial training centers are in charge of the intensive farmers' training for developing new regional specified crop or expanding the cultivation area of crops selected as the regional specified ones. This training which is inferred for farmers to officially identified main production areas, has the purpose of improving cultural techniques of the specified crops and efficiently manage the main production areas.

Problem solving in winter training (city/county)

January and February during winter, the training sessions are carried out in a day for each crop throughout the country. Around 0.5million farmers are participated in the training with well equipped facilities in public centers or schools, etc.

Some of the farmers' technological needs and problems can be identified and solved in this training. Farmers get new agricultural policies, techniques, information and revise their annual farming plan with the training.

Table 5. Training for Farmers (2001)

Course	Duration (days)	Number of Participants	Target Participants
Total		1,206,914	
<National level >		<7,070>	
Income crop growers	4	1,000	Those who applied
Professional farmers	3	700	Government loan recipients
Radio open class	1 each	5,000	Those who applied
Agri-machinery technicians	10	200	Those who applied
Rural women leaders	2	200	Home improvement leaders
<Provincial level>		<30,910>	
Regional specified crops	1~2	21,374	Specified crop growers
Farm mechanization leaders	10	1,380	Those who applied
Professional farmers	2~3	2,976	Appointed person
Women leaders	1	5,180	Home improvement leaders
<City/County Level >		<1,168,934>	
Area Specified commodities	1	64,620	Those who applied
Farming training in winter	1	533,024	Those who applied
4-H Project & Career guidance	1~3	16,844	4-H members
Farm machinery users	1~2	21,185	Those who applied
Farm machinery safety	1	110,707	Those who applied
Home improvement	1	274,250	Home improvement members
Computer information	1~ 3	130,056	Those who applied

Government supports the selected young farmers training

Selected farmers receive government financial support to cover their expenses for board and lodging, training materials for practice purposes, teaching text materials, and training uniform. After completing the training, the participants easily receive government fund farming operations. They also have preference in a follow up education with radio, internet lectures and printed materials on farming.

Various counseling

Various counseling methods for farmers are also very useful extension method, including face to face counseling, telephone counseling, internet homepage counseling and/or letter counseling.

Those analyzed information by the local level extension agents are feedbacked to RDA or PRDAs hierarchically every year. The subject matter specialists(SMS) or researchers in RDA or PRDAs review and accept these information in their works.

Table 6. Counseling Status at RDA (Head office only)

Year	2001	2002	2003	ave/yr	counselor	Response within
Total	4,405	3,391	4,227	4,008	6	-
document (permit)	2,082	1,189	1,584	1,618	1	4~90 days
internet	1,586	1,472	1,131	1,397	4	5 days
phone	737	730	1,512	993	1	3 hours
Visit	198	192	274	221	-	3 hours

During the past 3 years, Counseling by phone is increased by 107% on average. It's a handy method to make a question and get the answer directly.

The Linkage of Research and Extension

The institutional cooperative relationship of the extension service system with provincial and local governments, generally known as general administrative agencies is another characteristic. With this relationship, the extension program is not only easily integrated into comprehensive rural development policies, but also supported from the administrative agencies.

Besides, this close cooperative relationship between the extension program and administrative policies at all levels, the budget for agricultural extension services comes from central, provincial and city/county governments in collaboration with each other.

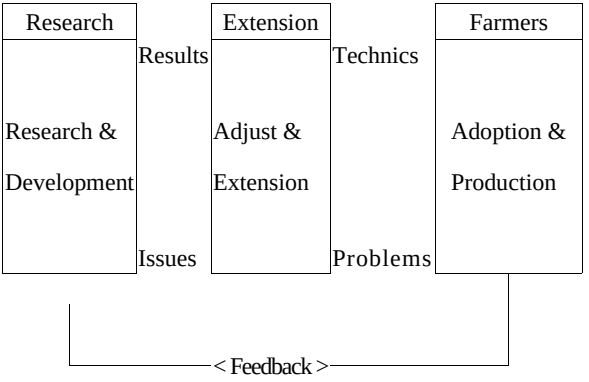

Figure 4. The Linkage of Research and Extension

The Join Evaluation Committee System

Since both functions of research and extension are integrated under the same Administrator of RDA, the research results and newly-developed techniques could be more effectively, efficiently and timely disseminated to the farmers though the nationwide extension channels and networks.

Research results are thoroughly examined, screened, and given economic analysis by the researchers, extension agents and economists joint evaluation committees. These results are reflected for several related policies. Related extension specialists are always aware of research programs going on and participate in research planning and evaluation actively.

Participation of researchers in extension programs is not only helpful for technical dissemination but also provides very useful information for improving agricultural research programs. Researchers have opportunities to review the applicability of their research findings on the farm field through their involvement in extension activities such as field observation trip, training farmers, evaluation meeting, etc.

Problems which occur in the course of extension activities can be easily adopted as research projects.

So there are many advantages for both the research and extension services.

COLLECTED INFORMATION FROM AGRICULTURAL EXTENSION

Decreased Rural Population

The farm population and farm household has been decreased greatly, and farm labor has shifted toward women and the aged farmers. Korean farming population was decreased from 44.7% ('70) to 7.5% ('00)

The sharing rate of 60 or above aged rural population was increased from 7.9% (1970) to 32.2% (1999) of the total farm population. With the severe shortage of agricultural labor, more women's participation in farming and farm mechanization is required.

Table 7. Farm Population by Age Groups (Unit : 1,000 people)

r	Total population		% by age group(farming pop.)		
	South Korea (%)	farming (%)	14 & under	15-59	60 & above
0	32,241 (100)	14,422 (44.7)	43.5	48.6	7.9
0	38,124 (100)	10,827 (28.4)	29.8	59.7	10.5
0	42,869 (100)	6,661 (15.5)	20.6	61.6	17.8
0	47,640 (100)	3,591 (7.5)	11.4	55.5	33.1

Source: MAF, Statistical Yearbook of A&F, Korea, 2002.

Increased Greenhouse Farming

There were busy and slack farming season in Korea, summer and fall demanded more labor hours in farming compare with winter and spring time.

With decreased Korean farming population from 44.7% ('70) to 7.5% ('00) women's participation ratio in farming has increased from 32.6% ('70) to 47.8% ('00). After the greenhouse farming was generalized among farmers, women shares working for not only paddy field (rice), but barn-cleaning and feeding (livestock) and more in greenhouse (horticulture) which demands more intensive farming labors through fall, winter and spring seasons.

Horticultural areas are increased from 16.1% ('90) to 30.9% ('00).

Table 8. The Rate of Women's Participation in Farming

Sex	1970	1980	1990	2000
Female (%)	32.6	42.6	47.3	47.8
Male (%)	67.4	57.4	52.7	52.2

Source : MAF, "Statistical Yearbook", Korea, 2000.

Health Conditions of Rural People

The representative symptoms of farmer's syndromes are shoulder pain, lumbago, numbness hands & feet, bed-wetting, difficulty in breathing, sleeplessness, dizziness, and swelling of stomach and so on.

The average rate in 1994 shows 28.5% which is higher than that of 1984 (19.8%). The rate of syndrome of male is 13.9% in 1994 and 21.5% in 1999. female is more changed than man 26.4% in 1994 and 36.5% in 1999.

Concerning with the ratio of Farmers Syndrome, women's conditions were worse than those of men. The proportion of women who had Farmers Syndrome in busy farming season was 26.4% that was almost twice of those of men (13.9%).

Table 9. Farmers Syndrome Ratio (Unit: %)

arming	Average	paddy	fruit	livestock	upland	vinyl-house
1994	19.8	22.3	20.7	12.9	17.4	23.8
1999	28.5	25.8	26.6	31.0	30.0	33.9

Source: RDA(RLSI), Korea, Research Report for 1999.

With the farmers' training, RDA identified their bad condition with long time hard working that cause of farmer's syndrome. Approximate farmer's syndrome showed 28.5% in 1998 which is increased than that of 1994(19.8%).

Especially Korean rural women's farming roles are increased and dual-burden in farming and housekeeping can give the rural women a very serious health problem. Traditionally husband doesn't help cooking or housekeeping works in Korea.

Though TV dramas show women's decision making power up from cities to the rural areas. But until now, the decision making in a rural household is led by the husband.

Farmers needed convenient house facilities and taking a rest from farm working.

RDA and each local governments supported budget to farm households to build improved kitchens, intermediate resting rooms in greenhouses, working clothes and convenient tools to improve their farming and housekeeping conditions.

After that rural people could take a rest and adapt themselves to temperature gap between inside and outside of greenhouses.

In some rural villages are supported a health management room. Some kinds of health check-up tools and exercise tools are supported by RDA and/or local governments.

It needs husband and children's helping by sharing of housekeeping to keep the rural women's social position and health condition.

So RDA educate both rural women and husbands to share housekeeping.

Because rural women's good health condition is more important than a little more of monetary income for both their family and the country.

Rural women's activities in Korea are to be influential for food production & processing, income generation, farm management and home management. Under the transformation of the traditional farming system into a modern economic system, women's role in farming has been enlarged from simple farm labor to farm planning and decision making.

Counseling Result

By the counseling, Many farmers are interested in Marketing and characteristics of newly developed varieties, diagnosis and management of pest, fertilizer using, bio-agriculture with various healthcare crops. Especially other consumers mainly live in urban area are interested in healthcare food crops as non chemical or low-input agricultural products and fiber-added rice (not delicious to eat) for fat people.

THE CHANGING DIRECTION OF EXTENSION FUNCTION TOWARD 21C

As the circumstances of agriculture has changed, the role and function of extension must be coped with those changes.

The extension organizations have to provide for environment-friendly farming in the era of WTO system, computer-based IT knowledge system, and various need-assessment of wide range of clientele and solve their problems. Those function can be expressed as Improvement the Quality of Rural Life.

Knowledge Based Extension Agencies are Needed

- Highly specialized extension personnel
- Integrated Knowledge based agricultural training (technology multi-media+ management life)
- Rolling for leading organization to manage the related institutes including experiment & research institutes, Agricultural colleges and leading farmers

Environment-Friendly Farm Management with Pollution Control

- Environment-friendly agriculture for sustainable agricultural technology

- Preservation of rural culture and tradition with low-input & bio-agriculture
- IPM, Pest forecast and biological control (natural enemies).
- Plant protection from meteorological calamity.
- Valuation of Rural Amenity
- Safety and Healthy farmers, products and rural area

Income Increasing Technologies

- Cash crops : vegetables, flowers, fruits, special purpose medicinal crops
- Environment controlled Greenhouse cultivation, tissue culture
- Animal husbandry and livestock sanitation
- Developing competitive cost saving technology toward world open market

Targeting toward Wide Category of Clientele

- Wide categorizing of clientele: consumers+farmers ＋ related organizations (local government, foreigners & international organizations)
- Developing wide program and method of extension
- Need assessment of various clientele
- Extension method : Utilization of pc & multi-media+traditional methods

CONCLUSION

After Korean War, the resourceless poor country faced by problem of starvation. The RDA developed a high-yielding rice varieties and well educated extension agents disseminated the new technologies with various extension methods. It took about 20years to achieve self-sufficiency in the main food and, 10 more years in year-round fresh vegetables. FAO and many countries report this agricultural development a successful case.

However, from the beginning, the research results were transferred to the farmers by a "top-to-down" enforcement type through the government's bureaucratic organizations. It was not a perfect method for the farmers.

In the 21st century, the resourceless Korean agriculture faced other problems too. Government-supported and protected agriculture couldn't expect no more subsidy from the government. It has to compete with advanced countries under the WTO system. Now, the agricultural extension service receives many kinds of requests from various clientele, while its personnel is decreased year by year.

In this aspect, 'Farmer Participation in the Identification of their Technological Needs and Problem Solution' can be a very useful strategy for not only one country, but also for many other countries.

In providing this strategy, extension agencies has to identify and review the farmers' technical felt needs, unfelt needs and problems, as well.

I'd like to recommend the audience to widen your clientele from farmers to consumers, related institutes and all the other areas available. Because with our experience, they may need our cooperation and we may need their helping, in the near future.

And on this workshop, I expected to exchange much of mutual interests and experiences each other, and thank you all the Staffs of APEC and all the audience.

Thank you again!

AGRICULTURAL EXTENSION IN BRUNEI DARUSSALAM

Haji Anjah bin Haji Abdul Rahman

NEGARA BRUNEI DARUSSALAM

The Country

Brunei Darussalam is an independent Islamic Monarchy strategically situated at the northwestern coast of the island of Borneo. The country is divided into four districts; the Brunei-Muara district, the Belait district, the Tutong district and the Temburong district. The capital of Negara Brunei Darussalam is Bandar Seri Begawan located in the Brunei –Muara district.

Brunei Darussalam covers a total area of 5,765 square kilometers. The country is endowed with natural resources. The shoreline of 130 kilometers has a continental shelf rich in minerals, petroleum and marine life. Inland primary forests cover 70% of the land. Much of the area is carefully preserved in its natural state. Of the remaining 30% of the land, approximately 10% have exploitable timber. Agriculture occupies some 5% of the total land area and efforts are being made to convert much of the secondary forests and wasteland into productive agriculture, agro-forestry and fishery activities.

Population

The population of Brunei Darussalam is estimated at 345,000 persons. Brunei Malays constitute 75% of the population. Other races include Chinese 15%, and others 10%. The country growth rate is 3.5% per annum. The populace is young, about 70% are 30 years old and younger.

Climate

Brunei Darussalam has a humid equatorial climate characterized by warm temperatures, high rainfall and humidity. Temperatures show little variation throughout the year with a monthly mean of 28 degrees Celsius and monthly maxima and minima of 32 degrees Celsius and 25 degrees Celsius respectively. Nights are always cooler and sunshine of 12 hours varies little throughout the year. The country is located outside the typhoon belt. Rainfall is influenced by the North East and the North West Monsoons.

The annual precipitation is 2300 mm distributed quite uniformly throughout the year. Seasons are not well defined, but there are generally two rainy periods: September to January and May to July. The months of February to April are generally dryer.

Economy

The economy of Brunei Darussalam is dominated by the export of crude oil, petroleum products and Liquidfied Natural Gas (LNG). The Government plays an active role in the economic development. The series of five-year National Development Plans here injected large amount of money into the development of infrastructure and expansion of the service sectors. Government expenditures stimulated construction activities which have become a major industry creating employment opportunities for locals and foreigners. The public sectors and Shell Petroleum activities are the two largest employers absorbing about 80% of the local work force. Prudent fiscal and monetary management and political stability have made Brunei Darussalam one of the most prosperous nation in the world with a per capita income of US$17,000 in 1994. To a large extent, exports of oil and gas and the vitality of young and enterprising population have maintained economic growth.

The overall economy of the country has now entered a new phase. Diversification from total dependence of oil and LNG has been accorded priority. Agriculture and agro-industry have become an important economic sector motivated by the need of diversification and the desire to self sufficient in the major food items. Annual import value of major perishable food commodities alone exceeds $80 million. Private sector involvement has been steadily increasing. Substantial capital has been committed towards importation production and distribution of the major food commodities. Brunei Darussalam is now producing sufficient table eggs to meet domestic demand. The role of the Government, through the Department of Agriculture, is to promote and facilitate sustained growth designed to produce sufficient food for the country.

Language and Religion

The official language of Brunei Darussalam is Bahasa Melayu, or Malay, but English is widely spoken and is also used in the education system.

Brunei Darussalam is proud of its strong Islamic tradition. Some contend that this dates from as early as the 7th Century, although modern scholars place the spread of Islam to Brunei Darussalam around 13th century. His Majesty The Sultan and Yang Di-Pertuan is head of the faith in the country. Religious freedom is guaranteed under the Constitution.

Education and Health

Half the population of Brunei Darussalam is under the age of 20 and the education service within the Sultanate has expanded in recent years. His Majesty is committed to provide better education for the people and has accorded high priority to education services. For all citizens from age of five, education is provided free. The Government also provides scholarships to deserving Bruneians for further studies overseas.

The University of Brunei Darussalam and the Brunei Institute of Technology provide arts, science and technical training leading to baccalaureate degrees and technical diplomas. Post-graduate studies are also offered at the University of Brunei Darussalam. There are also various other technical and vocational institutes whose graduates are intended to meet the shortages of skilled technicians in the public and private sectors.

The quality of health care in Brunei is among the best in the region. Many major diseases in the country have been eradicated. Malaria has also been eliminated since 1970. Cholera and smallpox are no longer a threat to the communities. The Ministry of Health carries out regular immunization programs and Brunei Darussalam has substantially met the health requirements laid down by the World Health Organization in its Health for all by the Year 2000 Program.

Healthy life-style combined with a successful record in preventive medicine has meant that Brunei Darussalam's health standards are similar to those in developed countries. The health service is free for Brunei Darussalam's citizens, with a very nominal charge for permanent residents, foreign citizens and their dependants.

AGRICULTURAL DEVELOPMENT IN BRUNEI DARUSSALAM

Introduction

Agriculture sector is becoming more important as Brunei Darussalam strives to increases domestic food production to meet increasing demand. The Department of Agriculture, a national institution operating under the Ministry on Industry and Primary Resources, is entrusted with the responsibility to promote and facilitate agricultural development. As to ensure a continuity of supply of food in the country, the Department of Agriculture promotes domestic agricultural activities and at the same time facilitate import of foods to meet national requirements. The core activities are geared towards rational utilization of resources for optimal food production to revitalize the rural economy, foster agro-industrial development and encourage sustainable agriculture to conserve the natural resources. The aim is to accelerate food production in the country to promise a meaningful degree of food security.

National Development Plan

In an effort to boost the activities of the non-oil industries, the private sector has been encouraged to play greater roles in economic diversification. The Government through the Ministry of Industry and Primary Resource (MIPR) has been encouraging the Small and Medium Enterprises (SME) as a base for economic growth and emphasis is given to the development of agriculture, fisheries and other non-oil activities. Agriculture including the livestock sector becomes the most important economic activity under the National Development Plan (NDP); where about $18.8 million was spent in strengthening the industry over a 5 year period from 1996 to 2000.

Some of the Government's projects had been taken over by private sectors as a move to involve greater private participation in the economic growth in the country. However, the Government will continue to accelerate the socio-economic development, Hence, in the 7^{th} NDP (1996-2000) a budgetary allocation of $7,200 million has been provided for socio-economic development.

Agriculture Industry in Brunei Darussalam

Agriculture in Brunei Darussalam accounted for 2 percent of the GDP in 2000. Major food commodities are imported and the annual expenditure on food and food produce exceed B$ 400 million.

Conscious of the need to expand agricultural activities, the Government has oriented its agricultural policy towards identified suitable land areas for cultivation of crops and available land for livestock development (see figure 1). A series of 5 years National Development Plan has provided funds for basic infrastructure development and it is now the take off point for agricultural development to increase production and accelerate agro-industry activities related to food security.

Figure 1. Area Suitable For Agriculture

In 1994 Brunei Darussalam was self-sufficient in egg production and other commodities are still below self-sufficient level. Table 1 shows the trend of production in selected agricultural commodities. In 2000, the local producers of tropical vegetables (few types of leafy vegetables) able to fulfill requirement, and the rest are still imported. In addition, other commodities such as rice, fruits, chicken beef and other food items are still imported. To meet the food demand, Brunei expended $300 to $400 million annually on its food expenditure through import. With increasing population, it is expected that food will continue to be imported.

To reduce import of food item especially on commodities that can be produced or grown in the country, the Government will continue to support the sustainable agricultural development through new technology transfer and continuous assistance from training and visit by extension staffs. Support services for farmers are mainly came in the form of subsidized materials for agricultural production including subsidized seeds, fertilizers and farming equipments. Other support service include the end-product subsidy scheme for rice producers and provision of infrastructure such as access roads, irrigation and marketing outlets. Improvements in product quality and quantity had been made through advances in technology such as in the field of hydroponics farming and tissue culture and through efforts of the technical and extension services in the form of pesticides residue analysis, soil and food analysis, crop protection, farm management, marketing and the animal health programmes. Unfortunately, these advances have not been taken commercially by farmers.

Table 1. Production of Selected Agriculture Commodities and Self-Sufficiency (%) 1998 – 2002

STRATEGIES TO STRENGTHEN EXTENSION SERVICES FOR AGRICULTURE TECHNOLOGY TRANSFER AND TRAINING: THE PNG EXPERIENCE

Geoving P. Bilong [1] and Samuel B. Lahis [2]

INTRODUCTION

The Government of Papua New Guinea adopted the policy on decentralization and Provincial Government in 1997. This policy effectively transferred all agriculture extension to Provincial Governments. Because these transfers were done without subsequent resources such as finance and personnel, the extension in the provinces could not be implemented effectively. The small holder farmers have since been complaining of lack of general agriculture extension services. The Department of Agriculture Livestock in response to this implemented two extension delivery strategies; the project approach to extension and the program or corporatised approach of extension. The project approach to extension was where public investment projects were designed and the project paid for all the input costs of extension and development. In many cases, the areas of coverage by projects were restricted to small areas and extension ceased once funding were discontinued. Extension in a way, took a new meaning- as delivery of cargo to the people. The program or corporatised system of extension was where semi –commercial institutions were created under the Acts of Parliament to promote particular crops or livestock. The general idea was to promote particular commodities from production to marketing.

While these attempts did contribute some extension, the services were not improved substantially because of the limitations in the resources, unclear extension delivery systems and accountabilities by officers were lacking. In addition, corporations did not have direct control on production systems because smallholders still maintained control and thus made the system dysfunctional.

General agriculture extension services, traditionally is a transfer of information, skills and knowledge as well as new technologies. Ideally these efforts should make the small holder better off than prior to extension effort. This however could not be done because there was neither sufficient funding nor the system flexible enough to cater for the wide range of issues arising from the small holder needs. As such, the general extension staff took the "sit and wait" approach and thus created development of bad attitudes to work and thus the extension delivery system as well the production system collapsed.

In addition, the capacity of staff in the extension sections within the provincial extension to coordinate and deliver effective and efficient support services was weak and needed improvement. Common constraints were insufficient operational budgets, difficulty in covering remote areas, poor housing, lack of transport as well as other support and lack of project planning and monitoring. In 1995, the government further introduced the New Organic Law on Provincial and Local Level Governments – commonly referred to as reforms- with the view to improve decision making and service delivery. The Department of Agriculture and Livestock in response to this sought assistance

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from the Asian Development Bank under ADB Loan No. 1652 - PNG to improve general agriculture extension service delivery in the provinces. This paper reports on the progress of implementing that project and the lessons and experiences learned.

DESCRIPTION OF SMALLHOLDER SUPPORT SERVICES PILOT PROJECT (SSSPP)

Delivery of agriculture extension support services to small holders were reported to be non existent. This pilot project was therefore designed to develop an improved extension system that would address three issues; (i) improve delivery system that is flexible to meet the wide range of issues faced by general extension system, (ii) improve the capacity of the extension staff to be able to provide effective extension and (iii) improve productivity and production from the small holder sector. An additional issue was to see how this project could promote working relationships and linkages among extension staff between various levels of government. The objective of the project is to improve access by small holders in two provinces of PNG- Eastern Highlands and Morobe, to improved agriculture support services. The associate goal is to enhance the status of women in agriculture by targeting support services assistance to food crops production which is dominantly domain of women.

The project has three components; (i) the Support Services Contract Facility (SSCF) which contracts extension projects and manages their implementation, (ii) capacity building which is to assist agriculture agencies at different levels of government in building new competencies required for the new roles and accountabilities as managers and (iii) project coordination which will ensure coordinated implementation processes.

Support Services Contract Facility (SSCF)

This is the main service delivery component of the project. In this project there are two Support Services Contract Facilities, one in each of the two provinces. The objective of this component was to provide performance based small holder support services on a contract basis. Each of this section has a team of staff (local staff as well as contracted consultants) who form the management unit of the project. The team is accountable to a steering committee which approves and oversees the project implementation. The two SSCF units report to the Project Steering Committee which oversights both SSCF in the provinces.

Capacity Building

The objective of this component is to assist the agriculture agencies at different levels of government in building new competencies required by the new roles under the reform as managers of service providers. This is a change from previous roles when the extension staff are expected to provide extension. The additional objective is to enable the agriculture extension staff at different levels of government to plan and manage resources allocated to them more rationally and effectively.

Project Coordination

This component is based in the national department and ensures that the two provinces implement the project in a coordinated manner. The Project Coordination Unit will work closely, help guide the activities carried out under the contract facilities and oversee implementation of the capacity building component and be responsible for the project monitoring and evaluation and quarterly reporting. The Project Coordination Unit also acts as secretariat to the Project Steering Committees which meet quarterly to review and monitor implementation by each of the SSCF Management Units. The Project Coordination Unit prepares project reports and accounts for all expenditure to the National government and the Asian Development Bank.

Contracting Delivery of Agriculture Extension Services

"Contracting for delivery of agriculture extension services is a widespread strategy used in many countries and situations. In developing countries contracting often shifts delivery of extension from public to private providers." (Rivera W. M and Zijp W, 2002). In PNG, contracting agriculture extension is relatively new even though some attempt was made by Morobe Province but lacked effectiveness and efficiency of managing service deliverers. The project designed under the ADB Loan No. 1652-PNG called Small holder Support Services Pilot Project (SSSPP) was flexible enough to allow for development of the improved delivery system that would be based on performance contracts. The project is based on process oriented approach- meaning that within the overall agreed framework, specific activities may be adjusted to suit changing variables as the project is implemented.

The contract system designed in the project took into consideration the following: (i) the contract facility was clear and transparent to reflect the extent of finance outlaid by the Government and the Bank; (ii) purchaser-provider distinction would be strictly enforced; (iii) the service provider selection and engagement will be transparent, objective, competitive and efficient; (iv) the support services to be provided and their envisaged impact on agriculture production, productivity and income would be clearly specified thereby providing basis for monitoring impact and assessing cost benefit ratios; (v) that there would be accountability for results an clear incentives to enhance performance; (vi) competition amongst service providers may allow for better service provision to small holders; (vii) with the contract facility being based on period contracts, the government would have the flexibility to reduce or increase financing, change service providers, realign the strategic focus of the program or even terminate it at will. (ADB, 1998).

The improved agriculture extension delivery system developed is now referred to as the SSCF processes. Figures 1 & 2 show the flow diagram and processes involved in the development of extension project, contracting and monitoring. The main steps in delivering contract extension are:

1. That the projects developed and contracted are derived from the farmers needs analysis (small holder) thus satisfy the government's bottom up planning.
2. That the needs identified are very quickly turned into an extension project.
3. That the projects are economically, financially and socially sound to pass the viability test.
4. That this project is implemented at the shortest time possible through contracting out to service providers.

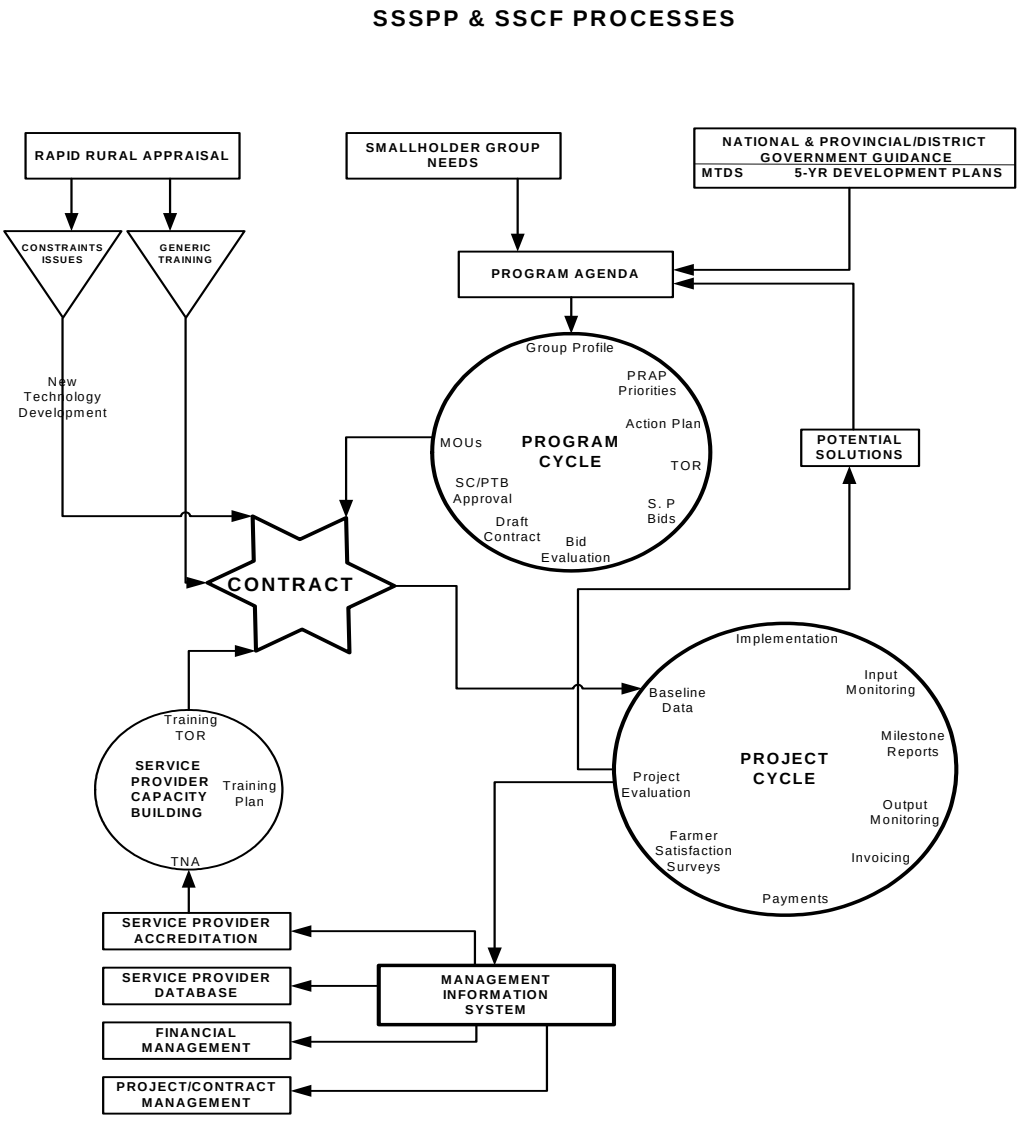

Figure 1: Flow Diagram of the Contract Extension Management

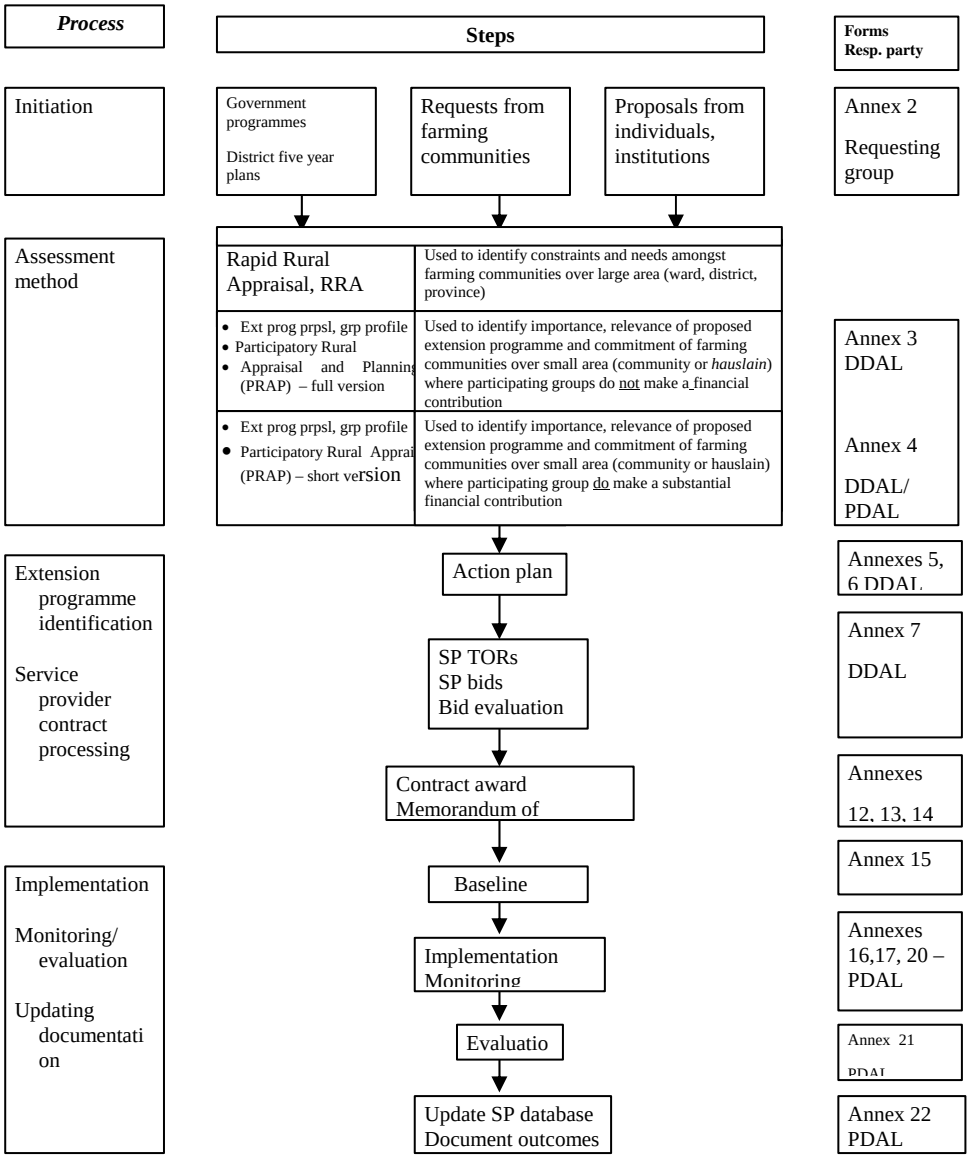

Figure 2: Steps and Processes of Contracting Extension

IMPLEMENTATION RESULTS

Issues Identified

Prior to implementation of the project activities in 2001, the SSCF teams in Eastern Highlands and Morobe (two sites) carried out needs analysis using participatory rural appraisal planning (PRAP) and rapid rural appraisal (RRA) processes respectively. Some of the results of these appraisals are:

Some results of RRA carried out by SSCF Unit in Morobe Province

- That there was lack of sufficient extension information in rural areas.
- That there was total lack of delivery of agriculture extension. This was regardless of how far away from the nearest extension officer or office.
- That the farmers' real need was not credit as was believed but need for soap and night lighting (kerosene).
- Costs of livestock materials (small ruminant) fencing wires were beyond the farmers reach.
- Costs of broiler chicken feeds in rural communities were extremely high.
- Rice growing was becoming increasingly popular but milling machines and techniques were in short supply.

Results of Some Issues Identified Using PRAP by SSCF Unit in Eastern Highlands Province

- Farmers in rural communities (villages) have no formal organizations to which production groups could apply group extension.
- There are real deficiencies in rural communities in knowledge and skills on technical knowledge of many introduced and cash crops.
- There are very little skills and knowledge in bookkeeping, entrepreneur skills and business management.
- Farmers in rural communities were willing to form permanent or temporary groups to meet their need as needs rose.
- Farmers were often not responsive quick enough to changes to economic opportunities.

These then formed the basis for how extension services were delivered from 2000 -2002.

Development of Unified SSCF Process

In 2002 the review of the project conducted noted following:

1. The two needs identifications processes can be employed as and when need arise. The RRA process could be applied for identification of technological solutions to needs which can be applied across large areas like the whole province or district. PRAP processes can be applied to identify needs of communities that are very much localized.
2. The new extension delivery system be based on:
    - Small holder farmer needs analysis (demand driven)
    - Local Service Provider Delivery System
    - Output based contracts
    - DAL role in the new delivery system will be
        - Extension program identification and preparation
        - Contract management
        - Monitoring and Evaluation.
3. Guiding Principles
    a. Dedicated Fund for Extension Contracts.
    b. Transparency

- Funding /management separate from delivery
- Contracts awarded on technical merits and value for money
- Stakeholder Steering Committee as watchdog

c. Work with farmer groups
   - Women, youths and children

d. Focus on smallholder ownership and commitment
   - Farmer set agenda and specify needs
   - Farmers contribute towards cost

e. Service Philosophy based on Self Reliance.

f. Change role of provincial/ District and LLG staff
   - From Extension worker to manager & Facilitator

g. Fewer full time staff
h. Develop a large numbers of service providers
i. Contract service provider capacity building

Progress of the Extension Services Provided to date

- Over 120 Service Providers. Seventy percent of these service providers are small scale enterprise.
- Over 300 contracts.
- 5000 + Direct farmer contacts.
- 5000+ indirect farmers contacted
- 6000 vanilla farers trained.
- Rising demand now putting pressure on funds and processes needs streamlining.
- 80 DAL staff trained, 75 % of staff trained in Morobe.
- Information awareness on radio, market information and awareness
- New technology on jatropha for live fencing and soap and fuel as well as vanilla crop expanded
- Cost efficient Service Delivery
  - Extension program cost less (K15 to K40)
  - Follow up 20 percent of conventional cost.
  - 61,000 additional vanilla wines planted.
  - Small holder coffee nurseries cost recovered in one year.
  - Coffee rehabilitation generating income for wet factory

Progress made on the Capacity Building

- Project Preparation and Proposal Preparation Manual developed.
- Staff trained on needs analysis techniques.
- Staff trained in computer and use of information and technology.
- Staff trained on project evaluation skills.

Progress Made on Coordination

- All extension projects in Provinces are approved by sub- committee of the Provincial SSCF Steering Committee (implemented following signing of contracts) thus promoting ownership and implemenation by provinces.
- The staff activities are funded though following performance based budgeting idea.

Input ⟶ Output ⟶ Outcome

- Good monitoring an evaluation system (MIS) being developed.
  * Linkages between National/Provinces and Lower Level implementing agencies improved through clear roles and responsibilities identified and carried out.

Lessons Learned

The lessons and experiences learned are that the contract extension now operates on applying both needs analysis approaches. The use of PRAP as a process of community extension needs identification is preferred as it satisfies the project goals to improve smallholders' access to knowledge, information/ skills and technologies (SSSPP Midterm Review and Action Plan, 2002).

Information, Training, Technology Transfer and Management

The extension contracts awarded fall into one of the four categories; **I**nformation, **T**raining, **T**echnology **T**ransfer and **M**anagement (**IT^{3}M**). Table 1 shows the break up of projects funded from both sites to June 2004. This process clearly identifies general extension as opposed to extension and development as done in project and corporatised approach to extension.

Table 1. Extension Projects Contracted to June 2004

Extension Project Category	Morobe Province (Lae)	Eastern Highlands Province
Information/awareness	47	6
Trainings	81	101
Technologies Transferred	21	9
Management skills	6	9

Information

Projects relating to this category includes development of videos on crop and livestock husbandry, radio programs, simplified pamphlets and awareness programs on the project itself as well as new technologies.

Training

This refers to transfers of knowledge/skills in formal classroom as well as on the fields. Trainings sessions were conducted for vanilla husbandry, sheep pasture development, coffee quality control, use of mulching, pruning, fish net repairs, rice cultivation, round onion cultivation, and nutrition.

Technologies Transferred

Technologies transferred include development of prototype rice mill, development of hand oil press, use of jatropha in live fencing and oil production for soap making, cow calf operation, as well as improved varieties of cocoa, African yam, soybean and mung beans as well as use of vetiva grass as soil erosion control.

Management Training

Management training include book keeping, gross margin analysis, money, time and resource management.

The trend of projects contracted indicates that in the first two years, more and more farmers requested for information and husbandry skills as their extension needs. In the last 12 months the need for improved management skills has being identified as a need requiring priority attention.

Training contracts became a more common means of extension service provision. This service was more effectively carried out by farmer experts. The use of farmer experts for farmer to farmer extension has proved more efficient and effective. This has now enabled the project to concentrate on development and use of farmer experts (farmer to farmer extension) as a main system of delivering extension to the rural communities.

Farmer Experts as Cost Effective Extension Providers

The service providers utilized included extension officers from lower levels of government, staff from other government institutions, farmer experts, trained private individuals as well as consulting companies.

Farmer experts are farmers who have demonstrated that they do know their subject and have been practicing or producing the crop or livestock fro some time. Their skills and knowledge is utilized to extend to other farmers (small holders). To date have utilized up to 50 such persons in the contract system to provide extension support. Analysis shows that the cost effectiveness farmer training has been greatly improved by use of the farmer experts using contract system. Table 2 shows the analysis of trainings contracts given as compared to one training conducted for staff by staff.

Table 2. Cost effectiveness of Farmer Expert Utilization in Vanilla Training

Description	No. people trained	Average cost (kina/person)	Trainer
Extension staff	30	981.33	Extension Officer
Farmers	480	73.49	6 x Farmer Experts

Technology Transfers may include Development

In Morobe, it was found that some technologies had to be researched and developed vigorously by ourselves. Some technologies developed this way include:

Kojo System

As need for soap and kerosene was identified as one of big need for many rural villages, the SSCF management unit decided to seek for a technology that would help meet this need. In order for us to achieve this it required us to identify several different technologies ; jatropha plant, oil press and development of a KOJO system (Coconut Oil and Jatropha Oil system). This technology is now being promoted through several awareness contracts.

Prototype Rice Mill Development

As rice mill was becoming increasingly important for many rural communities which were growing rice, a mill suitable and cheap with PNG made parts were contracted out. This is still in its development stage.

Chicken Feed Growing and Mixing.

One rural village was encouraged (contracted) grow major feed ingredients and used to dilute commercial feed to finish broiler chickens. Following six batches of chicken being produced, it was demonstrated that cheaper chickens can be produced. This particular demonstration produced chickens that were K6.00 cheaper than those fed commercial diets without affecting commercial traits.

THE WAY FORWARD

It is now believed that contract extension is an effective way of providing general agriculture extension in Papua New Guinea. It has many advantages and so this must be institutionalized. Some of the efforts being done are:

1. The process is now being promoted and being written into a national extension policy for adoption by extension agencies as one of the methods for improving agriculture extension delivery system.
2. The two provinces (Eastern Highlands and Morobe) are now mainstreaming contract extension into their systems of operation as a standard method of extension service delivery.
3. The process is being taught and promoted for adoption by various extension agencies and government levels; districts and local level Governments.
4. The processes are also being promoted by Coffee Industry Corporation for coffee extension in coffee growing provinces.
5. Discussions are in progress to extend contract extension to two other provinces in 2005.

ACKNOWLEDGEMENTS

Several organizations and numerous individuals have all contributed in one way or another to the evolution, development and implementation of the Smallholder Support Services Pilot Project (SSSPP). We wish to acknowledge their contributions, in particular the Asian Development Bank, Department of National Planning and Rural Development, Department of Agriculture and Livestock, Eastern Highlands Provincial Government, Morobe Provincial Government, service providers, consulting firms, smallholder farmers, project staff from the two pilot provinces and Project Coordination Unit.

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SOCIAL ACCELERATION OF ZERO-TILLAGE MAIZE CULTIVATION TECHNOLOGY AT NORTH GALESONG, TAKALAR REGENCY

Amirullah, St. Najmah, Mansur Azis, Djafar Baco [1]

ABSTRACT

To meet rising demand of maize yearly, it is essential to strive increasing maize productivities. One of them is expansion of corn plant area by using farmland after rice season. However, maize cultivation after rice season with tillage usually fails because of draught season. To anticipate it, application of cultivation maize technology with zero tillage that proven to be yielding better corn plant performance than tillage, as shown by assessment result of AIAT South Sulawesi accordingly, is quite important. However, zero-tillage maize cultivation has not broadly known yet, and proper socialization of the technology to farmers is necessary. In addition, the technology performance mixed with verbal communication method and print media spreading is matching with the farmer characteristic in Bontolebang Village, North Galesong Sub-district. The result of socialization in the village, conducted in March – August 2003, showed positive response from local farmer on zero-tillage maize cultivation technology and then it has adopted. The area of maize plantation with zero tillage in planting season 2004 has reached 40 hectare, of which 4 hectare performed in 2003.

[1] South Sulawesi Assessment Institute for Agricultural Technology (AIAT).

BACKGROUND

As one of maize producer regions, South Sulawesi has eminent role in fulfilling the demand for maize in Indonesia. In 1994, there is 309,190-hectare (about 10% of the national plant) maize plant in South Sulawesi that produced 602,616 ton of corn and productivity rate of 1.949 ton/hectare. The most problems found in maize farming systems are low productivity rate due to farmers had implemented only simple technology and unarranged agribusiness scale.

One way to increase maize production is an expansion of maize plant area by using dry farmland after post rice harvesting. However, it mostly fails because this time always coincide with dry season that creates drought in the field.

To decrease the risk of harvest failure and production cost, it is required to develop zero tillage maize cultivation and water shallow pump technologies. The technologies could decrease both failure of harvesting and cost of production especially on land preparation as indicated by the AIAT South Sulawesi's assessment results where the zero tillage gave profit Rp 2,666,100 with R/C ratio of 2.48. The zero tillage technology could also gain other profits such as reduced irrigation cost, fixed land priority, and shortened the interval between previously plant harvested and next maize plant.

However, zero-tillage maize cultivation has not broadly known yet by farmers. Therefore, proper socialization of the technology to user (farmer) in the field, mainly in the maize developing areas in South Sulawesi, is necessary.

Location Selection

Bontolebang Village, North Gallesong Sub district, Takalar District selected as the location for the application of zero tillage cultivation maize technology. The village considered as one of the potential areas supporting maize development in South Sulawesi, appropriate and similarity with agro-ecological zone (AEZ) of the original area where the assessment technology commenced on 4.920 ha maize plant area and 4.849 ha harvesting area. The observation showed that the farmers have not been utilized their land after rice season, although those lands particularly effective for zero-tillage maize cultivation using reminder inland water after rice harvesting.

Farmer Group Target Selection

The target for socialized technology was one Bontolebang farmer group with 38 active members dealing on rice and maize. The requirements to be a cooperator farmer are dynamic, creative and innovative membership with which has a chief, including four farmer members. These requirements are important for cooperator farmers in order to motivate other farmer groups to spread out zero-tillage maize cultivation technology. Since the chosen cooperator farmer having respected social status for all farmers, it will influence innovation for other farmers.

Socialization Method

To accelerate distribution and adopted process of zero tillage maize cultivation technology in the field location needs application of proper socialization method considering educational level of the target farmers. The educational attainments of local farmers was varied considerably, i.e. 39 % never go to school, 30% elementary, 21 % junior high school and the rest of 10% were senior high school.

The show of direct technology which is mixed with verbal communication and print media, is an appropriate way of socialized method cope with educational level of farmer in the field location.

SOCIALIZED APPLICATION

1. Leaflet

Leaflet contents of application procedures for zero-tillage maize cultivation as well as other excessive of those technologies. The written application procedures in terms of a guidelines leaflet is simplified using common words, lot of pictures and illustration that make farmers easily understood in applying the technology. On the other hand, extensionists can use it as a work partner in socialized of the technology.

2. Appreciation

Initial meeting consists of farmer groups as a socialized target, extensionist, village apparatus, and local agriculture institutions, usually it called as appreciation. The purpose of this activity is to notify participants about the aim of socialization activity, coming activity, advantages of zero-tillage maize cultivation technology, schedule of technology demonstration on the field, and supporting from connected institution, and also to get feedback from participants regarding this appreciation.

3. Technology Demonstration

The show of the technology conducted on cooperator land from May to August 2003. The activity showed application of maize cultivation technology with zero tillage system on 4 ha of the land field of the five cooperator farmers. It consisted of land preparations, seed arrangement, planting, fertilizing, embroidery, weeding, pest and disease controls, harvesting, and post harvesting. The period of the show of the technology was adapting with maize grown, which covered from land preparation to harvesting and post harvesting. The application of technology package was conformity with recommended technique guideline.

The cooperators farmers directly implemented the provided technology on the field under supervising of AIAT's researcher and extensionist, including local field extensionist. Thus, farmer will be accustomed and skilled in applying the technology. Farmer group members while discussion with researcher/extensionist could directly watched each step of the applications of the technology. The cooperator farmers and the farmer group members could also judge the technology worthiness on field, whether it could be accepted and implemented. On the other hand, researcher/extensionist of AIAT could observe the responses level of farmer regarding the application of the technology through farmers' commentaries and attitudes as well as directly discussion on the field. The following table presents the result of observation and judgment of the farmers responded to the technology.

Table Farmers respond to maize cultivation technology with zero tillage system at Bontolebang Village, North Galesong Sub-district, Takalar District.

No	Technology Component	Respond	Percentage (%)	Reason
1.	Land Preparation	Easy	100	Less cost and employees
2.	Variety: Lamuru/Semar 10	Good	100	Plant grows diversity and high production
3.	Planting procedure	Easy	100	Dibbled 1-2 and plant distance arranged
4.	Fertilizing procedure	Easy	100	The same as tillage system
5.	Fertilizing cost	High Mid	10 90	Need additional cost for purchasing fertilizer. Land preparation cost can be altered for purchasing fertilizer
6.	Irrigation	Easy	100	Easy application and keep prices down 1-2 of irrigation cost
7.	Weeding procedure (shading)	Easy	100	Using tool can accelerate shading /weeding time
8.	Harvesting procedure	Easy Difficult	80 20	Harvesting procedure similar with tillage system Separation troubled between maize's knob and stem(Lamuru)
9.	Production	High Mid	70 30	Diversity of knobs Production nearly the tillage system

4. Field Day

Field day and harvesting time simultaneously commenced in the last activities. However, the field day held on each application stage of technology components and it showed in the field with certain farmer groups. The participants of the field day consisted of the cooperator farmer, the farmer group members, the non-cooperator farmers, the extensionist, the local agricultural agency, and the village/sub-district/ district apparatuses. The purpose of the field day is to explain how to apply, what the advantages and the achievement results of the applied technology. In addition to convincing farmer, the field day can be play as a spot to receive feedback from farmer, extensionist, local apparatus agency, and government for completion of the next assessment. In the field day, leaflet that content of the guideline of maize technology with zero- tillage system distributed to all participants.

SOCIALIZATION IMPACT

The impact of socialized implementation of the zero-tillage maize cultivation technology was mastering the members of cooperator farmer groups and even non-cooperator farmer on the technology application. Maize plantation with zero tillage system at the cooperator land has expanded and adopted from the beginning of 4 ha in the planting season of 2003 to 40 ha in the planting season of 2004.

The development of zero tillage maize cultivation technology made the plant-design in location of assessment activity reached IP-300, thus, increasing income of the farmers.

CONCLUSION

1. Zero-tillage maize cultivation technology got well respond from non -cooperator farmers living around the location of the activities.
2. Technology socialization activity needs support from the government policy, primarily in the availability of production facility (e.g. financial capital) to meet farmers demand.
3. The implementation of socialization method shall concrete in the next different location and technology.

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THE APPLICATION OF SOME INDIGENOUS BIOPESTICIDES FOR ENVIRONMENT- FRIENDLY PRODUCTION

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ABSTRACT

Vegetable is one of important crops since they have a higher value in business, though many constraints appear during its cultivation. Generally, loss assessment of vegetable crops reached 45-80%, due to pest and diseases infestation. To solve pest problems agriculture has spent about 15-16 tons of pesticide that resulted negative impacts rather than solving the problems. A high pesticide residues are exposed on vegetable product mainly of the organic phosphate compounds, beside the biomagnification that occures on its agro-ecosystem. Indonesia during 1992-1998 has achieved success story on transfer technology through the Integrated Pest Management program, inclusive vegetables. The strategy of implementing IPM on famer scale through Farmers Field School (FFS) will be discuss in the paper, including how technology transfer was achieved. However the constraints is still there to be solved, one, is short of 'ready made' biopesticides or natural resources manipulation. In fact Indonesia is one of the 'Mega-biodiversity' country in the world, second country after Brazil; inclusive the indigenous natural resources that are potentially produced as biological pesticides. Biopesticides will assure a non pesticide product as well supporting the Integrated Pest Management program, simutaneously. Some plant materials as Dioscorea as well Pachyrhizus erosus plus Baculovirus formerly were studied as indigenous product and effectively controlled major insect pest on Alliums, hot peppers, tomatoes up to 34%. The Arachnid toxin were suspected to be potential as well for biopesticides that shown by faster respond than Dioscorea, as well Baculovirus. The formulae of some of these indigenous products was studied and promoted as biopesticides BIONOCK, that will be eco-efficient, means efficient either ecologically as well economically. However the most important aspect is its adoption by farmers or users. Paper will cover as well a novel biopesticide was promoted last year.The biopesticide research outputs were: 1). Natural toxin that resulted some promising mortalities on target insect pest; 2). Biopesticide formulae that transovarial infected on target insect, and inhibited more than 35% reproduction rate; and the application of Biological pesticide formulae that expected to be having positive impact especially on predator biodiversity and farmers adoptivity. Bio pesticide should have not any affect to biotic indicators such as the bees and annelids. More than 80% out of sampled farmer realized the importance of biopesticide and willing to apply it. However, there are some constraints appear, which is ready made biopesticide, means the enhancement program for biopesticide industry are seriously expected by vegetable farmers.

Key words : IPM, Biopesticide, Indigenous Natural Resources, Adoption.

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INTRODUCTION

Indonesia has achieved a good standard for implementing Integrated Pest Management (IPM), that followed by other developing countries. During 1989-1992 IPM was first nationally wide elaborated in 10 rice growing provinces simultaneously, by the support of BAPPENAS (National developing Planning Agency). Second phase was coordinated by The Ministry of Agriculture (MOA), by 1993, a five year IPM training project (IPM TP) was organized in 12 rice growing, as well vegetables and other secondary crops provinces (Agenda 21). Trainining comprised of three components :

- Human resources development (training of trainers –TOT and farmer field school – FFS)
- Support studies for field investigation by farmers and institutional as practical research
- Policy support on regulation and environmental management of pesticides.

The Integrated Pest Management in Indonesia was enforced by Presidential Instruction No:3/1986. By 1992, 300,000 rice farmers in 20 provinces and 2450 vegetable farmers have been trained in IPM. About 8000 agricultural field and extention workers have been trained as well (Kusumaatmadja, 1995). IPM was not involved only the pest diseases management but also other aspects of farming as balance fertilizing, efficient use irrigation water, crop rotation and soil conservation. It concerns to reduce farmer expences and minimizing risk of damage and pollution in the environment and human being. Through the IPM program the targets of technology components will be strengthened and trained people can reach some sufficient target, the institutional interface will be improved in order to pave ways for a real sustainable agriculture. The application of 'accurate' technology package and transfer technology still a problem, though. Each eco region has its own character for specific IPM approach.

Farmers are supposed to have good opportunity to be involved directly in a novel technology, instead of sitting down in the room listen to boringly government talk about new technology. A demonstration plots may be not encouraged farmers to try new technology that has an uncertain risk for their economy. For farmers opinion, eg. pesticides, is a safe technology for them and a kind of insurance for their success harvest. It was hard to believe slowly a good understanding arose among farmers that 'a magic tool called pesticides' has a big risk for their natural enemies richness. This understanding was achieved by a closer relationship through the Farmers Field School.

Farmers Field School is a model of farmer training approach based on the adult education that covers principe of 'learning by doing' adds to farmers knowledge and experiences by direct experiencing and deciding some related action in the field (van de Fliert and Braun). They could learn better and directly improved their capacity as 'a farm manager' actively.

Through the Farmers Field School (FFS) farmers had highly significant knowledge of defining the pest, observe and take their own decisions for further act by the guidance of pest-disease observers (named : PHPs).

The monitoring system for analising agroecosystem was learned whereas pest and diseases as well the agro inputs such fertilizers, pesticides and water management and basic environmental knowledge were also included.

THE FFS MODEL BASED ON PARTICIPATORY TRAINING METHOD AND COMPRISED OF 8 ACTIVITIES.

According to van de Fliert and Braun (2000) FFS involved eight activities are a basic activity in principe :

- Field observation
- Charting the growth and development of the crop
- Agroecosystem analysis
- Presentation of results and discussions
- Economic analysis
- Observing insect behaviour
- Group dynamic exercise
- Special topic (natural enemies or specific other topics occurs in the field).

FFS changed farmers attitudes, self confidence, improved knowledge, improved understanding on their own environment, eg. beneficial biotic factors.

These activities follows by group evaluations, and coordinated by the extention workers. The extention workers who involved on FFS have passed Training of Trainers (TOT), and 97% totally from pest diseases observers (PHPs) under diploma program were trained in collaboration with agricultural universities. Additionally 43% were specialist on vegetables crop protection (Sastrodihardjo, 2001).

Second factor success of technology transfer of IPM was participatory action research (PAR) as a joint action between PHP or extention people and farmers. Strenghtening by PAR and supported by researchers from IAARD plus universities lecturer, the FFS understand how biotic afctors as predators grows and take a role in their ecosystem; thus farmers become an investigators and a decision maker on their own farm. This is the reason that facilitator should have a wide knowledge of 'natural enemies and its relationship with insecticides' to facilitate all questions and actions. Of course in some cases showed up a non-ready answers or even a non-ready action to solve farmers problem in the field. These most covered a problem of 'ready made bio-pesticide' if a chemical one was banned.

Support of Government also covers Pesticide Commission new regulations that review and recommend pesticide policy, in 1997 about 57 kind of chemical pesticide were prohibited. At the institutional level involved ministrial and governors declared the enhancement of IPM implementation program, especially in the regions. At the village levels, Kepala desa, the leaders, also commited for their local resources to the program. However the constraints are still there since pesticide manipulation, unstable price, uncertain demand for certain vegetable are the major problems.

A continues action by farmers when the project is finish is still a question mark; also lack of manipulation of natural resources as botanic materials, natural toxin, and the influence of non IPM farmers are also problems for sustainable IPM. There is no current data available due to the continuation of nation wide IPM on vegetables as a holistic action; however the provincial or even district level in some aspect, IPM is being performed. Actually a carefully attitude was built through the IPM program, eg. in decision making for pesticide choice, a better fertilizer quality and agro-labours efficiency. In West Java, Bandung regions eg, Ciwidey, Rancabali districts about 45% farmers are being applied the IPM strategy on their vegetables field (Djedje, pers.comm, 2004).

A very high expectations from West Java and Central Java vegetable farmers, to continue IPM program also with a high expectation for biopesticide technology since some of the pesticides were not effective anymore against key pest diseases problems.

Execessive pesticides use may cause negative impacts to the environment either biotic and abiotic; these evidence was occured on shallots (Alliums) and general vegetable community. Currently a number of enlargement rate was shown of more than 7% pesticide use annually, proved notoriously condition of crop damage and losses. To improve yield quality of food crops and the environmental sustainability some potential indigenous biological agents/materials should be manipulated (Dibiyantoro et al. 2002). Most of the potential bioagents are under-utilized among common farmers. Thus providing research based on the natural resources exploration and exploitation is urgently needed; in accordance to a hard effort for reducing synthetic chemical compound as pesticides.

It is always essential to evaluate the number present and their character of vast bioagents that will be beneficially for Integrated Pest Management and yield quality, to promote vegetable sustainability, particularly for its product safety (Dibiyantoro, 1998; Dibiyantoro et al, 2000). In resolve of crop management, important bio-components in the crop are interrelated, including the role of bioagents as the bioregulator to suppress pest levels (Dent, 1995). Robust entomopathogenic-microorganisms and the novel natural 'Arachnid toxin'. are the important investigation for IPM strategy. Novel toxin that will be formulated and tested by bioassay and at the second step will be applied on farmer field will be studied for the natural toxin release (Dibiyantoro et al. 2002).

Justification

- Indonesia attains the amount of 22.5 million of agribussiness and other agricultural activity have involved 32.18 million of labour and manpower (Darmawan, 1999). These activities automatically have the impact of pesticide utilization widely, up to 16 thousand tons per year, and more than 7% increasing rate per annuum (Adiyoga et al. 2000).
- These condition are contra-productive for the agriculture sustainability as it might degrade land condition and crop carrying capacity (Djayadiningrat, 1995; Kusumaatmadja, 1995). Thus the research on biopesticide are expected and may reduced cost production for agrochemical compounds.
- Based on the Government Law no 8/1999 for the consumer protection as well Government regulation no. 69/1999; Laws no. 7/1996 that government and people have their responsibility for the food safety production. Meaning the laws and regulation pushed growers to produce clean product, gradually.
- The research and study for digging and explorating the potency of indigenous natural resources are beneficial for local farmers and could maintain agricultural sustainability and free of pesticide vegetables. Ideas of formulating and utilizing novel biopesticide so called BIOTOX as well BIONOCK, and AMPUH (depends on its active ingredients and type of enhancer compounds) from indigenous resources are valuable to be studied and should achieve the evaluation for testing their bio-efficacy against the target key insect pest on different season and multi agroecosystem.

The character of biopesticide was possible to be autodisseminated in the environment through the off spring of insect that pronounce in laboratorium as trans ovarial or trans ovum mechanism (Schapiro and Argauer, 1995). The persistence of the formulae in the ecosystem is also important, their resistivity into the UV exposure as well their stability in the soil until some certain years was tested. Applied technology should be adopted by farmers widely, the farmers acceptance and perception could be evaluated through a simple survey, as long as the demontration plots of biopesticide are provided.

Objectives

- To study the purification, separation and formulate the indigenous natural product as biological pesticides against major insect pest on Allium and hot peppers, tomatoes eg. Spodoptera exigua; S.litura, Helicoverpa armigera. In further study also tested on insect key pest on potatoes, beans, Cruciferae and some miscellaneous crops.
- To study the mortality of target insect affected by Arachnid novel biopesticide.
- In the near future will be minimizing usage of synthetic chemical pesticide on Allium ecosystem and major important vegetables.

Long Term Objectives

- To study the augmentation predator biodiversity on vegetable especially Allium- hot peppers ecosystem.
- To create local bio-pesticides industry, as home industry on farmers as well bigger scale as a joint work by the industrial aspect.

Expected Research OutPut

- Indigenous natural product (so called Bionock, or other names depends on its active ingredients, isolation methods and process and its enhancer) as Arachnid neurotoxin that caused some mortality that effectively inhibit the 'reproduction rate' of Spodoptera exigua ; S.litura or H. armigera., and other important insect pest.
- Farmer adoptivity (acceptance) for biopesticide at least more than 50% out of the farmers respondent.

Methodology

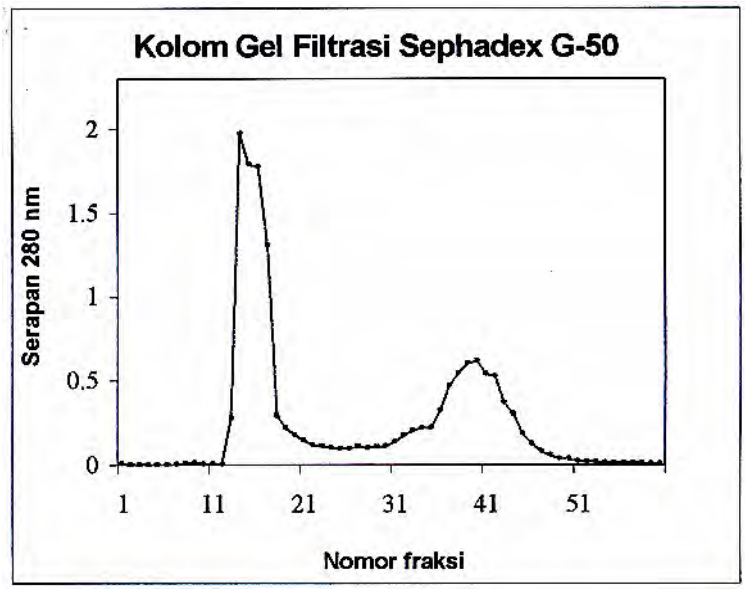
- The Arachnid and some other toxin bio-material isolates resulted from the purification were blended as a novel biopesticides formulations by the addition of some enhancer; potency of inhibition on reproduction rate of target insect life cycle was studied.
- BV as one of the component was expected as potential agent as a vechile of compatible toxin to maintain the biopesticide persistence in the ecosystem.
- The agro-economic for farmers adoption were executed through Adiyoga et al (2000) method.

RESULTS AND DISCUSSION

Purification of the Arachnid toxin were tested against S.exigua that effectively caused rapid mortality and was initiated at 9hrs, and followed at 24-48 hrs post treatment. The toxin of Teraphosidae were having a better result compared to Nephilla; beside its rearing was much easier in laboratory. BIONOCK was succesfully inhibited reproduction rate of target insect more than 40%-72%; the pupae shown as an incomplete form and having an invagination that resulted crippled imagos. Arachnid toxin as a 'Formulae Blending' were shown a higher toxicity compared to their single toxin formed on S.exigua.

GEL ELECTROPHORESIS ANALYSIS ON THE TOXIN

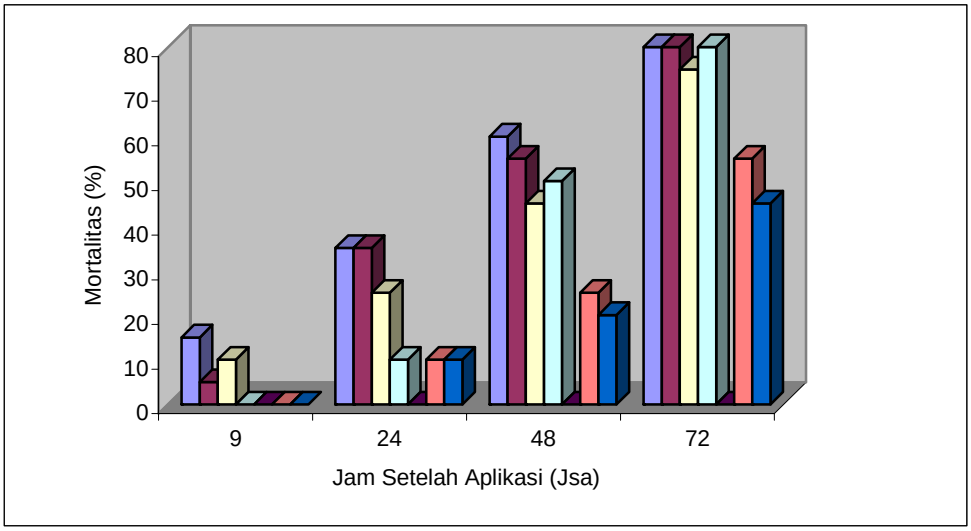
The toxin analysis by using Sephadex G-50 gel electrophoresis method resulted several fraction that compared to the standard. The peak showed potential fraction which 13,14,15,16 and 17 and was calculated to evaluate the protein contain of some toxin. Potential peaks are shown below on Graph 1.



Graph 1. Fractination of protein of Javanese *Arachnid*

St A 14 15 16 17 38 39 40

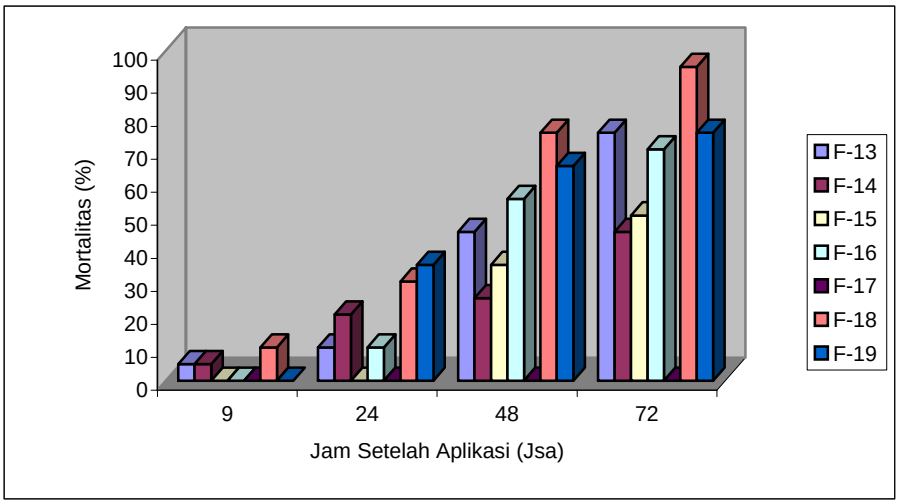
Based on the protein standard then the potential peak are suspected contains of the protein as well since they have similarity on the protein flow. The possible protein contains are around 331412014 ug/ml. Huwen. et al (2001), described the protein complex in *S.huwenensis* that the moleculair weight around 4000. Other author as Ori and Ikeda (1999) also mentioned the similar MW above 4000, actually protein consist by three different level of MW those are lower than 1000, between 1000-3000 and Between 3000-10.000. To confirm the MW further research are being proposed for year 2004, in the near future an amino acid sequencer are utilized to determine the MW protein.Following graph showed the effectivity of each potential protein fraction against the testing insect *(S. litura and Crocidolomia binotalis).*



Graph 3. *S. litura* mortality by the potential protein fraction

The most effective and potential among those fraction were number 13,14, 15 and 16 compared to others, fraction no.17 was not effective.

Bioassay of these fraction was tested as well against *Crocidolomia binotalis* (cabbage crop caterpillar) shown below.



Graph 4. *Crocidolomia binotalis* (Brassicas crop caterpillar) mortality by the protein fraction of potential Aracnid toxin.

Protein fraction that most caused Crocidolomia mortality were number 13, 16, 18 and 19. The type of protein will be determined for next year research since problem appears when the range of protein molecule weight was informed and no accurate standard available.

Formulation of Arachnid toxin and its bioassays against target insect and inhibiton of reproduction rate

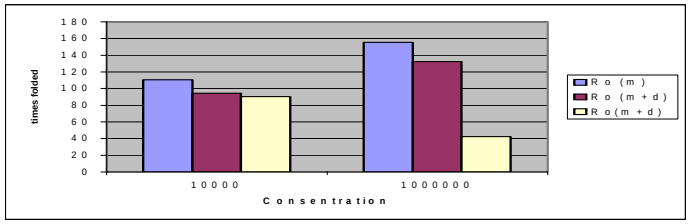
The Neurotoxin biopesticide formulae affected *S.exigua* diferrently on their mortality, in some cases formulae was effectively caused mortality between 48-72 hrs post treatment. These condition similarly to the effect of *B.thuringiensis* or pyrethroid synthetic insecticides on key insect pest on most of vegetable crops. Meaningly the Arachnid toxin formulae could be utilized as biopesticide for further field evaluations; which will be tested in year 2004 experiments for farmers participatory plots. The enhancer function on this formulae was a kind of 'toxin vehicle' in the environment, since the vehicle could carry and stablized toxin for more persisting for the physical changes, as temperature, humidity and UV lights (Dibiyantoro. et al. 2002).

Persistence of neurotoxin biopesticide was supported by the capability of stimulation the inhibition of reproduction rate on *H.armigera* as shown on the following tables and graphs.

Table 1. The effect of novel biopesticide on H.armigera for its fecundity, viability and survivalness.

No.	Treatment	Fecundity (F)	% egg hatching (V)	% survivalness (S)
1.	10 6 PIB	1217	62,84	19,71
2.	10 4 PIB	537	47,74	27,65
3.	Control	1425	65,68	64,39

The advantage of BV as an enhancer is the capability of its trans ovarial or trans ovum transmitted from parental generation through their offspring. Thus fecundity capacity was reduced from 1425 to 1217-537 (decreased by 14.60-62.32%); percentage of egg hatching from 65.68 down to 62.64-47.74 (4.63-27.31% decreased). These condition commonlly inhibited the mechanism of reproduction rate; as an comparison normal rate was 361.5910 decreased to 90.4408-42.5307 (74.99-88.24%). Nevertheless the debilitating effect (d) and maturating effect (m) as a natural factor on insects were able to reduced these inhibition. These persistence is importantly indeed for biopesticide as a biological agent that released in the field.



Graph. 5. Reproduction rate of *H.armigera.* inhibiton caused by Biopesticide formulae with BV as an enhancer material on 10^4 and 10^6 PIB Concentration.

The success of biopesticide experiments should be supported by the acceptance of users and beneficiaries. A preliminary agro-economic survey was carried out to trace the opinion, curiousity and willingness of farmers for biopesticides technology. The survey method was designed by Adiyoga et al. (2000) and indicating that approximately 80% farmers out of in Brebes, Central Java and more than 88% in Pacet, West Java (Soetiarso and Dibiyantoro, 2001) agree and very curiously willing to accept and to apply biopesticide on their field. The requirement was 'availability of biopesticides if they needed.

IMPLEMENTATION OF BIOTOXIN FOR CROP QUALITY AND CHEMICAL INSECTICIDES REDUCTION

Biotoxin pesticide was applied on shallots (Allium cepa var.ascalonicum L.), in Brebes (Central Java) successfully achieved lower damage similarly to chemical insecticide (Proclaim) damage. Implementation of Biotoxin pesticide were involved as well by farmers in Klampok and Keboledan, Brebes. Farmers were able to compare directly beneficial of reducing synthetic chemical insecticide down more than 90%. Hence, a significant differences occured on tuber diameter 7.61% wider than chemical treatment, meaning crop quality were improved on biopesticide treatment. Biotoxin contain of protein that might be stimulated photosynthetic process. The solid contains tuber resulted by Biotoxin was 28.89% higher than chemical treatment.

Tuber weight of 20.79% more than tuber yield sampled from chemical treatments. Water content on Biotoxin treatment tubers was 82.61% whilst on chemical treatment was 82.81%. Biotoxin application did not give negative impact on beneficial Arthropods, that have a higher biodiversity indices according to Shannon Weaner diversity formulae; meaning this Biotoxin was environmentally safe if it applied on vegetables (Dibiyantoro et al., 2002).

CONCLUSIONS

- Indeed IPM has achieved success on technology transfer in Indonesia, however the continuation of this program is very important to allow attitude maintenance of farmers.
- Lack of the IPM should be supported by realistic way to minimize agro-manpower by application more appropriate technology.
- Biopesticide formulae is one of appropriate technology that need further action and support from related institution or government.
- Bionock formulation affected the H.armigera fecundity capacity that reduced by 14.60-62.32%, percentage of egg hatching reduction was 4.63-27.31. These condition commonlly inhibited the mechanism of reproduction rate at a range between 74.99-88.24%, and resulted crippled adult.
- Implementation of biotoxin resulted good prospect for synthetic chemical insecticide reduction and achieved improved shallots tuber quality, however larger scale and multilocation biopesticide testing are needed.
- Mass production and 'scalling up' participatory research is needed to provide 'ready made' pesticides that will help farmers to practice the realistic IPM.

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IMPLEMENTING FARMERS LED EXTENSION SYSTEM THE MALAYSIAN EXPERIENCE

Muhamad Damanhuri bin Ahmad[1]

ABSTRACT

In the early seventies, the agricultural extension system in Malaysia started to implement training and visiting model under the sponsorship of the World Bank. It was effective to alleviate the farmers' problem and increase their income, but to meet the demand of the country's development this system has undergone numerous changes. In the early eighties, the system adopted the group farming approach. Comprehensive crop manuals were introduced to the farmers during that period. Nevertheless, the training and visiting model still played an essential role in the system. In this new millennium, new elements such as business plan have been introduced into the system by incorporating complete technology packages. It is concluded that the agriculture extension system is a dynamic approach to meet the demand of the country's development. Implementing farmers led extension system is the best extension system in term of sustainability and the successful of the projects. Through Malaysia's Department of Agriculture experiences, farmers led extension system is newly introduced to boast the "community driven" approach.

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INTRODUCTION

Under the leadership of Malaysia's new Prime Minister, Dato' Seri Abdullah Ahmad Badawi, the agricultural sector has been given new emphasis to increase the income of farmers and the living standard of the rural community. The agricultural sector must find new sources for its value added products. Therefore, the government has given new emphasis for the development of the agro-based industry as one of the means to increase the farmers' income. Hence, he renamed the former Ministry of Agriculture as the Ministry of Agriculture and Agro-based Industry.

At the same time, the Prime Minister has also directed all the government agencies to upgrade their delivery system so as to benefit the rural community. In line with this, the new ministry must upgrade and strengthen its extension services.

In Malaysia, there are many government agencies that provide extension services to the farmers and the rural community. Amongst the agencies are the Department of Agriculture, Department of Veterinary, Department of Fishery and RISDA (Rubber Industry and Small Holders Development Authority). This paper aims to relate the Department of Agriculture's experience in implementing extension services.

BACKGROUND OF DOA EXTENSION SYSTEM

Malaysia's Department of Agriculture has the longest history in implementing the agricultural extension services. For some states, the Department of Agriculture was established as early as 1898.

In early seventies, the extension system known as the training and visiting system was implemented under the sponsorship of the World Bank. It was an effective system to alleviate the farmers' problem and increase their income. However, this system has undergone numerous changes to meet the demand of the country's development.

In the early eighties, the agricultural extension system adopted the group farming approach. Comprehensive crop manuals were introduced to the farmers during that period. Nevertheless, the training and visiting system still played an essential role in the extension system.

In this new millennium, the extension system never ceased to grow and change. New elements such as business plan have been introduced. At the same time, the Department of Agriculture also introduced new programmes such as "Paddy 10 tonnes" and "Mango 30 tonnes" programmes. To achieve its goal, these programmes come with complete technology packages.

GROUP FARMING

In Malaysia, there are two main groups of farmers, the group farmers and the individual farmers. The Department of Agriculture provides extension services to both groups of farmers. However, more emphasis is given to farmers who adopt the group farming system in terms of more frequent and systematic visits.

JKKK or Village Development and Security Committee plays an important role in helping the DOA implement the group farming system. Group farming cannot be formed without the sanction of JKKK. A particular area's group farming is made up of local farmers who are also members of the Farmers Organisation. Most of them are active farmers who are always ready to accept new technology, making the process of technology transfer more effective. Their influence is important so that other farmers can follow and utilise the new technology. In fact, some of their influences have reached the neighbouring areas.

Group farmers can be divided into a few categories, namely the excellent group, the potential group and the normal group. The excellent groups are able to form mini estates, nucleus farms and even companies. Usually, the excellent groups and the potential groups play a part in the agricultural extension services. However, the excellent group plays a bigger role by acting as project managers.

Selected groups will receive services from the MoA Inc. (Ministry of Agriculture Incorporated). MoA Inc. is formed by the Ministry of Agriculture to help farmers, rural folks and agriculture entrepreneurs carry out their activities and increase their income. Under the MoA Inc., all the agencies involved will pool their resources together to aid a project, programme or activity that is carried out by the farmers and agriculture entrepreneurs. This way, the government can save its manpower, cost, sources and time, resulting in more efficient services.

THE ROLE OF GROUP LEADER IN EXTENSION SERVICES

In Malaysia, Agriculture Technicians are extension agents at the grass roots level. Each one of them has to supervise 700 to 800 farmers and 8 to 10 group farmers. Their area of service is called the extension service area. Besides, there are also Agriculture Technicians who manage the Women Extension Group. They are assisted by Agriculture Officers from the technical division in term of counselling services and technical information.

Group leaders function voluntarily as they are not paid for their job. Nevertheless, some of them play their role well, leading to many successful projects. Among the roles played by them are:

- identify issues and problems
- collect data and information
- project planning
- organise campaigns
- act as trainers
- implement demonstration plot
- act as project managers
- find marketing prospects

The roles of group leaders differ according to their groups' progress. In excellent groups, the group leaders play a bigger role. Usually, these group leaders are made up of local politicians who intend to further develop their village, senior citizens or retirees who wish to develop their village and those who wish to venture into politics or contribute to the society.

Generally, any problem or issue will first be forwarded to group leaders before being brought to the attention of Agriculture Technicians during JKKK meeting or group meetings.

For more advanced groups, data collection was jointly carried out by group leaders and Agriculture technicians. This effort usually produces business plans that become the guide for the group to carry out its agricultural project. A planned programme is usually submitted to the JKKK for their views and comments.

For the excellent and potential groups, the role of group leaders is clear. They take part in campaigns and provide explanation to those who need it. They work closely with the district agricultural offices too.

Group training is provided by the Agriculture Technicians themselves. However, if a particular agricultural problem is too complicated and requires more technical expertise, then technical officers from agriculture stations will provide assistance. At times, group leaders and educated farmers will play a part in providing training too. In Malacca, there are a few progressive farmers who are involved in providing training nationwide. For their voluntary effort, the agriculture department pay them allowance based on their qualifications and the amount of time they put in.

There are also exemplary farmers inside or outside the group farming system. Usually agriculture departments and agriculture research agencies select them to carry out observation and demonstration plot. Some of these exemplary farmers like to share their experience with other farmers.

NEW TREND

In line with the change of time, there are changes to the structure of group farming management. The then relaxed management system has become more formal. There are excellent groups, which turn into mini estates and registered companies.

There are also group leaders who possess entrepreneurial skills. They have transformed their groups into farming group owned company. In Malacca, there are two such groups that set up companies where the less capable or unable farmers would transfer their land ownership in the form of shares to the registered companies for better management and development. The company would then manage their land based on the contract signed between them. The company management is responsible for the development of their respective group farmers and extension services are directly provided to the management of the company. As a result, productivity is tremendously increased.

The neighbouring group farmers and non-group farmers are observing this new trend keenly.

CONCLUSIONS

The agriculture extension system is a dynamic approach to meet the demand of the country's development. Implementing farmers led extension system is the best extension system in term of sustainability and the successful of the projects. Through Malaysia's Department of Agriculture experiences, farmers led extension system is newly introduced to boast the "community driven" approach.

BEEF CATTLE RICE-BASED AGRIBUSINESS IN GARUT

Dedi Sugandi, Y.Surdianto, IGP Alit Diratmadja, and Oswald Marbun[1]

ABSTRACT

The assessment of Beef Cattle on rice farming system has been conducted in Banyuresmi Subdistrict, Garut District from 2000 to 2002 using "participatory on farm research approach". It was started in 2000 by: (a) selecting and building farmer cooperator, and (b) introducing beef cattle fattening technologies such as permanent shield of animal husbandry , fermented straw for main ration (ad-libitum) and 50 : 50 hush and corn comb powder for additional ration of 5 kg. In 2001 the activities were: (a) raising fund for Bull (young cattle) for replacement stock from the farmer group members and private investors, and (b) applying replacement stock management and technical guidance for cattle rising and ration supply. In 2002, the activities were: (a) building for leading farmers and other farmer group, (b) raising fund, (c) providing technical guidance for cattle rising, and (d) marketing. The results showed that in 2000 the farmer cooperator of beef cattle on rice farming system could produce 1,62 ton of waste/cattle/season (6 months) and earned average benefit of Rp 183.000,-/cattle/month. In 2001, there were two periods of cattle rising: the first period was fattening 12 cattle from 13 investors and the budget of Rp.32.750.000, and the second period was fattening 19 cattle from 17 investor and the budget of Rp 53.000.000,- . The average daily gain ranged from 0.78 – 0.80 kg. The waste production was 10 kg/cattle/day and the benefit was Rp 162.000,-/cattle/month. The share of benefit between investors and farmer's group was 60 and 40 % from the total benefit, respectively. In 2002, the activity were participated by 3 leading cattle farmers, 2 new farmers group in Garut District, and 3 new farmers group outside Garut. Their fund for cattle replacement stock came from the farmer members, private investors, and the Local Government credits. The achievement of those cattle farmers were the average daily gain of 1.06 kg, produced 10 kg of waste/cattle/day or equal to 1.5 – 2.0 ton/cattle in 4 - 6 months period. The constrains were how to sell cattle during off season (i.e. outside Iedul Fitri and Iedul Adha).The effort to deal with the problem were to join the slaughter company outside Garut District. Beef Cattle fattening on rice farming system were prospective and produced prominent income. The most constraining to the system were small farming area and limited capital. Some aspects that should be taken into considerations are availability of appropriate technology, fund raising effort, and scaling up business through corporation management.

Key-word : Beef Cattle, Agribusiness, Rice straw

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INTRODUCTION

Meat consumption, particularly beef in West Java tends to increase along with economic growth and awareness of nutrition's food consumption. West Java Animal Husbandry service (2000) reported that animal protein consumption has considerably increased from 2.36 to 3.76 gram per capita per day (39.33%).

In West Java meat consumption contributed up to 56.72 % of the total animal protein consumed, of which beef has contributed to 24.35 % of the total meat production. From this, only 12,03 % (33.000 beef cattle per year) was produced locally, and the rest was imported. This indicates inability of the province to fulfill local demand of beef cattle. Actually the possibility of the province to increase beef cattle production is very high considering the fact that West Java has abundant stock of rice straw to be converted as potential animal feed through ammonization, hydroxidation, and fermentation technologies (Diwyanto, et al., 2002).

Kusdiaman and Yuliardi (2001) reported that cattle fattening on rice farming system were prospective and yielded prominent income. The use of compost as a waste of rice-straw processed could increase the rice yield up to 12.75 % - 14.06 %. However, the constraints were the capital and small land area for farming. Therefore, to implement feeding cattle technology on rice based agribusiness should consider appropriate technology application, fund raising, and scaling up business through corporation management.

To gain more information on beef cattle rice based agribusiness, and to test whether the system could increase similar profitable results, the assessment was conducted in Garut District, West Java.

METHODOLOGY

The research had been conducted in Suka Senang Vilage, Banyuresmi Subdistrict, Garut, West Java from 2000 to 2002. This assessment used "participatory on farm research approach" with the following stages: In the year 2000, the activities started by: (a) selecting and building farmers group as cooperators, and (b) introducing beef cattle fattening technology such as animal husbandry in permanent stall, feeding cattle with fermented straw as main feed (ad-libitum), and 50 to 50 husk and corn cob powder mixture as feed supplement (5 kg per animal per day). In 2001, the activities were: (a) raising fund from the farmer group and investors for cattle replacement stock, (b) providing technical guidance for cattle replacement stock supply, and animal husbandry and feed supply as the previous year. In the year 2002, the activities were: (a) building leading farmers and new farmers groups, (b) raising fund, (c) giving technical guidance as for the previous year, and (d) marketing the product.

Technical and social economy data such as the growth of the number of the investors and the farmers, and the expansion to the new location, the cooperator farmer group dynamics, the number and value of the cattle investment, and the cost benefit analysis of the beef cattle were collected. The collected data were tabulated and descriptively analyzed.

RESULT AND DISCUSSIONS

Site Description

Sukasenang village in Banyuresmi Subdistrict, Garut. geographically lies on the main road of Garut Town to Limbangan Sub District. This main road connects the town of Tasikmalaya to Bandung, the capital city of West Java Province. The distance of Sukasenang village to the town of Garut is about 10 km, while to Bandung is about 60 km. The type of climate in Sukasenang is D (Schmidt and

Ferguson classification) with average annual rain fall of 1683 mm, six wet-months and four dry-months, average daily temperature is 19 – 200 C, and humidity is 60 – 70 %. This Characteristic is prospective for farming system development through out a year, including beef cattle rice farming system. The farming area of Sukasenang village is 310 ha, consisting of 216 ha wet land, and 94 ha upland. There are 202 ha irrigated land, and 14 ha simple irrigation land. Most of the land (70 %) is used for rice the rest was planted with second crop (palawija) and fruits.

Most of the farming pattern in the village is rice – vegetable without livestock, and some have livestock. Livestock kept in this village are sheep, buffalo, local chicken, and duck. The prospect of this livestock is not conducive, due to the non business-oriented farming. In additions prospect for ruminants is constrained by limited available forage, because it is difficult to obtain forage in intensive rice farming. According to the report of the Agricultural Extension Field Services (BPP) Banyuresmi, there were no cattle farming in this village due to difficulty of forage availability, particularly during dry season.

Agribusiness Performance

The growth of the farmer cooperator. The farming system in the research area was individually managed with the average land area of 0.10 – 0.25 ha per household. Actually the system was not suitable for commercial farming system because this will not be able to be expanded to be a commercial farming scale with professional management under the farmer group. Therefore building a farmer cooperator group would be a necessity condition.

The model of farmer group organization was formed according to the planned activities such as animal husbandry, agro inputs marketing, and public relation. The animal husbandry section was responsible for cattle fattening management, supply of feed with fermented straw, and animal waste management into compost. Agro input section was responsible both for distribution and repayment of agro input to and by the members. Marketing section with other section were responsible for selling fattening and ready slaughtered cattle, and mature compost. Public relation section was responsible for enhancing communication among farmer group members in their activities, pioneering partnership among farmer groups, businessmen, and creditors (banks). The organization structure of the cooperator farmer group in the research area is presented in figure 1.

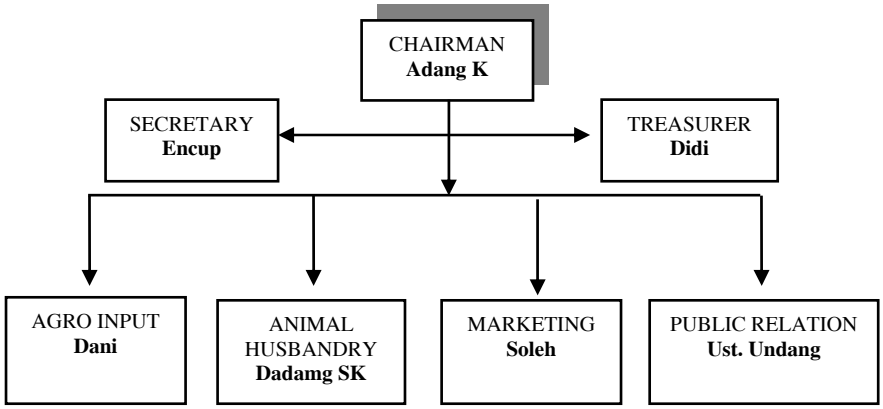

Figure 1. Organization of Farmer Group

The Performance of Beef Cattle Agribusinesss in 2000. Cattle fattening with main feeding of dry fermented straw began on early August 2000. The average daily gain (ADG) of the cattle in the early research period was fluctuating (figure 2)

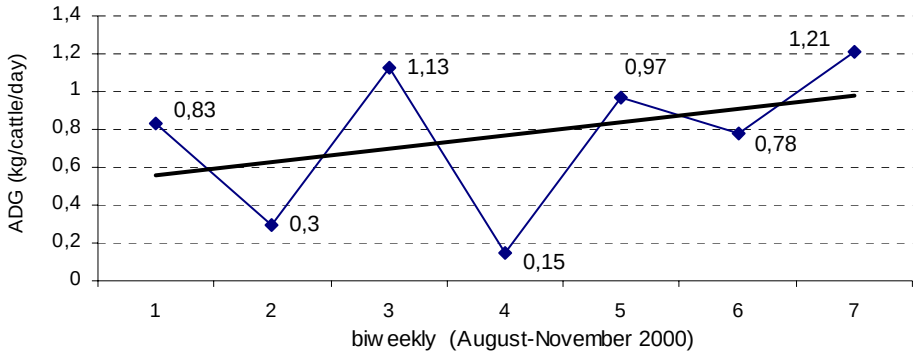

Figure 2. The Average Daily Gain (ADG) of The Beef Cattle in The Integrated Crop Livestock Assessment in Garut. 2000

Figure 2 show that the ADG of the cattle in the early stage was 0.83 kg/cattle/day, but in the later stages it fluctuated drastically. The main factor of the fluctuation was estimated due to the beginner status of the farmer without any experience in livestock management. In addition, in the early stage, the farmer was still not fully believe and low confidence on the advantages of using fermented straw for cattle to be fattened. According to Haryanto, et al (1999), straw nutrition value could be increased through fermentation technology using Cellulomopasw sp and Alcaligenesis faecalis bacteria that increased the digestion up to 75 %.

After intensive extension given to farmers, their confidence to fermented straw increased which was resulting on growth of the cattle. In the late November 2000, the ADG was 1.21 kg/cattle /day. The average ADG of cattle fattening in this period was 1 kg/cattle/day. This growth rate seemed to draw interest of the community to try fermented straw technology to fed cattle because easy to apply and low cost of the respected technology.

In addition to give better meat production as shown by increasing ADG, the fermented straw technology also produce organic fertilizer in the form of composts from animal waste and straw in the shelter. The C/N of the compost was 12, which was rated very well. According to Sosrosoediardjo, Rifai, and Prawira (1974) in Suriapermana et al., (2000), organic material for fertilizer should have the C/N ratio nearly the same to soil C/N i.e. between 10 -12. This indicates that the composts of the fermentation of rice straw in assessment area was very suitable for organic fertilizer.

Cattle produce wet waste of 4 – 5 ton/year. This would produces composts of 1,5 – 2,0 ton/cattle/rice season. The compost can be returned to the paddy field or be sold. One hectare needs 1,5 – 2,0 ton of composts. Composts fertilizer could improve soil physical properties and reduce costly chemical fertilizer.

Partial calculation shows the cost to produce composts was Rp 125,-/kg. The composts price at the farmer level was Rp 250 – Rp 300,-/kg, Basic price of compost was Rp 400 – Rp 500,-/kg. One hectare of rice field could feed 2 cattle, and then those two cattle could produce compost about 4 – 5 ton/year. The composts price at farmer level from the 2 cattles was Rp 1,500,000 – Rp 2,000,000,-. If it managed properly at the farmer level, it will absorb labour, increase soil fertility and land productivity, reduce organic fertilizer application, which in turn could increase the income. Table 1 shows financial analysis of cattle fattening management in the first period by the cooperator.

Table 1. Financial analysis of cattle fattening with fermented straw in Garut. 2000

No	Variable	Value (Rp)
1.	Cost production	35.706.000
	Replacement stock	32.125.000
	Feed	2.912.000
	Supplement	69.000
	Mandays	600.000
2.	Revenue:	40.640.000
	Meat	38.000.000
	Compost	2.640.000
3.	Income	4.934.000
4.	R/C Ratio	1,14

Income of the cooperator farmer from the livestock and composts were Rp.38.000.000 and Rp 2.640.000, respectively. The cost in the farmer cooperator was Rp 35.706.000 and the profit was Rp. 4.934.000.

R/C ratio shows that for entry Rp 1 of production cost, the farmer cooperator could receive 1.14 in turn. In other words, the cooperators earn profit of Rp 14.00 per Rp 100 of cost production of the cattle fattening farming systems by the cooperator, and it looks financially suitable.

Performance of Beef Cattle Agribusiness in 2001. Because of higher ADG and prospective financial analysis of beef cattle, more farmers were interested in the farming system model. This was shown by increasing number of farmer investors in Table 2.

Table 2. The growth investment beef cattle in "Berkah Tani" farmer group, Sukasenang village, Banyuresmi sub district, Garut district.

Periode/Year	Number of cattle	Investor	Value Investation (Rp)
I / 2000	9	9	21.800.000
II / 2001	12	13	32.750.000
III/ 2001	19	17	53.000.000

In 2001, there were two periods of management: (i) 13 investors with the capital of Rp 32.750.000 who raised 12 cattle, and (ii) 17 investors with the capital of Rp53.000.000 who raised 19 cattle. The management could achieve ADG as much as 0.78 - 0.80 kg/cattle/day and animal waste production of 10 kg/cattle/day.

The growth rate of the 3 periods of cattle fattening within two years tends to increase (Table 3), even though the cattle fattening management was not only to achieve the higher ADG, but also how the cattle could utilize agricultural waste from local resources as feed to get meat production as described

by ADG and decomposed organic waste (composts) as well. According to Sarief (1984), organic fertilizer from the animal waste could improve soil physical and fertility.

Table 3. Average daily weight of beef cattle and waste production in Garut, 2000-2001

Periods	Number of cattle	Average of weight rate (kg/cattle/day)	Average of waste production (kg/cattle/day)
2000	9	0.70	14
2001	12	0,78	19.5
2001	19	0,80	29,0

There is interesting to find out that feed natural from various waste, such as rice and corn straw for basic feed, and rice waste (by-product of milling used as animal feed) crushed corn cob, and coconut waste (industrial waste of sweets) for supplement feed, are not yet optimally used by the farmers in Garut.

Performance of Beef Cattle in 2002. Beside investors, there were some individuals or key farmers from cooperator group members who tried to apply the techniques and management in their business. For example in 2002, there were three individuals or key farmers, and two new farmer groups in Garut, and three farmers group out side Garut who applied the cattle fattening techniques. The fund rising of the individuals or key farmers was conducted through the benefit shares of 40 % for the manager and 60 % for the investors. The capital for the new farmer group in Garut and the outside came from the local government in the form of credit loan for the cattle replacement stock.

The achievement of ADG in the individuals or key farmers was 1.06 kg/cattle/day that higher than that of previous farmer cooperator. While the organic fertilizer or compost production was almost the same of 10 kg/cattle/day or 1.5 – 2.0 ton/cattle/period of management (1 period of management = 4 – 6 month). The constraint for farmers until now is selling the cattle beyond Iedul-Adha and Iedul Fitrie days. This was due to low price and difficult to enter existing traditional market. The possible effort to over come these problems is to arrange a partnership between the farmers and beef cattle businessman who have large market network in West Java. The businessmen location fortunately is not so far from the assessment area.

CONCLUSION

1. Beef cattle fattening in rice farming system through farmer group using fermented straw technology were prospective.
2. Fund rising were conducted based on with the benefit sharing of 40 % for the investors and 60% for the farmers, respectively.
3. Outside iedul- Adha and iedul-Fitrie days, the marketing constraint was possibly to be solved through arrange a win-win partnership with commercial beef company.

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AGRICULTURAL EXTENSION IN URBAN AREA

Heni Wijayanti, Didi S, and Suwandi[1]

ABSTRACT

Agricultural extension in urban area differs from the one in rural area due to the nature of agricultural activities, the need of consumers, access to information and institution related to agribusiness activities and the available infrastructures. Agricultural activity in urban area is characterized by production of high value crops such as ornamental crops, activity on vaslue added agricultural products and the quality of agriocultural products. The agricultural extension in urban area should, therefore, focus their efforts in making available information on those aspects of urban agricultural activities. To be successful, the agricultural extension in urban must work in cooperation, collaboration and partnerships with research, service regulatory, entrepreneurships, and social institutions.

[1] Jakarta Assessment Institute of Agricultural Technology (AIAT)

BACKGROUND

Agricultural activities in urban area differ from the ones in rural area due to specific conditions of the agricultural resources, biologically as well as socio-economically. The agricultural activities in urban area demands specific agricultural extension which is not only due to the specific conditions of urban area, but also because of the agricultural products needed by consumers and the access of agricultural information.

Agricultural extension serving farmers of ornamental plants in Jakarta is a typical agricultural extension activity in urban area. Although the basic principles of agricultural extension in urban and rural areas are the same, but some approaches need to be adjusted to the conditions in urban area. Moreover, the extension system in urban area, particularly for ornamental plant farmers, have specific challenges, therefore, it has also specific system. Agricultural extension as non-formal education system requires organization, management, strategy, program, method, human resource, finance, and a clear goals (Anas Rasyid, 2001). Agricultural extension system must be dynamic in facing the day to day changes of situation and challenges.

AGRICULTURE IN URBAN AREA

Urban area is dominated by activities of services, industry and marketing. The needs of agricultural products, however, are increasing due to increasing number of population, urbanization as well as the demand of quality agricultural products. Farmers in urban area, therefore, stress their efforts in producing quality products and value added of agricultural products that produced in rural area, and marketing them. Urban agriculture is also characterized by small land size, scarcity of water and unfavorable environment conditions. As expressed by Suradisastra (2001) the urban ecosystem limit operational activities of agricultural sector. Agricultural intensification is a must do in urban area, which is directed toward the application of intensive and appropriate technology and information in agricultural business.

Farmers must pay attention to the changing needs of the consumers, particularly on the ornamental plants, which include freshness, distinctness, exotic and nobleness in term of color and appearance, and attractiveness. These aspects determine the price of products. Moreover, the consumers of the ornamental plants are the middle class people and above who have no constraints in purchasing power. They do not care too much for the price; the most important thing is fulfilling their desire. The ornamental plant farmers, therefore, frequently must compete with imported products that attract more consumers. These situations call for a better information seeking behavior of farmers in urban areas.

Wijayanti (2003) showed that farmers of ornamental plants in West-Jakarta expressed the important of all aspects of agricultural information (Table 1).

Table 1. Percentage of the Ornamental Plant Farmers based on the level of information importance, West Jakarta, 2003.

Aspect of Agricultural Information Required	Percentage of farmers based on the level of information importance (N =100)			
	Low	medium	high	Very high
Technology	5	8	55	32
Finance	5	11	42	42
Best business area	5	12	53	30
Production inputs	6	10	65	19
Market Information	1	5	53	41

Source :Wijayanti, 2003.

In addition, Wijayanti (2003) showed also some pattern of information utilization (Table 2), based on ornamental plant business as demanded by consumers and the availability of information as follows:

- Farmers seeking effort is in medium category. Farmers tend to seek the required information from other farmers, in accidental manner and expected that the information is free of charge;
- The main sources of information are successful farmers, production inputs retailers and consumers, due to easiness in obtaining the information, simple and easy to practice them and free of charge. They rarely used information provided by government, including extension service, due to the fact that most information provided by government are government project oriented (Tjitropranoto, 2003).;
- The initiatives the farmers seeking information was high, however, they seek information mostly to other farmers, the influence of the extension workers and other people were at minimal level. They seek formation mostly on consumers' need and desire, particularly on the nobleness of the ornamental plants;
- Farmers prefer electronic media, radio and television, rather than printed materials. When they need important information, they do not access the printed media, but they prefer to contact the main source of information such as research institution for technology and bank for financial maters.

Tabel 2. Farmers (%) Level of Information Seeking Effort

Aspects of Information Seeking Efforts	Farmers (%) in the Level of Information Seeking Effort			
	Low	Fair	High	Very High
Willingness to seek information	14	71	15	0-
Contacting Source of Information	53	44	3	0
Initiative in seeking information	5	21	48	16
Mass media Utilization	17	28	42	13

AGRICULTURAL EXTENSION IN URBAN AREA

It is believed that agricultural extension in Indonesia was started on early as 19 century and there were some changes based on the needs of agricultural development. During the green-revolution, the focus of the agricultural extension was on the increase of productivity of agricultural commodity. Stress was given to rice due to the role of rice is not only as staple food of Indonesian people but politically also as the most important commodity. The success of agricultural extension in increasing rice productivity and production, which was dominated by transfer of technology, then, the approaches was used to other food crops such as corn and soybean, and also to other agricultural commodities, such as estate crops and horticultural crops including ornamental plants. The development of agricultural extension, however were much better in rural area than urban area. The food crop's extensions , particularly rice, was better than other commodities, since most of the agricultural extension workers were trained in rice production technology and other food crops. Due to unfavorable conditions of infrastructures, particularly roads to reach remote villages and lack of transportation facilities for agricultural extensio0n workers, then, the training and visit (TV) approach, which was successful in some areas, particularly in Jawa island, was left, particularly during the decentralization era started in 1999.

Agricultural Extension in rural areas is dominated by government programs and project, and perceived by most people as the arm of the government to reach the target of the programs. As observed by van de Ban and Hawkins (1999), agricultural extension solely transferring technology,

centrally organized, and the scope was national in nature. In the decentralization era started in 1999, the agricultural extension responsibility was transferred from national government to district government. This transfer could provide better opportunity to district government in the utilization of agricultural resources optimally through the utilization of local specific technology.

Agricultural extension in urban area, however, was less dominated by government programs and projects, particularly in ornamental plants. It was developed based on the changing needs of the consumers. Farmers in urban area have limited natural resources, but getting better access to information and service. Based on this situation and the existing opportunity and challenge particularly in farmer's information seeking behavior, therefore, the strategy of agricultural in urban area should be directed toward:

- Availability of information in all aspects of agribusiness for almost all agricultural commodities that are produced in urban as well as in rural areas;
- Consulting services for improving knowledge and skill, particularly for less
- experience farmers;
- Facilitating partnerships between farmers with agribusiness entrepreneurs, of all
- aspects and financial institutions and related institutions.

The agricultural extension service in urban area, therefore, could not fulfill all services by themselves, but they have to build cooperation, collaboration and partnerships with other institutions, particularly research and service institutions, entrepreneurs, financial institutions, farmers – particularly farmers' institutions and leaders, and other related parties.

Slamet (2002) stated that organizational structure and working mechanism of the agricultural extension and agricultural research should be in a solid unit of institutions before trying to work cooperatively with farmers. As early as 1995, in anticipating decentralization, agricultural research has decentralized its function by developing Assessment Institute of Agricultural Technology (AIAT) in each province. Each AIAT is staffed with researchers and extension workers who were in research stations and Institute for Agricultural Information in respective province. Jakarta-AIAT, as one of the AIATs established, tries to integrate its efforts to serve farmers by establishing "Urban Agribusiness Clinic" or "Klinik Agribisnis mperkotaan"m (Suwandi et al 2004). The Urban Agribusiness Clinic has several activities, including:

- To make available, routinely, information in all aspects and commodities related to urban agribusiness;
- To conduct diagnostic identification of problems faced by urban farmers and provide possible solutions;
- To organize training courses to those who are interested in urban agribusiness;
- Facilit6ating business contacts with entrepreneurs in marketing of agricultural products in particular and in all aspects of agribusiness in general.

In order to perform all of the urban agribusiness activities, the Urban Agribusiness Clinic working in cooperation, collaboration and partnerships with institutions in the field of research, regulatory, service, production inputs, production, processing, marketing, value added agricultural products, farmers' groups, farmers' leaders, and human resource development.

CONCLUSIONS

Agricultural extension in urban area differ from the one in rural area due to availability of natural resources, consumers' demand and needs, availability of information and business institutions.

Agricultural activity in urban area, therefore, kharacterized by production of high value crops such as ornamental plants, the activitiy on value added agricultural products, and uality of agricultural products. The agricultural extension in urban area should, therefore, focus their efforts to the following activities:

- Provide various information in supports of all aspects of agribusiness in urban area.
- Solve a holistic problem.
- Narrow down the gaps between farmers, as producers. and consumers of the agricultural products.
- Strengthen the linkage between farmers and researchers, extension workers, and entrepreneurs.
- Make farmer as protagonist of agricultural development.

It should be arange for agricultural extension in urban area to work closely and in cooperation, colaboration and partnerships.

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AGRICULTURAL TECHNOLOGY TRANSFER AND ITS DEVELOPMENT IN NORTH SULAWESI (AN EXPERIENCE OF NORTH SULAWESI AIAT)

By J.G. Kindangen dan I.E.Malia [1]

INTRODUCTION

Agriculture sector in the next several decades will remain the primary factor in North Sulawesi economic magnitude. However, the economic value attained by this sector is not optimal yet because low adoption rate of necessary technologies, inconsistency in transfer process, low support from related institutes especially those located at farmer levels, and the necessary integrative system is not synchronized yet.

Production improvement and farming system income, and technology transfer process are inter related since the people livelihood can not be separated with technology innovation and dynamic changing of technology in certain periods. In this context technology transfer plays important role. However transfer of technology is a process in both technical and non-technical aspects, therefore, it should be solved integrative. The main objective of transfer technology is to improve people welfare that could be attained gradually and continuously. In North Sulawesi Province, there are still some weakness of technology transfer such as inappropriate of channels, technology delivered is not applicative in specific location, and lack of rural based institute and the transfer is not integrative among the doer.

The province has been established an institute expected to serve as a problem solving of the next technology utilities called AIAT (Assessment Institute for Agricultural Technology), an provincial institute under AARD (Agency for Agricultural Research and Development). North Sulawesi AIAT in the first decade has produced a lot of technology selected directly by stakeholder and user before utilized. Therefore, AIAT is also continuously analyzed its performance. Then, based on the analysis, is determined, that majority of the technology recommended are still not utilized or adopted by the user. Whereas, some of the technology packages were identified as well adopted.

ASSESSMENT RESULTS AND TECHNOLOGY AVAILABILITIES

AIAT establish in 1995 in North Sulawesi has produced a lot of technology packages recommended by the Provincial Assessment Committee, as shown in the Appendix 1.

North Sulawesi AIAT has transfered 29 technologies that produced mainly by research institutes under AARD. Further applications of the technologies were not thoroughly adopted by farmers even not continuously yet. Dissemination activities or technology transfer is important activity that can't be separated from the technology production process. Therefore, the appraisal used by AIAT is participative and integrativeof all components directly in assessment process.

Implementation of assessment and dissemination is done systematically, starting by planning, identification, implementation, monitoring and evaluation. Planning and identification is done by using PRA (Participation Rural Appraisal) to identify what really needed by the user. The participatory includes participation of farmers, extension agents, researchers, local government, etc. Then, the planning will be approved by Provincial Technology Committee and Technical Assessment

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Team. Furthermore, the identification results are processed in an integrative planning of assessment program.

TREND OF TECHNOLOGY ADOPTION ASSESSED BY NORTH SULAWESI AIAT

The 29 technology packages assessed by AIAT and recommended by The Provincial Agricultural Technology Committee are not thoroughly adopted by the farmer or other user. There are only several technologies adopted and initiated by the cooperator farmers involved in assessment process. In addition, the technology adopters did not adopt full technology given without modified first. The modification results are very impressive due to the tradition at the farmers' level where they will follow innovation after they see, try and apply the technology. By observing the performance of other farmers that have adopted the technology and success, they will start to apply the technology carefully.

The several technologies that well adopted and then spread out to the farmers are discussed briefly as follows:

Direct Seedling of Lowland Rice

The assessment was conducted in 1997 and formally recommended in 1999. The technology substance assessed is focused on input utilization especially seeds and labor. The excellent assessment show the increase in unpeel rice weight from 9,45 t/ha/year become 15,74 t/ha/year, and increase benefit from Rp 2.434.334/ha/year to Rp 4.970.834/ha/year

In that time initially there was no spectacular impression of adopters, even they denied some components, which its mechanism cannot be matched to the farmer's custom. The adoption of the technology came few years later. In 2000, the number of adopted increase significantly and reached hundreds and the began to be spread out to farmers in some neighbor sub districts. In 2003 the number of adopter has reached 8200, which spread out within at least 3 sub district surrounding covered 5000 ha.

The Single Seedling Indirect Planting of Rice

The single seedling indirect planting of rice is an innovative technology focused on efficiency and effectiveness of the plantation. The method in delivering the technology to the users and stakeholders is called PTT (Pengelolaan Tanaman Terpadu) or Integrative Plantation Management. It was done collectively by farmers, local government, local agricultural services, extension agents and researchers started in 2003. It was conducted in 2 districts, namely, Minahasa and Bolaang Mongondow district. Although it was conducted in 2003, the adopters grow quickly. Until June 2004, the adopters have reached 300 farmers. In addition, it is also adopted by the local government and field extension agents in formulating their agricultural development policy. The amount of adopters have expected to increase faster, especially after the National Farmers Week PENAS XI KTNA), conducted in Tondano the Capital of Minahasa District, demonstrated the technology in 7 ha farmer's land of 18 improved varieties of rice located near to the fiesta center.

Farming System Corn-Based in Dry Lowland

The farming system corn-based was conducted in 2000. The technology components demonstrated were spacing of plants (75 cm x 20 cm), balanced fertilizer, and plantation index. The system could increase corn productivity from 7.88 t/ha/year to 15.53 t/ha/year, and increase financial benefit from Rp 514.500/ha to Rp 3.287.050/ha. Moreover, impact analysis has shown that number of adopter despite it was not as high as the technology on rice seedling, but it was adopted at least by 100 farmer families.

Tuna and Skipjack Catching Technology (1999)

The assessment was conducted in 1998. The technology focused on some locally specific catching equipment for tuna and skipjack in North Sulawesi's society. The prospective output gained by the activities were: Increasing of catching productivity from 143,3 kg/ trip to 338,3 kg/trip, and financial benefit from Rp 27.8 Million/year to Rp 31.4 Million/year; and number of adopters was 45 fishermen (3 groups)

Agricultural Technology Clinic (Klittan)

Agricultural Technology Clinic (Klittan) is an innovative concept in technology transfer and playing as an alternative in solving problem in rural area that generally lack of technology adoption in which the development is still not designed and focused well, thereby, the development in rural area has no sufficient orientation and direction. Klittan is an exclusive institute belongs to the farmers, established by farmers and for farmer welfare. The Klittan development concept emerges as a reaction on the existing rural institute both established and owned by government or by NGO which in some cases were not effective and efficient since their farming system program in rural area was not farmer-based.

Attention on development of rural institutes sometimes is lesser compared to the program of technology application although it is very important since the technology requires socialization to its targets or users that can be managed by the rural institute. It needs to balance developing effort of farmer with developing of supporting institutes as a medium of interaction factors in the farming system (Zachri, 2000). Strengthen farmer institute is an absolute term in developing strong and sustainable agribusiness. Experiences has proved that developing of economic institutes in the rural area through dominant intervention or top-down policy, eccentric and instructive generally faces failure in its implementation because it is not local society based (Kindangen, 2002).

Development of Klittan is initiated in North Sulawesi Province in 2002, where initial concept is provided by the North Sulawesi AIAT, and then further it is adopted by some farmer groups in Minahasa District. The Klittan thoroughly funded by the farmer group and based on their own wishing. On the other hand, the services given by AIAT and other related institution is limited only on provision of assistance and facilitation. As a new organization, Klittan, rationally face much problem and obstruction. Fortunately, it can survive and continue to improve gradually, and having expected response from farmers and stakeholders thorough out Indonesia

Now a day, adoption rate of Klittan in North Sulawesi could be seen by the number of klittan established not less than 25. In addition, many farmer groups express their willingness to establish similar institutes in their areas. Furthermore, the stakeholders thorough out Indonesia, have adopted the concept of Klittan. Many AIAT in Indonesia has given assistance program in establishing Klittan in their working area.

DISCUSSION AND TECHNOLOGY TRANSFER STRATEGY

Establishment of AIAT in 1994 by Agriculture Ministry Decree No.798/Kpts/T.210/12/94, is aim to fasten agricultural technology transfer, supporting provincial development and optimizing agricultural resources utilities. In implementing its mandate, the institutes has produced various innovation that could be determined quantitatively, as expressed in the number of technology packages released in the late several years.

Based on the evaluation of AIAT performance since it is effectively operated in 1995, North Sulawesi AIAT has produced a lot of locally specific technology. However, there is only a few recommended technology i.e. less than 25% has adopted by the user and stakeholders. Adnyana (1995) pointed out that the effectiveness and efficiency of technology application and its feedback is depending on some factors such as: mechanism applied; function and role of each related institution; capability, willingness, and character of official in charge (researchers, extension agents, and users); available facilities and commitment of government to support the application of technology

Mechanism Applied

Based on the North Sulawesi AIAT experiences in the technology assessment and technology transfer mentioned above, the adoption rate of some technology packages such as: direct seedling of lowland rice (Tabela), single seedling planting of lowland rice, and the Klittan are sufficiently high. The adoption process in the farmer level, usually after little modification and adjustment needed by farmers, and adopted from other farmer that has proven the success of the technology application.

In rice farmer case who apply direct seedling, the farmers modified the heavy original tools used to lighter one and change hand tractor's power to drought cattle power to pull the tools. In the single seedling technology, many farmers modify it to two seedlings instead of 6-10 seedlings in existing technology by considering that one seedling is risky by pest and disease attacks. However, the principle of efficiency and effectiveness is still takeni into considerations by the farmers who make modifications.

The examples above (direct seedling and single seedling of rice) indicate that adoption mechanism is effective if it is occurred horizontally where the role of the farmer in technology transfer is dominant. It is also shown that role of researchers and extension agents is only significant in reaching the cooperator in assessment process, and then, the role is handed over to the farmers (cooperators) who will pass the technology to the other farmers.

In the Agricultural Technology Clinic (Klittan), the rural institution improves fast because farmers have realized that both their farming system and the supporting institution are farmer's need based.

Function and Role of Related Institution

Function and role of related institutions in agricultural technology transfer especially in rural area is very essential as supplier or sources of technologies, facilities, and assistances to support users and stakeholders. The role is mainly needed to anticipate the technology innovation due to the changeable properties of technology. Therefore, the institution in rural area could be classified as the main institution at farmer level and the supporting institution at government and stakeholder level. The first institution is mainly focused on communication and consultation media as well as facilities supplier nearest to the farming system. The latter institution is focused more on technology sources, assistance, facilities, funds source and policy.

Capability, willingness, and character of official in charge (researchers, extension agents, and users)

The approach of AIAT in conducting assessment is participative and integrative where farmer, researcher, extension agent, technician involve directly in assessment process at farmer land. Therefore, technology transfer using the method will go well if the main doer has capabilities, willingness, and appropriate characters. The role of researchers and extension agents are to facilitate the assessment resuls to be delivered to the farmer sustainably and consistently without changing the farmer role as the main doer in farming system.

Availability of Facilities

In technology transfer mechanism, the main and supporting facilities is very important and it is correlated to the availability of funding. The funding problem is not only on its insufficiency but also on its timing. The amount of fund in a assessment/research topic is usually planned before, but the timing of funding is usually come late, thereby, the effectiveness of the assessment is not attained. The supporting facilities such as mean of transportation is also limited factor e.g. in archipelago area in the northern part of the North Sulawesi where many islands difficult to be reached, thereby, the technology transfer is very slow.

Commitment of Government to Support the Application of Technology

In the technology transfer process, the commitment of government could be consider as "precondition". It means that technology transfer will continue if the government commit and highly support. The commitment of government that accelerate transfer of technology should include policy, funding, facilities and supporting facilities such as conducive environment in terms of economical, cultural and political stabilities.

Technology Transfer Model.

Uphoff (1995) determined 4 approaches (models) commonly used in transfer of technology as follow: vertical, horizontal, triangular and integrated models, as shown in the following Fig. 1.

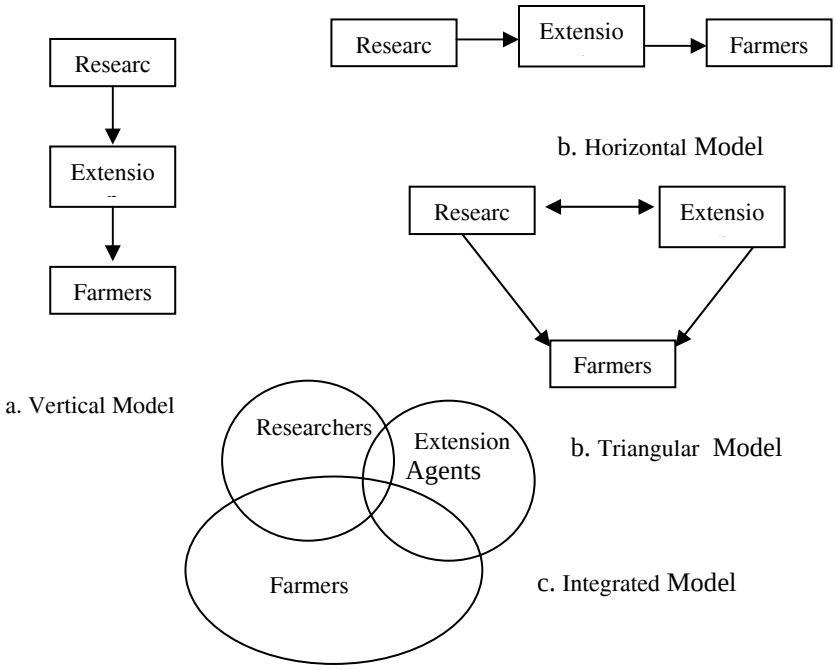

Figure 1. Transfer of Technologies Approaches

The AIAT experiences in the last 9 years in conducting assessment on agricultural technology show that the most relevant approach to be adopted in the North Sulawesi condition is the Integrated Model (Fig 1.d). This model could be applied through modification of the original model that give larger portion to the farmers role. An example of actualization of this model in North Sulawesi is establishment of Klittan that may serve as a medium of technology transfer driven and led by farmers.

To determine and understand well what the real needs and willingness of farmers, availability of the integration among researchers, extension agents and farmers is a must. The Klittan development concept is not only to fasten technology transfer, but also to investigate, determine and understand the rural problem. Developing Klittan means to strengthen development of agribusiness at rural level, thereby, all technology transferred not only being mastered by the researchers and extension agents, but also in its interaction process that continue to be able to adapt to the location specific

CONCLUSIONS

1. There are many available technologies information at the technology sources level, but it is only few has reached and applied by farmers.
2. Technology transfer should be put in appropriate condition as "participative before assessment"
3. Quality of technology has to be up-dated continuously and effectively.

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SYSTEM OF RICE INTENSIFICATION (SRI) AS ONE ALTERNATIVE TO RICE PRODUCTION

Oswald Marbun[1]

ABSTRACT

The System of Rice Intensification (SRI) developed in Madagascar due to drought in 1980's. It has been reported and tried in several countries with promising results. The SRI has been developed as efforts to obtain optimal crop growth, such as optimal root growth, improving soil structure, less plant competition, and better timing of tiller growth. The SRI was location specific in the terms of varieties, soil, location, and climate, The practices of SRI were early transplanting to produce more tillers, one seedling transplanting per hill to have less plant competition, planting technique to minimize root disturbance, planting distance to optimize plant growth and less seeds, intermittent irrigation to have better soil aeration and root growth, and the use of organic fertilizer to improve soil structure, These components of the SRI were briefly discussed. One experiment of the SRI was conducted in the Philippines during wet season, 2001. Modern, improved, and traditional varieties were used in SRI, local farmer practice, and conventional rice production systems. Generally, the results showed no variability in all rice production due to variety and production system. However, the SRI is still promising for the future research.

Keywords : System of Rice Intensification, (SRI), early transplanting, one seedling per hill, planting technique, intermittent irrigation, organic fertilizer.

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Background

Rice production has been increased through the green revolution in the last three decades. High external inputs and breeding efforts in rice cultivation has increased rice yield. Rice producers and farmers become familiar with rice cultivation using the green revolution strategy to maintain high rice yield. However, inputs required to maintain high yield potential are sometimes unavailable in certain areas. Water is scarce, fertilizer price is high, and the traditional variety and biodiversity have been reduced. Pollution and degradation of land and air also resulted from the use of external chemical inputs. This has been exacerbated by global climate change. Since the global climate changes, the patterns of seasons become severe. El Niño and La Niña recycle in a shorter period.

The return to 'traditional ways' of rice cultivation is a possibility to maintain rice production in certain remote area and marginal lands.

System of Rice Intensification (SRI)

One of the traditional ways of rice cultivation is that reported by the late Father Henry de Laulanie in Madagascar in 1980's (de Laulanie, 1993; Rabenandrasana, 2000).

He documented and popularized a rice production system being done by farmers in Madagascar. This system that is combined later with other practices is being called the System of Rice Intensification (SRI). SRI practices resulted in higher rice yield. In brief, SRI emphasizes water saving that gives chance for rice plant to have stronger growth and performances. Rice seedlings are transplanted earlier, resulting in the increase in the numbers of tillers. This system can increase rice yield with less water during vegetative stage. This system then is being combined with other practices to obtain optimum rice plant growth, such as vigorous root growth. SRI is known to be suitable for small farmers in the lowland rainfed area with small marginal lands, since it uses less water during vegetative growth. It has been shown to be a sustainable rice farming technology that can help small farmers increase their rice yields without depending on hybrid seeds, chemical fertilizers and pesticides, even though the increase for the first year will be only in the range of 1-2 tons per ha (Vallois, 1997).

SRI has been tried in several countries such as China, Cambodia, Indonesia, and the Philippines with satisfactory results (Uphoff, 1999a, 2000; CECAP and PhilRice, 2000). SRI is suggested for lowland rice cultivation, marginal lands, and remote areas to increase rice yield and to support farmer self-food sufficiency. Since SRI has given promising results, it is worth conducting SRI experiments through seasons and locations to obtain better location specific technologies in different parts of a country.

The SRI practice has been practiced in Pangasinan, Philippines, with satisfactory results (CECAP and PhilRice, 2000). It has been reported that this system gave promising results (Uphoff, 1999b; CECAP and PhilRice, 2000; Asikin and Koswara, 2000; Yang Saing Koma, 2000).

In addition, farmers need to have good experience in soil and nutrient management in rice production. Farmers need to be familiar with some modifications such as field leveling by dividing the rice field into smaller plots, establishing small canals in the field for field drainage, and the application of organic matter.

SRI practices are location specific (Uphoff and Fernandes, 2002). This means certain components, such as transplanting age, varieties, planting distances, nutrient availability, soil fertility, and intermittent irrigation, will give best results only for certain location.

There are also some additional technologies that must be taken into consideration such as land leveling and weeding. However, farmers tend to save the inputs such as water and seeds. Farmers habit and experiences on rice cultivation determine the practices applied in his field.

Since SRI is location specific, there are constraints and possibilities that would result in having adaptation and modification of SRI principles in the field. These changes should be analyzed to give some suggestions of SRI principles in the location. This information was used to determine possibilities and constraints in SRI practices and suggestion of the practices in the future. SRI has several components, which are briefly discussed.

Early Transplanting

Early transplanting will give the plants opportunity to produce more tillers. The time interval to produce tillers for rice plants is called *'phyllochrons'* (Vallois, 1997). It is the time between the emergence of tillers and leaves to form main tillers (Uphoff, 1999a). Nemoto *et al.* (1995) found that the leaf emergence, tillering, and rooting of each tiller were synchronized with leaf emergence on the main stem. Phyllochrons decreased with environmental factors such as temperature, light, and nutrition. It increases with planting density. Humidity that is dependent on temperature regime, also influences phyllochrons.

Transplanting older the seedlings reduce tillers, since the plants are *'disturbed'* and are set back when pulled out of the seedbed. Early transplanting of seedlings that are 8-12 days old, depending on the variety, gives the plants opportunity to produce more tillers (Uphoff, 1999b; Vallois, 1997).

Transplanting Technique

The basic principle in the SRI is minimum disturbance to the roots during transplanting. The transplanting technique that causes the least disturbance to roots affects the growth of seedlings (Uphoff, 1999a; Matsushima, 1976). The root is maintained in the downward direction, not upward direction, unlike in the conventional transplanting system, after transplanting. It is ensured that soil is still attached to the root when transplanting the seedlings to avoid root stress. The soil attached to roots of the seedling may not be disturbed until the plant is transplanted in the field. Another technique is to pull the seedling gently from the seedbed. The soil is pressed to give space for the seedling to lay down and the roots are put horizontally. The roots then are covered with soil. The roots are in horizontal position and the seedling is almost horizontal (45 degrees) when transplanted.

Number of Plants per Hill

Planting of one seedling per hill eliminates the competition among plants within the hill thus giving the plant maximum opportunity for growth. However, one or two seedlings per hill will give the same yield in conventional system (Vergara, 1992).

The plant and its roots will grow faster. Planting one seedling per hill results in less seed requirement. However, the replacement of dead seedlings will increase.

Planting Distance

Appropriate planting distance determines the vigor of plant growth. The wide the planting distance, the less competition among the plants on nutrient uptake (Uphoff, 1999a). This results in better growth of any single plant per hill. Higher yield is expected at optimum planting distance. However, weeds will have greater opportunity to grow in wide planting distance. Therefore, more weeding is conducted in SRI. In addition, location, weather, cultural practices, and varieties affect

SRI. Appropriate planting distance for one variety on certain area is strongly suggested for SRI practices.

Water Management

Rice plant does not need abundant water during vegetative growth (Uphoff, 1999a). Intermittent wetting and drying during the vegetative stage will allow better aeration thus oxygen becomes more available to the roots. Roots will grow better (Joelibarison,1998, in Uphoff, 2001). Single rice plants under SRI condition requires higher force to be pulled up compared to rice plants under conventional condition. The method to measure root-pulling resistance was described by O'Toole and Sumartono (1981) and Ekanayake et al.(1986).

Organic Fertilizer Management

Organic fertilizer such as green manure and animal manure can be used to replace mineral fertilizers in the rural area. Organic fertilizers generally contain 2% to 4% of nitrogen, green manure 2-4% and animal manure 1% (Cosico, 1985). For SRI, the level of organic fertilizer applied depends on the available amount of organic fertilizer in the soil. Compost can be used but it will take some time for the organic matter to decompose in the soil during land preparation and vegetative stage (Herrera, 1980).

Important Practices in SRI

There are some important practices in SRI application. Wide planting distance will reduce competition of nutrient uptake among plants. In addition to reduce water utilization during the vegetative growth, weeds will grow much more in wide planting distances due to less competition of nutrient uptake by rice plants (Vergara, 1992). It is expected that wide planting distance will have more weeds compared to close planting distances. Therefore, weeding is necessary and this means additional labor for the SRI practice. The purpose of flooding in conventional rice cultivation is to control weeds. Reduced water utilization and intermittent wetting and drying will result to weed growth and snails disturbance to rice plant especially for very young seedlings as used in SRI practices. Proper land preparation and snail control by picking them up is very important in SRI practices.

Surface soil aeration may increase yield with SRI practice. More weeding improves soil aeration and contributes to biological nitrogen activity (Uphoff, 2001b). Increasing number of weeding will increase yields. The higher yields may compensate for the additional cost of weeding.

SRI as Practiced in the Farmer's Field

New practices need to be conducted on the farmer's field after being tested in the experiment station. Farmer's field gives actual condition where the new practices can be applied and modified. Some new practices can be compared to farmer's practices. This analysis will result in better modification of new practices. Often, farmer's practices are superior to new practices since the former has been accustomed to the location for a long time. Other possibilities are the modified or combined practices with farmers' (Colfer *et al.*, 1989). SRI has been conducted in various farmer's field (Uphoff, 1999a;2000; Asikin and Koswara, 2001; Yang Saing Koma, 2001). Rabenandrasana (2000) provided SRI practices on farmer's field in Madagascar.

SRI has been tried in Indonesia both in the experiment stations (Uphoff, 2000) and farmer's field (Asikin and Koswara, 2001). SRI in the farmer's field gave promising results due to increasing number of tillers. Better growth of the rice plant applying SRI practices resulted in pest and disease resistance. The length of panicles are longer with SRI practices than that of the conventional system

in the farmer's field. This needs further research. It is expected that the number of panicles will increase since the number of tillers increases.

Yang Saing Koma (2001) in Cambodia tried SRI in the wet season. He described farmers' practice on the same SRI principles and techniques suited to local specific Cambodian situation. If farmers have difficulty in field leveling, they divide their fields into several small plots. They may lose some of their land, but the total yield is actually higher due to the improved distribution of nutrients and water. The optimal age of the seedling is 8 to 12 days. However, farmers tried out different ages of seedling (8 days to 20 days), depending on the rice variety and the growing calendar (Vallois, 1997). Seedlings were transplanted at one seedling per hill and the space between each plant was wide, from 25 to 50 cm.

Farmers can also try to find out the optimal density that is suited to their specific conditions. Improving soil and water management is essential to ensure that there is a constant, good supply of nutrients and good soil aeration. The important practices are the use of compost, and no field flooding or minimal water table (1 to 2 cm) and allowing the field to be in a dry and a wet condition (especially during the whole vegetative stage). It is also recommended that farmers apply organic matter to the surface of the field during the vegetative growth (Yang Saing Koma, 2001).

The number of farmers that would participate in SRI is important. The appropriate explanation and examples given to farmers become important. Farmers' background that would affect their perception (Harun, 1988) determines the farmer's acceptance of new practices, such as SRI, in the farmer's field.

The Experiment in the Philippines

The SRI experiment was conducted in the Philippines (Marbun, 2003). The experiment was conducted in the wet season (June to November) of 2001 at the UPLB Central Experiment Station, with the objective to determine agronomic performance of SRI, MASIPAG, (local farmer's practices), and conventional systems using different varieties. Soil type was Lipa clay loam (Fernandez and Clar de Jesus, 1980). The soil at the UPLB Central Experiment Station has been cultivated for many years. The experiment area, where the SRI and MASIPAG (Vicente, 2001), production systems, were planted, has been applied with organic manure for three years. The surrounding experimental area is planted with Gliricidia (Gliricidia sepium). The conventional production system was planted approximately 30 meters away from this area. This area has been previously planted to rice in the conventional manner.

Varieties

The experiment used modern variety PSB-Rc14 (PhilRice, 2001), improved traditional variety M45-1 (MASIPAG), and traditional variety Sampaguita for the SRI, conventional, and the MASIPAG rice production systems (Table 1).

Table 1. Description of varieties used in Experiment 1.

Variety	Height (cm)	Days to Maturity	Potential Yields (t/ha)
MASIPAG M-45[a]	125	138	2.63
Sampaguita[b]	110	112	-
PSB-Rc14[c]	92	110	3.6

Source: [a] MASIPAG, 2001; [b] Personal communication, Rice Section, Dept. Agronomy, UPLB, 2001; [c].Philrice, 2001a

Planting Distances and Fertilizer Recommendation

The SRI, MASIPAG, a local farmer's practice, and conventional production systems were conducted as the 'package of technology' (Table 2). The SRI practices for weeding, plant spacing, planting age, the transplanting of one plant per hill, and intermittent watering was done according to that described by Uphoff (1999a). Briefly, it consists of the following: transplanting date of SRI was 8–12 days (averaged 10 days); the plant was planted almost horizontally (L-like shape); planting distances were 50 x 50 cm, 40 x 40 cm, and 20 x 20 cm to find out the most appropriate planting distance using SRI. For the MASIPAG system, transplanting was done 21 days after sowing (DAS) with planting distance of 40 x 10 cm. No pesticides were used. The control treatment was the conventional system with 21 days transplanting date and 20 x 20 cm planting distance, and usual transplanting technique.

Green manure such as Gliricidia and animal (carabao) manure (Savant, 1999; Cosico, 1985) was applied to all SRI and MASIPAG systems during land preparation. The organic fertilizer level (green manure and carabao manure) were equivalent to about 20 kg N ha-1 for the first application. Green manure and carabao manure were applied two weeks before transplanting to allow them to decompose fully (Herrera, 1980).

Table 2. Description of the treatments used for SRI, MASIPAG, and the conventional systems in Experiment I.

Parameter	SRI	MASIPAG	Conventional
Seedling age	10 days	21 days	21 days
Number of seedlings/hill	1	1	2-3
Planting distance	50 x 50 cm 40 x 40 cm 20 x 20 cm	40 x 10 cm	20 x 20 cm
Irrigation during vegetative stage	Intermittent	Intermittent	Continuous
Fertilizer	Organic	Organic	Inorganic

The field then was kept flooded. The second and the third organic fertilizers (carabao manure) were applied during vegetative growth (Yang Saing Koma, 2000), at 20 and 40 days after transplanting, respectively. The amount of organic fertilizer was equivalent to 10 kg N ha-1. The total amount of N applied in SRI and MASIPAG systems were 40 kg N ha-1. The conventional practice used inorganic fertilizers as recommended by the UPLB Soil Science Department based on soil analysis, (80 kg N ha-1 and 40 kg P2O5 ha-1 in the wet season). Potassium fertilizer was not recommended in the experimental area. The control treatment (conventional practice) used the recommended N, P, and K fertilizers with 50% basal and 50% topdressing for nitrogen fertilizer (45 days after transplanting). The conventional practice was conducted in separate field.

Irrigation and Drainage

The intermittent wetting and drying were conducted to the whole SRI and MASIPAG experiment plots during the vegetative stage. Flooding during vegetative stage was applied in the conventional practice.

However, there were many rainy days during June to October 2001 that affected irrigation and drainage schedule. There were 'heavy rains' in one day but no rain in the following days. Drainage became crucial to prevent SRI fields from continuous flooding. Irrigation was applied once a week if there was no rain within the week. One irrigation treatment was approximately 30 mm day.1. Between June to October 2001, irrigation was provided four times in July and three times in August. At the early phase, 7 weekly irrigation were provided. During the reproductive phase, water was maintained

at 10-30 mm beginning on the first week of September until the first and second week of October. The irrigation for the conventional system was conducted twice a week provided there were no rainy days in the week and to maintain standing water. At the early phase, irrigation was provided 9 times in the conventional system.

RESULT AND DISCUSSION

Harvest index (HI)

There were no significant varietal differences in HI. The effect of production system on HI was significant (Table 3). The HI at 40 x 40 cm and 50 x 50 cm, which were the same, were significantly higher than in close spacing (20 x 20 cm) in SRI. The values of HI obtained in the present experiment were in general within the range of 0.37 – 0.50 as reported by Ramasamy (1997) and Ying et. al (1998) in the conventional system. The HI in the conventional system was significantly lower compared to those in SRI at 40 x 40 and 50 x 50 cm spacings. This can be attributed to rice bug infestation in the conventional system that reduced grain yield. The high level of inorganic fertilizer applied in the conventional system has made the plants more susceptible to rice bug infestation because it provided better nutrition for the insects (Reissig et al. 1986).

Table 3. Harvest Index (HI) in different rice production systems at the Central Experiment Station, wet season 2001.

Rice Production System	Harvest Index
SRI 50 x 50 cm	0.41
SRI 40 x 40 cm	0.41
SRI 20 x 20 cm	0.34
MASIPAG	0.39
Conventional	0.31

LSD 0.05 = 0.06

Grain Yield

Production system and varietal differences were significant in terms of grain yield. Interaction between production system and variety was also highly significant. For M-45, the highest yield of 3.83 t ha-1 was obtained for SRI 20 x 20 cm (Table 4). This was not significantly higher than the other systems except that for SRI 50 x 50 cm and conventional system. For Sampaguita, the highest yield was 3.35 t ha-1 and this was significantly higher only than the yield obtained under the conventional system. For PSB-Rc14, the highest yield of 3.77 t ha-1 was not significantly different from that obtained at SRI 50 x 50 cm and in the conventional system, but significantly higher than the yields in the other systems.

Table 4. Effect of rice production system and variety on grain yields at the UPLB Central Experiment Station, wet season 2001.

Rice Production System	Grain Yield t ha^{-1}		
	M-45	Sampaguita	PSB-Rc14
SRI 50 x 50 cm	1.50 c	2.90 b	3.00 a-b
SRI 40 x 40 cm	3.17 a-b	2.67 b	3.77 a
SRI 20 x 20 cm	3.83 a	2.87 b	2.67 b
MASIPAG	3.50 a-b	3.35 a-b	2.83 b

Conventional	2.87 b	1.33 c	3.17 a-b

Means followed by common letters are not significantly different at the 5% level by DMRT

Among the rice production systems, the highest yield at SRI 50 x 50 cm was obtained for PSB-Rc14 and Sampaguita, which did not differ significantly but were higher than the yield for M-45. For SRI 40 x 40 cm, the highest yield was obtained for PSB-Rc14, which was significantly higher than Sampaguita but not M-45. On the other hand, for SRI 20 x 20 cm, the highest yield was obtained for M-45 and this was significantly higher than yields for Sampaguita and PSB-Rc14 which did not differ significantly. The MASIPAG rice production system was not sensitive to varieties, as evidenced by the non-significant differences among the varieties. In the conventional system, yields for M-45 and PSB-Rc14 were not significantly different and were significantly higher than the yield for Sampaguita. The low yield for Sampaguita in the conventional system was low due to rice bug infestation. Sampaguita is an aromatic variety and it appears that this attracts rice bug more than the other variety during grain filling stage.

GENERAL DISCUSSION

SRI, MASIPAG, and the Conventional Systems

The grain yields of the SRI, MASIPAG, and conventional systems were generally not significant at the UPLB Central Experiment Station. It should be noted however that the conventional system was attacked by rice bugs which reduced its yield by about 50%. Agronomic performances of SRI, MASIPAG, and the conventional systems differed with varieties at the UPLB Central Experiment Station.

SRI and Varieties

There were different responses of varieties in SRI practice. The yield of modern and improved traditional varieties was higher than the traditional variety in the UPLB Central Experiment Station at wide spacing. These show that SRI practice is specific with soil nutrient availability, soil type and fertility, varieties, climate, location, and community. There is high variability of agronomic performance in SRI field.

The present experiment was unable to give specific recommendation for suitability of either traditional or modern varieties in SRI practices. However, the modern variety is more suitable for wide spacing than traditional variety at the UPLB Central Experiment Station, where there was better control of water management. Since modern varieties are usually used in a large area, there is possibility to apply SRI practices with modern varieties in a large area in the Philippines. Application of SRI practice in big areas requires modifications in planting distances, number of seedlings, and drainage systems that requires changes in structures of irrigation and drainage. Traditional varieties require less maintenance for cultivation and usually are transplanted in smaller and remote areas, where limited labourers and water is available. SRI practices, therefore, are more suitable for traditional varieties in smaller areas.

Modern varieties tend to be more appropriate in wide than close spacing. Improved traditional varieties from MASIPAG were also responsive to wide spacing. Traditional variety, particularly Sampaguita is not responsive to spacing in SRI practices.

Climate and Locations

The practice of SRI was found to be more appropriate in the lowland areas at the end of the rainy season or at the end of the dry season, depending on location. SRI is more appropriate at the end of the rainy seasons in areas where early transplanting could be subjected to flooding. In the upland areas, SRI should begin at the end of the dry season, since SRI practice requires less water during transplanting time. In addition, the cool weather in high elevation that is far from the equator could be more appropriate for SRI. The location of Madagascar, where most of high yields of SRI practices were reported, had benefited from these topographical locations (Uphoff, 1999a, 2001c; and Stoop et al., 2002). Temperatures and humidity affected phyllochron, time interval that determined number of tillers (Nemoto, 1995; and Vallois, 1997).

CONCLUSION AND RECOMMENDATIONS

1. The grain yields at different plant densities (spacings) in SRI practices differed with varieties. The grain yields among rice production systems also varied with varieties. The yield of traditional variety Sampaguita did not response to SRI spacings and was the lowest in the conventional system. The MASIPAG system was not sensitive to varieties.
2. The close spacing was compensated with higher plant densities than the wide spacing.
3. Doubling the spacing from 20 x 20 cm to 40 x 40 cm did not increase the grain yields.

General Conclusion

SRI practice is comparable to the MASIPAG and conventional systems. The practice has the potential to increase grain yield irrespective of the number of seedlings per hill and plant spacings. The practice is possible to improve grain yield with varieties used in the experiment, whether they are traditional, improved, or modern.

Recommendations

Future research must focus on increasing soil nutrient availability brought about by SRI practices such as improved soil aeration, biological nitrogen fixation and organic fertilizer application. Improved soil aeration will affect activities of the soil microorganism.

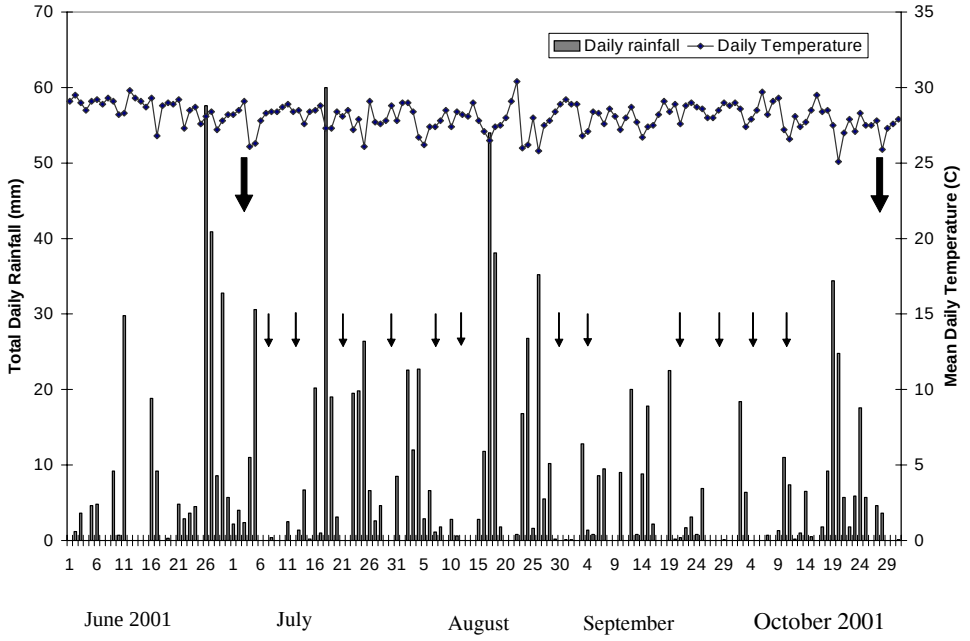

Fig. 1. Total daily rainfall (mm) and mean daily temperature (C) from June 1 to October 31 2001 at the UPLB Central Experiment Station. Small arrows indicate the application of the irrigation for SRI practice, while big arrows indicate planting and harvesting time, respectively.

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EFFICIENT TECHNOLOGY FOR POTATO PRODUCTION ON MEDIUM ALTITUDE LAND IN YOGYAKARTA SPECIAL PROVINCE

Mulyadi and B. Sudaryanto[1]

ABSTRACT

In Indonesia, in general, cultivation of potato was still limited on high altitude areas i.e. more than 700 m above sea level. However, this high altitude area is limited while demand for potato increases with increasing of population. Hence, it is important to extent the potato growing areas on potential ecosystem, such as medium altitude areas (300 -700 m above sea level). Related to the efforts, Assessment Institute for Agricultural Technology (AIAT) of Yogyakarta has conducted research and assessment activities to formulate an efficient and feasible technology for potato production on medium altitude in Yogyakarta Special Province. The location was on volcanic slopping land of Gunung Merapi within altitude of 300-700 m above sea level in Pakem and Cangkringan Subdistrics, Sleman District where the activities started in 1999/2000 to 2002. The results of the research and assessment alternatives technology packages that feasible and capable to give a relative high beneficial could be obtained and formulated. Those technology packages are potato cropping patterns intercrop with sweet corn or leaf onion that gained benefit of Rp 22,885,010 (R/C=2.01) and Rp 27,936,040 (R/C=2.24) per hectare, respectively. These benefits were higher than the benefit of monoculture system of Rp 21,089,920 (R/C=1.98). Technology components for the crop cultivation that should be paid attention are use of adaptive high yielding variety (Granola-G4), good quality of seeds, use of appropriate inorganic and organic fertilizers, straw mulch, and good maintenance of soil moisture and crop through applying of irrigation and integrated pest management.

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INTRODUCTION

Potato (Solanum tuberosum L.) is one of relative efficient crop in conversing energy from nature due to its high potential in producing of carbohydrate, protein, and vitamin (B1, B2, and C) per unit of time and area. In general, suitable lands for growing of potato are high altitude areas, more than 700 m above sea level, having favorable conditions, such as relative low temperature and high soil fertility (Asandhi et al., 1989; Asandhi, 1991).

Potato tuber is an important food source with relatively higher nutrient value and longer storable than common vegetable crops. Therefore, it can be use as an alternative food source in food diversification program. As a trade commodity, potato has high economic value and market opportunity. Currently in Indonesia, cultivation efforts of potato in general were still limited on high altitude areas, such as in Lembang, Wonosobo, Malang, Pengalengan, and Brastagi. The potato production cannot fulfill the domestic consumption needs. On the other hand, potato cultivation on the high altitude areas, in general, does not support the government's effort in conserving the natural resources and environment because potential erosion and pollution of the soil problems happened in the areas due to unwise use of pesticides especially fungicide to control fungal diseases (Asandhi, 1991). However, development effort of potato cultivation is important in increasing potato production, which in turns can provide working opportunity and increase farmer's income.

The most constraining factor in developing potato cultivation in Indonesia is limitation of high altitude areas. It becomes important to extent the potato growing areas to potential ecosystem such as medium altitude areas (300 -700 m above sea level). However, growing of potato on medium altitude areas faced a number of specific physical, biological, and socio-economical constraints (Asandhi, 1991). Therefore, an alternative efficient and feasible technology package for the medium altitude ecosystem should be formulated considering those constraints.

This paper elaborates the experience in introducing potato farming on medium altitude area in Yogyakarta Special Province, especially on slopping volcanic area in Sleman District.

POTENTIAL AND CONSTRAINTS OF MEDIUM ALTITUDE LAND IN YOGYAKARTA FOR DEVELOPING OF POTATO FARMING

There is about 6,000 ha out of 15.000 ha of medium altitude land that potential and suitable for growing of potato located in volcanic slopping area of Gunung Merapi in Sleman District, especially in Pakem, Cangkringan, Tempel, and Turi Sub Districts (IPPTP, 1996). Most of this land was irrigated land and it used for growing of rice, chili, and tomato. Potato cultivation was still not common for local farmers because limited suitable and feasible technology information and unavailability of potato seed that local farmers can easily get and affordable.

In relation with soil and climate characteristics in the medium altitude areas especially for growing of potato, relatively high temperature and low in nutrient buffering and water holding capacity of the soil need to be paid attention. Generally, soil and climate characteristics in the medium altitude area are as follows:

1. General Characteristic of Soil

Soils in this area are classified into soil family of Andic Eutropepts dan Typic Hapludands, volcanic ashy, mixture mineral, isohyperthermic. In general, these soils have moisture regime of udic, andic properties, and develop from sand-clay sediment and volcanic ash; drainage fast to slowly moderate and the effective depth of soil is more than 50 cm (LREP, 1994). Characteristics of the soil surface layer (0-20) are texture of sand to clay with low organic C-content (1,0-2,0 %), low to very low CEC (<16 mg/100 g of soil), moderately acid (pH 5,6-6,5), very high base

saturation (> 70%), low N content (0,1-0,2), very high in potential P2O5 and K2O contents respectively (> 60 mg/100 g of soil), high to very high available (extracted Olsen) P2O5 content (>46 ppm) with phosphate retention of 20-30 %.

Generally, the soil characteristics interpreted as soil with moderate fertility with high nutrients content (P, K, Ca, Mg) but their water and nutrients holding capacity were relatively low, so that the soils were relatively not efficient to fertilization. Hence, it is important to manage fertilization, including organic fertilization.

2. Climate Condition

Climate condition in the medium altitude areas, generally, has annual rainfall around of 2,309-3,192 mm and number of rain days ranged 130-200 per year. Average of monthly rainfall is about 50 – 300 mm, where wet season happens in November to April. Average of annual air temperature is 20.9 0C with average of annual relative humidity of 91%, average of minimum temperature of 16.6 0C occurred in July and maximum temperatures of 26.7 0C occurred in February. To grow well and yielded high tuber, potato crop needs optimum temperature, especially for tuber forming, on the average around 15.6 – 17.8 0C (Asandhi et al.,1989). For this reason, selection in time planting, varieties and applied technologies to control and adapt to high temperature condition is important.

RESEARCH AND ASSESSMENT FOR ASSEMBLING TECHNOLOGY PACKAGE OF POTATO PRODUCTION ON MEDIUM ALTITUDE LAND IN YOGYAKARTA

In attempting to provide a proper technology package for developing of potato cultivation on medium altitude land in Yogyakarta Special Province, Assessment Institute for Agricultural Technology (AIAT) - Yogyakarta have been conducted research and assessment activities since 1999/2000 until 2002. The activities conducted on farmer's land at several sites scattered in medium altitude area of "Gunung Merapi" on volcanic slopping area in Pakem and Cangkringan Subdistricts, Sleman District. The sites chosen were irrigated land in dry season where growing of potato was conducted after harvesting of wet season rice crop.

The preliminary researches to select proper technological components conducted in 1999/2000 until 2001. Evaluation of the technological components include involved varieties, use of mulch and fertilizers (organic and inorganic), and potato cropping systems of monoculture as well as intercropping with sweet corn and leaf onion (Allium ampeloprasum). Sweet corn and leaf onion were chosen as secondary crops on the intercropping systems because the crops have important role to suppress aphids (Mizus perciasae) on the potato crop beside for increasing land productivity as reported by Setyawati et al. (1993) and Ashandi & Suryadi (1982). Results of the researches indicated that potato crop could grow well and produced high tuber (20.34 – 21.68 ton/ha) if the technologies applied used adaptive variety of Granola with high quality of seed, fertilization of inorganic and organic. The use of rice straw of 5 ton/ha as mulch gave better effect to soil temperature and potato yield than the use of land cover plastic. The tuber yield obtained using rice straw mulch was around 24.59 ton per ha (Aliudin et al., 2000a; Aliudin et al., 2000b; Sarjiman et al., 2000; Sarjiman & Sutardi., 2000). The results of the cropping pattern research showed that average yields of monoculture potato tuber was 23.33 ton/ha and intercropping with sweet corn and leaf onion was 22.22 and 23.50 ton/ha respectively; while yields of corn and leaf onion consecutively was 4.39 and 2.13 ton/ha. Revenue to cost (R/C) values of the three cropping patterns ranged 2.62 to 2.67, meaning that all cropping patterns are feasible, where intercropping systems were higher than monoculture system (Mulyadi et al., 2001).

Base on the above results, selected technological components that potential to be developed was assessed in 2002. This assessment was conducted on farmer's lands scattered on three altitudes (400, 550, and 700 m above sea level) in Pakem and Cangkringan Subdistrits, Sleman. The assessment involved 27 cooperator farmers and three cropping systems i.e. monoculture potato, intercropping potato with sweet corn and potato with leaf onion with main components as presented in Table 1. This assessment was scaling up of the cropping pattern technologies conducted in 2001 in order to evaluate stability and feasibility of the technology packages and to introduce and disseminate to farmers in medium altitude area.

Table 1. Main Components of Technology Packages of Potato Cropping Patterns assessed on Medium Altitude Land In Yogyakarta Special Provinve, Dry Season of 2002.

Cropping Patterns	Fertilization and Mulching				
	Urea	SP-36	KCl	Rice Straw Mulch	Animal Manure
	Kg/ha			Ton/ha	
A. Potato + Sweet Corn:					
Potato	300	200	200	5	15
Sweet Corn	80	30	30	-	-
B. Potato + Leaf onion:					
Potato	300	200	200	5	15
Leaf onion	15	-	-	-	-
C. Monoculture of Potato	300	200	200	5	15

The Table 2 shows that yields of monoculture potato, intercropping potato with leaf onion and intercropping potato with sweet corn was 18.49; 20.47; and 16.00 ton/ha, respectively. While yields of leaf onion and sweet corn from the intercropping systems were 1.35 and 5.78 ton/ha, respectively (Mulyadi et al., 2002). Financial analysis of the three cropping patterns based on input and output value at that time indicated that average values of revenue to cost (R/C) of potato monoculture, intercropping systems of potato with leaf onion and potato with sweet corn were 1.98; 2.24; and 2.01, respectively. Benefit per hectare of monoculture potato was Rp 21,089,920, intercropping of potato with leaf onion was Rp 27,936,040 and potato with sweet corn was Rp 22,885,010.

Table 2. Financial Analysis of Potato Farming on Medium Altitude in Sleman District, Yogyakarta Special Province, Year of 2000.

No.	Items	Units	Kinds of Cropping Pattern		
			Monoculture of Potato	Intercropping	
				Potato + Leaf onion	Potato + Sweet Corn
1	Explicit Cost	Rp/ha	16,373,880	17,295,960	17,670,590
2	Implicit Cost	Rp/ha	5,063,200	5,224,000	4,914,400
3	Total Cost	Rp/ha	21,437,080	22,519,960	22,584,990
4	Crop Yields				
	Potato (tuber)	Ton/ha	18.49	20.47	16.00
	Sweet Corn (ear)	Ton/ha			5.78
	Leaf onion (leaf)	Ton/ha		1.35	
5	Value of Crop Yields				
	Potato (tuber)	Rp/ha	42,527,000	47,081,000	36,800,000
	Sweet Corn (ear)	Rp/ha			8,670,000
	Leaf onion (leaf)	Rp/ha		3,375,000	
6	Revenue	Rp/ha	42,527,000	50,456,000	45,470,000
7	Income (Revenue - Explicit Cost)	Rp/ha	26,153,120	33,160,040	27,799,410
8	Benefit (Revenue – Total Cost)	Rp/ha	21,089,20	27,936,040	22,885,010
9	Revenue to Cost (R/C) =		1.98	2.24	2.01
10	Benefit to Cost (B/C)		0.98	1.24	1.01

Remarks : Price of crop yield per kg for potato tuber = Rp 2,300, ear of sweet corn = Rp 1,500, and leaf onion = Rp 2,500.

Obviously, the figure indicates that intercropping systems give higher benefit than monoculture system; and all cropping systems are feasible economically. Furthermore, results of sensitivity analysis presented in Table 3, with the assumptions that each price of potato, leaf onion, and sweet corn

decreases 10 %, show that the yields of intercropping system is more beneficial than monoculture system.

Table 3. Sensitivity Analysis of Potato Farming on Medium Altitude in Sleman District, Yogyakarta Special Province With Assumption of Crop Yield Price Decrease 10 %, Year of 2002.

No.	Items	Units	Kinds of Cropping Pattern		
			Monoculture of Potato	Intercropping	
				Potato + Leaf onions	Potato + Sweet Corn
1	Explicit Cost	Rp/ha	16,373,880	17,295,960	17,670,590
2	Implicit Cost	Rp/ha	5,063,200	5,224,000	4,914,400
3	Total Cost	Rp/ha	21,437,080	22,519,960	22,584,990
4	Crop Yields				
	Potato (tuber)	ton/ha	18.49	20.47	16.00
	Sweet Corn (ear)	ton/ha			5.78
	Leaf onion (leaf)	ton/ha		1.35	
5	Value of Crop Yields				
	Potato (tuber)	Rp/ha	38,274,300	42,372,900	33,120,000
	Sweet Corn (ear)	Rp/ha			7,803,000
	Leaf onion (leaf)	Rp/ha		3,037,500	
6	Revenue	Rp/ha	38,274,300	45,410,400	40,923,000
7	Income (Revenue - Explicit Cost)	Rp/ha	21,900,420	28,114,440	23,252,410
8	Benefit (Revenue – Total Cost)	Rp/ha	16,837,220	22,890,440	18,338,010
9	Revenue to Cost (R/C)		1.79	2.02	1.81
10	Benefit to Cost (B/C)		0.79	1.02	0.81

Remarks: Price of crop yield per kg for potato tuber = Rp 2,070, ear of sweet corn = Rp 1,350, and leaf onion = Rp 2,250

CONCLUSIONS

Application of proper technology packages for potato cultivation on medium altitude land has made potato grow well and give higher yield of tuber. The technology components that should be paid attention are adaptive with high yielding varieties, good quality of seeds, use of appropriate inorganic and organic fertilizers, straw mulch, and well maintenance of soil moisture and crop through applying of irrigation and integrated pest management. Intercropping potato with other crops, such as leaf onion or sweet corn, could increase land productivity and more benefit than monoculture potato. The results also indicated that the technologies packages for potato production on medium altitude in Sleman District, Yogyakarta Special Province were feasible economically as shown by values of revenue to cost (R/C) of monoculture potato, intercropping potato with leaf onion and intercropping potato with sweet corn were 1.98; 2.24; and 2.01, respectively. In brief, the results also proven that medium altitude land is potential for developing potato-growing area

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THE IMPACT OF MARKET STRUCTURE ON AGRICULTURAL TECHNOLOGY TRANSFER

Charles F. Nicholson [1]

ABSTRACT

An agribusiness focus has emerged in public discussions as way to enhance agricultural production in Indonesia and to improve sustainable income for farmers. The focus has led to increased attention on marketing. Marketing agricultural products via processing technologies can indeed address national objectives of rural poverty alleviation. REI-Indonesia observed that limited marketing alternatives are frequently mentioned by farmers as a significant constraint. In Indonesia, a significant amount of institutional support currently exists for the ideas presented in this paper. In particular, one should consider the multifaceted mission of agricultural development in Indonesia, which includes: (a) policies that encourage competition and, therefore, create welfare improvements; (b) the creation of new processing enterprises that increase competition; (c) the establishment of processing facilities that are owned and operated by farmer cooperatives; and (d) the utilization of government resources to assess processing technologies. Thus, the mission of agricultural development, as articulated by the Department of Agriculture, already encompasses in a broad way the specific agenda presented here. This paper provides the rationale behind a specific program that is directed toward mission goals.

[1] Director of Agricultural Program Development REI-Indonesia

INTRODUCTION

An agribusiness focus has emerged in public discussions as way to enhance agricultural production in Indonesia and to improve sustainable income for farmers. Such a focus has motivated much research on farmer institutions and marketing. The agribusiness focus has led to increased attention on marketing, since marketing issues have a major impact on the incomes of agricultural households. In general, food processing of one sort or another has emerged as a possible marketing strategy that can improve agricultural household income. Indeed, processing agricultural produce creates added value, which, if captured by agricultural households, promises to raise living standards for a large segment of the rural population. Processing holds the additional benefit of potentially employing landless workers, who are isolated from any general improvements in agriculture. Thus, marketing agricultural products via processing technologies can indeed address national objectives of rural poverty alleviation.

At the household level as well, marketing issues represent a major concern. Utilizing an approach that invited farmer participation in agricultural training and technology transfer, REI-Indonesia observed that limited marketing alternatives are frequently mentioned by farmers as a significant constraint. Budianto and Zaini (2003) report results of a nationwide set of participatory rural appraisals among rice farmers that show that price issues are among the chief concerns for most of the participating farmers, earning the top ranking of all the mentioned issues. Price and profitability issues are prominent concerns among non-rice farmers, too. A thorough assessment of farmers' complaints of low output price levels requires an analysis of the downstream marketing channels for a given agricultural product in a particular area.

In West Java, a considerable amount of market power is wielded by retailers for a wide range of fresh produce commodities, including fruits and vegetables. In such markets, farmers typically receive only a third of the final marketed value (Kasryno, 2003). If the final product is marketed through a supermarket, the farmer's share of marketed value drops to 20%. These observations raise the suspicion that downstream market channels are characterized by imperfect competition.[2] Where imperfect competition exists in any stage of marketing, welfare losses will attenuate progress in agricultural development. As a preliminary response to farmers' marketing concerns, this paper will focus attention on the theoretical issues of imperfect competition and its impact on agricultural technology transfer.

An investigation of the way markets affect agricultural technology transfer will shed light on possible courses of action. In particular, the role of the regional AIAT offices can be enhanced by setting before them the task of improving competition in local agricultural markets. By utilizing AIAT the resources that are resident in the post-harvest and socio-economic departments, many market structure issues can be addressed. By successfully combating imperfect competition, strategies for agricultural technology transfer will be more fruitful.

The rest of the paper is organized as follows. Section A will discuss the basic elements of a theory of imperfect competition and the way in which agricultural technology transfer is affected by

[2] The fact that processors enjoy a generous spread between the price they pay for the agricultural good and the price they obtain for the processed good does not, in itself, imply imperfect competition. As risk averse processors bear price risk they must exact a premium to compensate for the uncertainty. For instance, Schroeter and Azzam (1991) show that the marketing margins of U.S. meatpackers included a significant component that was due to price uncertainty. Contracts that shift risk-bearing of agricultural prices from the farmer to the processor must include an expected profit for the processor that at least covers processing costs and price uncertainty.

market structure. Section B will describe the practice of market analysis and point out specific instances where agricultural technology transfer has been adversely affected by imperfect competition. Section C will present general conclusions that suggest a research program, which focuses on the role of farmer processing cooperatives in enhancing competition in local agricultural markets and in generating additional rural income.

BASIC THEORY OF IMPERFECT COMPETITION

In environments where imperfect competition exists in the farmers' output market, the farmers' share of marketed value decreases relative to the competitive outcome. Where agricultural produce is marketed as fresh produce or where the agricultural produce is processed into a manufactured product, downstream market power reduces the farmers' share of the marketed value. A strategy that increases competition in the output market holds out the hope that the resulting welfare improvements will create more and better development, particularly in rural areas.

In addition to the welfare losses of imperfect competition, further detrimental effects occur in the area of technical innovation. In this section, we will see that imperfect competition diminishes the benefits of agricultural technology transfer to farmers. In particular, we will consider the following question: How does the adoption of improved technology in a market environment that is characterized by imperfect competition impact aggregate rural incomes or aggregate rural output?

In order to shed light on this topic we will appeal to the two extreme cases of pure monopsony and perfect competition. Monopsony occurs when the demand of an agricultural product is used exclusively by a food manufacturer[3]. Figure 1 shows the demand of the agricultural product, which is derived from the food manufacturer's production function and represents the food manufacturer's marginal benefit of the agricultural good as it produces a processed good. The demand for the agricultural commodity is therefore the value of the marginal product (VMP) of the agricultural good. The supply of the agricultural good is derived from the growers' effort to minimize the cost of producing a specific quantity of the agricultural good. The supply of the agricultural good is the minimum cost incurred by the grower as his output increases one unit, i.e. the marginal cost (MC).

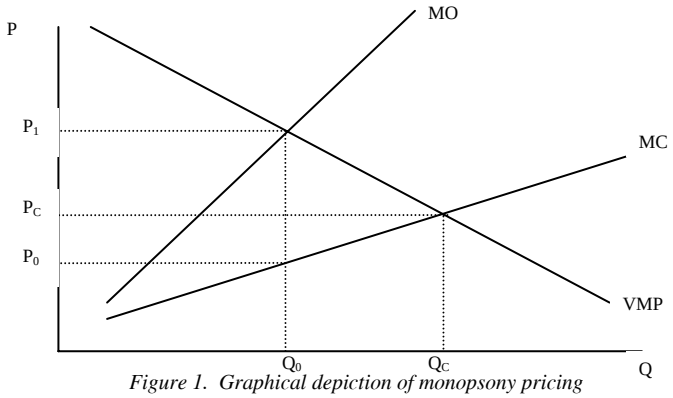

Figure 1. Graphical depiction of monopsony pricing

[3] Although the comparative static effects of the oligopsony model differs from the pure monopsony model presented here, shifts in supply, which is the focus of this paper, give rise to effects that are qualitatively the same in both models. See Chen and Lent (1992) for a thorough analysis of the supply effects in the oligopsony model.

Under perfect competition, neither the food manufacturer(s) nor the growers can influence the market price of the agricultural good. A Walrasian market emerges and yields a price that clears the market where VMP=MC. The competitive equilibrium price is PC and the market output is QC. Total sales of the agricultural product will be PCQC, which represents the aggregate income earned by the farmers.

A different result emerges when the food manufacturer is the only buyer of the agricultural product and can, therefore, influence the market price. As the quantity purchased by the food manufacturer increases by one unit, the price that he pays for that extra unit also increases, according to the growers' supply schedule. Consequently, the food manufacturer's marginal expenditures (or marginal outlays, MO) on the agricultural good are not the same as the supply curve that is generated by the farmers' cost structure. As a result, the optimal amount of the agricultural good for the food manufacturer is much lower than the optimal amount under perfect competition. The food manufacturer will purchase an amount of the agricultural good, Q0, where VMP = MO. Note that the farmers' income has dropped to P0Q0 from the competitive outcome of PCQC.

Now consider what happens when the growers adopt a cost-reducing technology, which effectively shifts down their supply schedule. Figure 2 presents in graphical form the market outcome of agricultural technology transfer. Note that the competitive outcome includes higher output and lower price. For this outcome to imply an increase in rural income, the demand curve must be elastic. That is, an inelastic demand will result in lower aggregate sales. Now observe that under imperfect competition output also increases with an improvement in technology but by a lower amount, demonstrating that imperfect competition reduces the output effect of agricultural technology transfer. Note also that both P1 and P0 decrease but P0 decreases by a larger amount than P1, showing that the benefits of farmers' adoption of cost-reducing technologies accrues mainly to the processor, not the farmer.

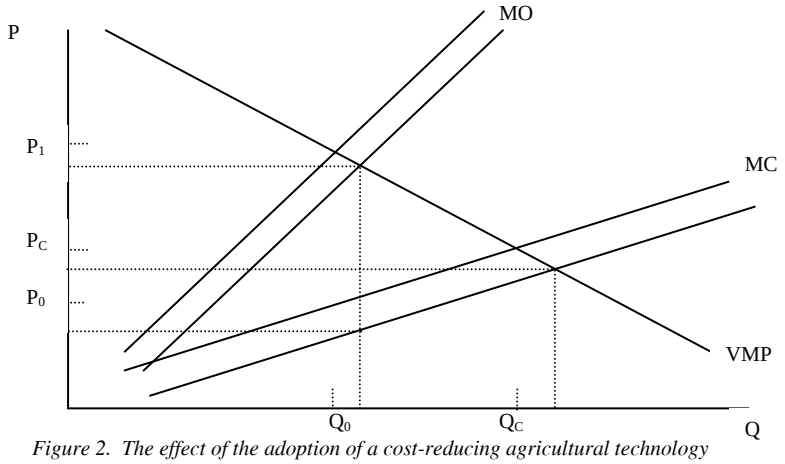

Figure 2. The effect of the adoption of a cost-reducing agricultural technology

When imperfect competition characterizes the market faced by agricultural producers, there will be relatively little increase in agricultural output after the adoption of effective agricultural technology. Consequently, farmers' incentives to adopt improved technologies are greatly reduced when their only marketing alternatives are those that are characterized by imperfect competition. In this way, market

characteristics can have a notable impact on agricultural technology transfer, as well as on poverty alleviation efforts.

Now let's change the market structure in two important ways. First, assume that a marketing cooperative was organized among farmers, such that farmers became owner operators of a processing facility. Assume further that enough of these cooperatives formed to eradicate imperfect competition. Second, assume that technology transfer efforts included processing technologies so that the demand for the agricultural product shifted up. Figure 3 presents the theoretical effects of such a scenario.

Technical innovation at the processing level increases demand for agricultural products. If competition prevails in the market, both PC and QC increase, producing unambiguous increases in aggregate rural income. Now compare the new competitive outcome with the monopsony case, where the pre-shift outcome was P0 and Q0. It is apparent that the benefits are huge when increased competition is combined with technology transfer at the processing stage. In addition, landless workers can be included in processing, creating important employment opportunities. The scenario that was just described is consistent with a strategy that provides technical information regarding processing to farmer organizations as they organize at the processing stage.

Fostering farmer-operated food manufacturing can create a host of benefits. First, by placing an increased portion of the value added in the hands of farmers, the incomes of those households will increase. Second, by a deliberate attempt to increase competition, rural markets will become more efficient. Third, as markets become more efficient, development efforts, like technology transfer to growers and processors, will generate greater benefits. Thus, a strategy that aggressively confronts imperfect competition in agricultural markets, encourages grower involvement in food processing and develops efficient technologies of production and processing in those markets promises to make a significant impact on agricultural and rural development.

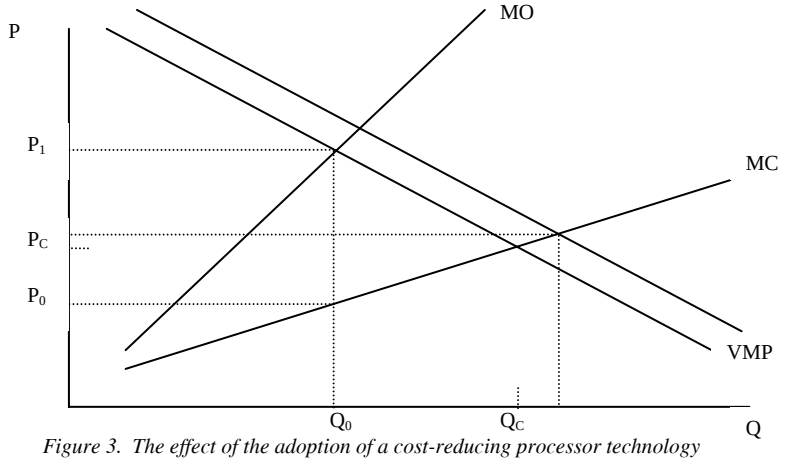

Figure 3. The effect of the adoption of a cost-reducing processor technology

ANALYSIS IN PRACTISE

In this section we consider ways to address issues of market structure so that multiple goals of development might be attained, including the enhancement of agricultural technology transfer, the

promotion of manufacturing in rural areas and the reduction of imperfect competition. All of these goals can be obtained with the resources and structures that are embodied in the agencies of the Indonesian Agency for Agricultural Research and Development.

Much previous work has been done that can provide direction for future analysis. In particular, the impact of market structure on technical innovations in agriculture has already received attention. For instance, by analyzing the impact of the adoption of mechanical harvesters in California from 1963 to 1967, Just and Chern (1980) provide evidence that imperfect competition existed in the market for California tomatoes. Moreover, they provided one of the earliest treatments of the effect of market structure on the potential impact of supply shifts, which include the impact of agricultural technology transfer. Huang and Sexton (1996) analyze a similar market in Taiwan, showing that adoption of the same technology (mechanical harvesters) created benefits mainly for processors, not farmers. They also showed that imperfect competition was the main culprit behind the eroded benefits of agricultural technology transfer. Previous work has demonstrated that the particular market environment can play a role in either enhancing or attenuating the benefits of agricultural technology transfer and innovation.

Aside from the impact on agricultural technology transfer, market structure also influences the potential of income-generation in rural areas. The literature exposes the detrimental welfare effects caused by imperfect competition. Specifically, in the processing tomato market in Taiwan, imperfect competition has resulted in large losses for farmers that amount to two-thirds of the benefits attainable under perfect competition (Huang and Sexton, 1996). Indeed, the verified existence of imperfect competition is identical to the verification of welfare losses.

It is important to note, however, that market structures can change. Public policy that encourages competition can effectively address welfare losses due to imperfect competition. In the California processing tomato market, for instance, no significant level of imperfect competition was observed during the 1980's (Durham and Sexton, 1992), which was two decades after the Just and Chern study, which provided evidence of imperfect competition. Indeed, public policy that stimulates competition (eg. reducing barriers to entry) will create a dynamic market environment that can reduce imperfect competition (Durham, et al, 1996). An evolving market structure that becomes more competitive over time offers hope that in Indonesia, too, agricultural and industrial policies that promote competition in all stages of marketing can successfully create environments where technology transfer efforts bolster national welfare.

In practice, then, a synergy exists between agricultural market assessment and agricultural technology assessment. Analysis that focuses on specific local markets and specific local technologies represents an area of endeavour that is particularly suitable for the regional Assessment Institute for Agricultural Technology (AIAT) offices. In particular, the post-harvest department of the AIAT offices can play an important role in the assessment of processing technologies. Similarly, the socio-economic department of the AIAT offices can play a role in the assessment of market structure, while the agricultural production department can play a role in agricultural technology assessment. By combining resources in this way the AIAT offices can perform a more thorough analysis that recommends cost-reducing agricultural technology, cost-reducing processing technology and pro-competition measures.

THE ROLE OF FARMER COOPERATIVES

Having uncovered the detrimental effects of imperfect competition and having considered ways to conduct analysis, we turn our attention to possible solutions that could either solve the problem of imperfect competition or provide additional direction in the analysis stage. Both as a potential solution and as a research direction, collective action among farmers offers hopeful prospects.

In an environment of imperfect competition, farmers have incentive to act collectively to secure more value. Such collective action represents a special case of vertical coordination that captures lost efficiency while it generates procompetitive influences. Specifically, if farmers realize that their agricultural good is underutilized because of imperfect competition, there is incentive for vertical coordination between growers and processors (Azzam, 1996). Collectively negotiated contracts are one way to create more vertical coordination and seize greater benefits for both the growers and the processors.[4]

Alternatively, farmers can form marketing collectives that process their own produce. Sexton (1990) shows that farmer cooperatives can provide a procompetitive influence on markets that are characterized by imperfect competition. Therefore, public policies that are favourable toward cooperatives can indirectly enhance competition and, therefore, bolster the impact of farmers' adoption of cost-reducing agricultural technologies. When a processing farmer cooperative enters the market, imperfect competition is reduced, allowing the efficiency gains of competition to be realized.[5] Thus, an effort to organize farmers around a processing enterprise promises to create at least 3 benefits of increased competition, namely increased rural income through increased product sales, increased rural income through the capture of additional value added in the processing stage and enhanced welfare effects of agricultural technology transfer to farmers.

In Indonesia, a significant amount of institutional support currently exists for the ideas presented in this paper. In particular, one should consider the multifaceted mission of agricultural development in Indonesia [6], which includes

1. "synchronizing policy to encourage the development of every agribusiness sub-system to develop strongly and harmoniously"
2. "facilitating and stimulating the development of agribusiness enterprises . . . both on-farm and off-farm (i.e. cultivation, processing and marketing) and stimulating the development of business partnerships"
3. "promoting the development of farmers' economic organizations and business networks in agricultural upstream and downstream industries"
4. "developing location specific and environment friendly technology innovation, either on upstream industry, on-farm business or agricultural downstream industry"

Note that number 1 presumably includes policies that encourage competition and, therefore, create welfare improvements. Number 2 includes the creation of new processing enterprises that increase competition. Number 3 includes the establishment of processing facilities that are owned and operated by farmer cooperatives. Number 4 includes the utilization of government resources to assess processing technologies. Thus, the mission of agricultural development, as articulated by the Department of Agriculture, already encompasses in a broad way the specific agenda presented here. This paper provides the rationale behind a specific program that is directed toward mission goals.

4 Note that the existence of contracts between growers and processors does not prove the existence of imperfect competition. Vertical coordination can arise for a host of reasons, including specialized assets (Williamson, 1985), uncertain supply (Carlton, 1979) and information asymmetry (Hennessy, 1996). Frank and Henderson (1992) show that vertical coordination arises mainly from the effort to reduce transaction costs, which only partly refer to the internalization of production and processing inefficiencies, like those that occur under imperfect competition.

5 Although one study found that "increases in the share of product handled by marketing cooperatives did not appear to increase competitiveness in the raw product market." (p. 990, Wann and Sexton, 1992), it is certainly the case that an increase in the number of marketing cooperatives will increase competitiveness.

6 Taken from Budianto and Zaini (2003)

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DEVELOPMENT OF COMPONENT TECHNOLOGIES FOR CONTROL OF BACTERIAL WILT IN POTATO.

O.Setiani Gunawan, Z. Abidin. R.S. Basuki, A.Dimyati, A. Asgar, Elske van de Fliert and Keith Fuglie.[1]

ABSTRACT

Research strategies to control potato bacterial wilt disease *(Ralstonia solanacearum)* were conducted in Pangalengan subdistrict in West Java from January to Decembre 2001. Activities were done to determine the following: 1) status of *Ralstonia solanacearum* in the farmer's and experimental fields, 2). effect of components including seed selectionn during storage, crop rotation, field sanitation mulching, and manuring with beneficial organisma added, on *Ralstonia solanacearum* population development in fields and potato yield. Soil, plant and tuber were taken from 83 location in 13 villages in the Pangalengan District of West Java, Indonesia. Virulence of *R. solanacearum* population was determined using the Kiraly methods(1970), positive. *R.solanacearum* reaction by NCM ELISA using Priou methods(1999), and Race and Biovar detection using the Haywrd method(1964). Race 1 Biovar 3 and Race 3 Biovar 2 were identified. All the isolates from wilt- affected potato plants collected from the 83 locations were highly pathogenic to tomato and potato but were less virulent to eggplant, pepper,and ginger. Race 3 Biovar 2 was found at more than 1.300 m asl, while Race 1 Biovar 3 was found at 800-1500 m asl. Seed selected four times at one –month intervals in Diffuse Light Stores resulted in 100 percent of plants showing no wilt symptoms when subsequently planted. Yield per plant was higher compared with the farmers practice. The rate of bacterial wilt disease development was lower following a 3 month maize rotation, a 3 month cabbage rotation and a 3 month bean rotation. Apparently, *Pseudomonas fluorescens* applied one month sfter planting increased the avirulent population. Field sanitation, by using black silver plastic mulch to cover root and stem debris after harvest and to control weeds, improved yield production compared with that of the untreated plot (2 intervals of handweeding). The *Indigenous Trichoderma spp* and *Lactobacillus spp* populations contributed to the development of healthy plants.

Key words : Ralstonia solanacerum, Solanum tuberosum, Race and Biovar, Pseudomonas fluorescens, Trichoderma spp and Lactobacillus spp, components, control strategies, rotation,, mulch

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Introduction

Bacterial wilt *(Ralstonia solanacearum)* or Brown rot is a serious disease of potato and is a major limiting factor of potato production in Indonesia The extensive number of plants affected by that bacterium includes not only important hosts, but also a number of weeds. Gunawan et al (1987, 1999) reported an extensive number of host from more than 50 families of weeds that were affected by the bacterium. The importance of indigenous vegetation has been clearly established when potato wilted in a field to have virgin soil, that was never previously planted with solanaceous crops (Jackson and Gonzalez1979, Martin 1979)

In many instances the incidence of bacterial wilt has decreased after the first planting with a susceptible host. Probably the mechanics of removing the soil layer after first planting has played an important role in decreasing inoculum in soil. . Studies conducted by Jackson and gonzalez (1979) reported that two common weeds were *Melampodium perfoliatum* and *Bidens pilosus*, had wilt symptoms. However, the bacterium was also isolated from plants showing no symptom at all. The effect of crop rotation and weed control was associated with a declining incidence and increasing yield. It was reported that more than 50 species of weeds associated with potato plant were the principal reservoir of inoculum for the next planting season (Gunawan *et al.*, 1999, 2000,2001a). In such intance, bacterial were effectively controlled by combination of soil sanitation and use of healthy planting material.(Gunawan *et al.*, 2001b).

Most of researchers working on bacterial wilt have agreed over the years that two principal means of controlling the disease are rotation and use of disease free seed. However, in order to establish a rotation program, it is imperative to know the host range. As early as 1939 Smith has worked on host range,to control the disease by rotation.(Martin 1979)

Elphinston and Aley (1992) reported, that control of bacterial wilt of potato has been done in many countries. In Rwanda one crop rotation with any of the five principal crops grown there greatly reduced wilt incidence, and longer rotation showed no advantage. Devaux et al (1987 *cit* Elphinston and Aley 1992), also reported that when rotation was followed by planting a resistant potato variety, wilt incidence was further reduced. In Columbia, potato strain damage was greatest with continuous potato planting or rotation of potato and tree tomato *(Cyphomandra betacea)*, which is also susceptible. Rotating maize for 8-10 months growth, with either potato or tree tomato gave good control (Navarro and Granada 1978 *cit* Elphinston and Aley 1992). Research on crop rotation as a control measure after a cropping of heavily infected potato showed that the bacterium survived least with either onion or carrot as rotation crops.

French (1996) reported, that rotation with maize and beans achieved good control in Honduras. Intercroping potato with beans, resulted in less spread of *Ralstonia solanacearum* than with maize as intercrop. Potato rotated with maize, reduced the population of bacterial wilt in the soil. Gunadi et al (1999), and Gunawan *et al.* (2001a) showed that a 3 month maize rotation, 3 month beans rotation and 3 month cabbage rotation with application of *Pseudomonas fluorescens* has reduced the bacterial wilt pathogen population and percentage of wilted potato plant. Soil sterilant Dazomet applied one month before planting potato has reduced the bacterial wilt population in the soil (Gunawan *et al.,* 2001b).

Compared with 5 to 10cm planting depth, planting shllower at 2cm resulted in less wilt from soil infection, but yield was less, with more tubers turning green. Seed borne wilt or latent infection has long been recognized as the principal method of disseminating the potato strain. The movement of seed tubers from an infected field at warm location to cooler sites has repeatedly been reported to produce latently infected seed in healthy looking field. Use the infected seed has often resulted in serious outbreaks or even epidemics of bacterial wilt in the field. The use of clean seeds (pathogen free) will reduce inoculum in the soil for next planting.(Basuki *et al.,* 1999).

Gunawan *et al.* (2000) reported that selection of seed potato in the storage before planting improved the quality of seeds. The use of Diffuse Light Store (DLS) resulted in strong seeds and vigorous sprouts, compared with those in dark storage. Incidence of all pests and diseases were reduced when potato was stored in DLS at 30-days intervals. The condition in DLS stimulated the sprouting hormone by sunlight.(Asgar *et al.,* 1994). DLS increased the quality of potato seeds by around 15 percent compared with those kept in dark storage (Nainggolan 1993), but only a few seed growers have the DLS technology (Gunawan, *et al.,* 2000).

The development of bacterial wilt associated with weeds species was recorded in more than 50 weeds that have been growing well in potato fields in Pangalengan, Lembang and Garut in Indonesia. They showed no symptoms that they were hosting *Ralstonia solanacearum*..(Gunawan *et al.,* 1999). Cortbaoui (1997) reported that use of mulch technology in potato cultivation has many benefits: it controls weeds, reduces competition for nutrient and space, maintains relative humidity and soil structure, reduces soil and microelement erosion, increases soil fertility,and minimizes the damage caused by full sunlight and rain. Using mulch technology resulted in high yields and clean tubers compared with conventional weed control methods (Unger, 1987 *cit* Reinjtjes, *et al.,* 1999). Moreover,using mulch in potato cultivation helped the roots to penetrate the soil easily, reduced weeds, and increased yield (Gunawan *et al* 2000)

FAO (1984 a *cit* Reinjtjes, *et al.,* 1999) reported that soil fertility caused by erosion has decreased in more than 554 million ha of lands. Soil productivity has beeb lost in the United States of America, (30%), Africa (16.5%), West Asia (20%) and Central America (30%) due to erosion. Generally in the tropics, farmers planting potato in the highland and heterogenous of environmentsentails very high risks. Sustainable agriculture technology need to be used to maintain the natural resources productivity to increase environmental quality and economic sustainability (TAC, CGIAR 1988, *cit* Reinjtjes, *et al*., 1999).

Material and Method

Research was conducted on January to December 2001 to determine the following status of *Ralstonia solanacearum* in potato cultivation, impact of seed selection, plant rotation, field sanitation, weeds control using black silver plastic (BSP) and using effective microorganism as a strategi for incresing production and for the control of bacterial in the soil..

Laboratory work on 83 soil samples was conducted at the Indonesian Vegetable Research Insitute in Lembang. The sample were collected at a dept of 40 cm at regular intervals during the rotation periods in 83 location (in 13 villages) in the field of Pangalengan, Bandung District West Java Province, Indonesia (800 m –1500 m asl). One gram of soil from from each sample was thoroughly mixed with 9 ml of sterilized destilated water (SDW) and it was found 10 –1 dilution of suspension. A 0.1 from 10-1 dilution was throughly mixed with 9 ml SDW and than a 0.1 ml those suspension was mixed with 9 ml SDW to find the 10-2 dilution of suspension until 7 series fold (10-7). A 0.1 ml of (10-7suspension from the 7 series fold) of each sample was purified on Tetrazolium (TZC) agar medium (Kelman1954), incubated at 30^{o} C. 72 hours until a fluidal colony was observed to be growing well. A virulent colony showed by typical fluidal, smooth, white appearance with red internal whirling patterns, while avirulent ones were dark red and round. Virulence was calculated and determined using Kiraly method (1970). All colonies were tested using NCM ELISA. For pathogenicity tests, pure isolates were inoculated to tomato,. potato, pepper, eggplant and ginger in a sreenhouse. Isolate from all location were tested for Biovar and Race groups using the Hayward methods (1964). By using six carbohydrates, a positive reaction shown by a color change means that an antigen of the bacteria was present in the sample carbohydrate media for Biovar (Hayward 1964). Biovar of *R. solanacearum* was determined based on the use of six carbohydrates: cellobiose, lactose and maltose, oxidation of the hexosa alcohol, manitol and sorbitol. A 0.1ml of *R. solanacearum* suspension was added to 3 ml of sterilized basal medium consisting of amonium dihydrogen phosphate

(1.0g), potassium chloride(0.2 g), magnesium sulphate(0.2 g), pepton (1.0 g), bromothymol Blue (0.03 g), agar (3.0 g) and distilated water (1000 ml), pH of medium was 7.0 to 7.1. (an olivaceous green color). The mixed suspensions were left for 3, 7 and 14 days. The suspension changed color from olivaceous green to yellow, an indication of increasing acidity. The procedure for classifying of *R.solanacearum* (Table 1).

Field experiment were conducted in the highland (1300 m asl) at Farmers field in Cinangsi, Pangalengan. The four field used had similar soil types (Andosol), and were infected with Race 3 Biovar 2, From January 2001 to December 2001, selected potato seeds in storage were studied regarding the storage's impact on the development of bacterial wilt and on yield production. Paired comparison was used, and 10 were replicated. The Improved (Researcher's) practice was compared with farmers practice. To ensure uniform inoculum distribution in the soil, the block was located in areas of the field where the previuos potato crop had been uniformly affected. Land was devided into 2 sites measuring 500 m 2 each. Each was surrounded by a drainage ditches 30cm wide and deep between blocks, and 50 cm wide and deep between treatments. Seed were planted in double rows of each block of treatments. Black Silver Plastic (BSP) for weed control was used.

Table 1. Procedure for classification of Ralstonia solanacearum (Hayward , 1964)

Physiological Tests	**Biovars(Bv)**				
	1	**2**	**3**	**4**	**5**
Utilization of disacchaarides:					
Cellobiose	-	+	+	-	+
Lactose	-	+	+	-	+
Maltose	-	+	+	-	+
Oxidation of alcohols:					
Dulcitol	-	-	+	+	-
Mannitol	-	-	+	+	+
Sorbitol	-	-	+	+	-

Notes: Bv determination is based on the following: Bv1= utilization and oxidation tests negative; Bv 2 = utilization disaccharides, does not oxidize the alcohol; Bv 3 = utilization and oxidation both positive; Bv 4 = utilization of disaccharides negative, oxidizes the hexosa alcohol; Bv5 = utilization disaccharides, oxidizes mannitol but not dulcitol or sorbitol

To determine time frequency and kinds of plant for rotation, 3 months each of the following crop were rotated: maize, cabbage and beans. Potato was planted for three months before rotation, to develop bacterial wilt inoculum. A randomized block design was used. For each treatment, an effective microorganism (EM), *P. flourescens* was added. Field sanitation and weeds control by mulching were conducted in the farmer's field with two treatments: with and wthout BSP. Paired comparisons were done in two bloks of 500 m^2 each.

Effect of effective microorganism or EM (*Trichoderma spp.* and *Lactobaccilus spp.*) on the quality of manure was also determined in farmer's field. The manures used were those of sheep, chicken, cow, horse and paddy straw compost. EM- treated and untreater manure were appiled on the fields and the plants were observed for disease incidence, population of BW, weed species, vegetative growth, and generative growth. Results were recorded on weekly and monthly intervals.

Result and Discussion

The rate of disease development of the virulent population was higher (13.9 x 10^7 cfu/g - 45.0 x 10^7 cfu/g soil) than avirulen population (0.9 x 10^7 cfu - 7.5 x 10^7 cfu/g.soil). were recorded from 83 villages (13 desas) as shown in table (2). Apparently the development of BW population was recorded in each sites very closed in virulent and avirulent characteristic. Where the virulent Bw population had

a higher rate than the avirulent population.The rate of the BW population had influenced by enviroments condition, especially where the vegetation were grown in those sites has improved or reduced the development of BW population (Martin, 1979). It was very closed by exudates was liberated by plants from methabolsm resulted to rhizosphere by resistant or susceptible vegetations to the BW. The rhizosphere of plant root is the principal reservoir of pathogen from one season to the next.. Role of indigenous vegetation and crops is very important to the development of BW where the importance of indigenous vegetation has been clearly established when potatoes have wilted in field never previously planted with solanaceous hosts or planted in virgin soils. (Johnson and Curl 1972, Martin 1979, Gunawan *et al.,* 2001a).

Table 2. Virulence characterictic of Ralstonia solanacearum in the soil was planted by potato in Pangalengan (2001)

Code No	Desas	Location	Elevation(m) above sea Level	*R solanacearum* (10^7 cfu))/g.soil sample	
				Virulent	Avirulent
1	1.Pangalengan	Bbk. Laksana	1310	21.8	2.1
2		Legok Kandang	1300	28.9	1.9
3		Jublegan	1310	15.4	1.1
4		Ciawi koral	1300	30.0	2.1
5		Pasanggrahan	1300	13.9*	2.3
6		Bojong	1300	24.8	1.8
7		Pangalengan	1300	15.6	1.0
8.	2 Marga Mulya	Pada Awas	1300	25.6	1.1
9		Legok Bako	1280	16.9	2.0
10		Norogtog	1290	21.3	1.9
11		Kebon Kopi	1290	21.0	1.2
12		Marga mulya II	1320	32.5	1.4
13	3.Marga Mukti	.Sukamenak Kln	1380	17.5	3.5
14		Sukamenak Wtn	1380	32.5	2.7
15		Cibeurum	1370	30.5	1.2
16		Cipanas	1390	35.2	1.2
17		Ranca manyar	1390	20.2	2.2
18		Pangkalan	1390	18.6	1.9
19		Kerta manah	1400	26.5	1.7
20		Cikole	1400	20.0	1.3
21		Los Cimaung	1450	31.2	1.6
22	4.Marga Mekar	Suka Mulya	1400	34.2	0.9*
23		Bbk Kiara	1450	30.5	2.4
24		Cieurih	1390	28.2	1.4
25		Los kulalet	1390	22.1	1.8
26		Kramat	1390	23.3	1.3
27		Cisangkuy	1300	22.0	3.9
28	5.Sukamanah	Sukallah	1480	14.2	4.1
29		Los	1500	18.7	3.2
30		BBI	1500	21.5	1.7
31		Kertamanah	1500	23.5	2.1
32		Citere	1470	19.5	1.4
33		Pintu	1500	17.6	1.4
34	6.Wanasuka	Cipanas	1500	35.7	1.3
35		Srikandi	1490	28.5	1.2
36		Pasir yunghun	1500	23.2	1.0
37		Kiara roay	1500	19.6	0.9
38		Wanasuka	1450	30.6	1.8

Code No	Desas	Location	Elevation(m) above sea Level	*R solanacearum* (10^7 cfu))/g.soil sample	
				Virulent	Avirulent
39	7.Banjar sari	Malabar	1510	35.7	1.4
40		Suka ratu	1510	40.0	1.7
41		Babakan	1500	28.6	2.0
42		Cibolang	1510	22.9	2.2
43		Banjar sari	1500	37.2	3.1
44	8.Tribakti Mulya	Baru petak	1050	37.3	7.5*
45		Ranca gada	1100	40.4	4.2
46		Patrol	1100	44.3	3.0
47		Cirancah	1100	29.0	1.6
48		Cihideung	1100	36.8	1.6
49		Lebak saat	1120	33.4	1.2
50	9.Lamajang	Ciburuy	910	29.5	4.5
51		Cibiana	900	45.0*	3.9
52		Badra	850	44.1	2.1
53		Karang tengah	800	43.3	2.1
54		Babakan tipah	850	39.0	1.4
55		Panenjoan	850	41.0	1.7
56	10.Pulosari	Taraju	1350	23.6	4.2
58		Sirnasari	1360	42.2	3.3
59		Dangdang	1360	28,0	1.2
60		Kiaragede	1360	30.0	2,8
61		Cinangsi	1350	21.5	4.8
62		Kiarasanding	1360	37.0	5.2
63	11.Sukaluyu	Ciseke	1400	34.5	5.4
64		Wates	1400	33.0	6.5
65		Satani	1420	42.1	6.0
66		Cilaki	1410	31.0	4,6
67		Dalima	1450	38.4	2.2
68		Busmir	1400	29.4	2.7
69	12.Margaluyu	Baruipukan	1480	37.8	3.3
70		Barukampak	1480	42.3	5.4
71		Puncakraya	1420	44.2	6.5
72		Puncangmara	1420	25.8	6.2
73		Baruwangi	1490	28.2	5.5
74		Cikole	1480	33.0	7.2
75		Gunungcupu	1490	34.2	3.2
76	13.Warna sari	Padahurip	1380	34.2	1.2
77		Warnasaritengah	1360	27.3	3.2
78		Kiaracondong	1350	41.0	2.4
79		Citus	1350	34.2	2.5
80		Cibeting	1370	22.7	3.4
81		Palayangan	1380	21.7	5.1
82		Cipangisikan	1370	32.5	2.1
83		Parabon	1370	33.0	2.3

Notes : Cfu = colony form unit. G= gram, *R*= *Ralstonia* The bacteria population is resulted and was recorded from averaged of two petri dish.

Informal surveyed were conducted to detemine farmer behavior on potato cultivation. Results showed that farmer have never consciously evaluate the kinds of vegetable they select for rotation after planting potato. Few farmers intercropped tomato or pepper with potato. One farmer reasoned that these vegetable were profitable. Indirectly, farmers have played a role in sustaining the bacterial wlit inoculum in their field. Another probable reason for the high BW population is the nutritional resources abundant in nature (Jonson and Curl 1972).

The farmers have never sanitated their fields of infected stems or infected tuber after harvest. All debris in the area were left until the next planting season. Moreover, weeds in areas planted to potato have promote the survival of the bacterium by serving as inoculum host. These weeds were symptomless (Abidin and O.S Gunawan 2000). It has proven that land sanitation and weed control reduce bacterial population in soil.(Gunawan, *et al.,* 2001b). The use of soil sterilant Dazomet reduced bacterial wilt in the soil.

Biovar classification of *Ralstonia solanacerum*

Bacterial wilt can be determined by the bacterial's utilization of the disaccharides cellobiose, lactose and maltose , and the oxidation of the hexose alcohols dulcitol, mannitol and sorbitol and all 83 isolates oxidated all the carbohydrates. The Hayward method classified *R.solanacearum* isolates from soil as Race 1 Biovar 3 and those from infected stem and tuber as Race 3 Biovar 2. Smith cit Kelman (1953) reported that Race 3 Biovar 2 only found in an infected plant and tuber of potato. Gunawan *et al.* (1999) reported that Race 1 Biovar 3 was detected only in the rhizosphere of weeds and in the soil. All collected bacterial wilt were positive in NCM ELISA and shown in Table 3

Tabel 3. Ralstonia solanacearum isolates collected and oxidized to six carbohydrates, and NCM ELISA. (2001)

Desas was surveyed	Race,Biovar from the soil		Race,Biovar, In tuber and stem potato		NCM ELISA
	Race	Biovar	Race	Biovar	
1. Desa Pangalengan	1	3	3	2	+
2. Desa Margamulya	1	3	3	2	+
3. Desa Margamukti	1	3	3	2	+
4. Desa Marga mekar	1	3	3	2	+
5. Desa Sukamanah	1	3	3	2	+
6. Desa Warna sari	1	3	3	2	+
7. Desa Banjarsari	1	3	3	2	+
8. DesaTribaktimulya	1	3	3	2	+
9. Desa Lamajang	1	3	3	2	+
10 Desa Pulosari	1	3	3	2	+
11 Desa Sukaluyu	1	3	3	2	+
12 Desa Margaluyu	1	3	3	2	+
13 Desa Warnasuka	1	3	3	2	+

Note : + = positive reaction in utilization disaccharides or oxidation of *Ralstonia solanacearum,* negatif = does not occur oxidize the alcohols and utilizatin of disaccharides.

Pathogenicity tests.

R.solanacearum was found to be pathogenic to: tomato and potato but not to pepper , eggplant, and ginger and can be showed in table (4) below. The pathogenicity of isolates to the host is depended on gen, where not all of vegetation or crops showed wilt symptoms although they was attacted by the pathogen (symptomless). Those condition very seriusly to find the attention and will be came inoculum resources for the next planting (Martin, 1979, Gunawan *et al.,* 2000)

The Impacts of seed selection.

The potato field showed healthy looking plants with no pest and disease incidences. There were no symptoms caused by *R. solanacearum*. After 90 days, plants that were seed selected by the improved way were taller, nearly 115 cm with the canopy diameter around 46-49 cm. Those produced by the farmer's practice averaged 113 cm in height with canopy diameter of 43-47 cm, and stem diameter of 2-2.1 cm. Seed selection is the main factor in increasing plant health and yield (Cortbaoui 1997) and shown in Table 5.

Table 4. Pathogenisity test of R. solanacearum isolates from the soil after planted

Desas was surveyed	***R.solanacearum* suspension(10^7 cfu/ml)**							
	Tomato	**Pepper**		**Eggplant**		**Potato**	**Ginger**	
1.Desa Pangalengan	+	+	-	+	-	+	+	-
2.Desa Margamulya	+	+	-	+	-	+	+	-
3.Desa Margamukti	+	+	-	+	-	+	+	-
4.Desa Marga mekar	+	+	-	+	-	+	+	-
5.Desa Sukamanah	+	+	-	+	-	+	+	-
6.Desa Warna sari	+	+	-	+	-	+	+	-
7.Desa Banjarsari	+	+	-	+	-	+	+	-
8.DesaTRibaktimulya	+	+	-	+	-	+	+	-
9.Desa Lamajang	+	+	-	+	-	+	+	-
10Desa Pulosari	+	+	-	+	-	+	+	-
11Desa Sukaluyu	+	+	-	+	-	+	+	-
12Desa Margaluyu	+	+	-	+	-	+	+	-
13Desa Warnasuka	+	+	-	+	-	+	+	-

Notes: + = positive reaction (pathogen), - = non pathogen or symptomless

Table 5. Vegetative growth of potato crops resulting from seed selection by Researcher and Farmers practices

Treatment	**Seed selection resulting by researcher (cm)**	**Seed selection resulting by farmer's practices (cm)**
Height of plant 30 dap	25.0	21.0
Height of plant 60 dap	80.0	75.0
Height of plant 90 dap	115.0	113.0
Diameter of canopy 30 dap	35.0	35.0
Diameter of canopy 60 dap	46.0	43.0
Diameter of canopy 90 dap	49.0	47.0
Diameter of stem 30 dap	1.0	1.0
Diameter of stem 60 dap	1.5	1.3
Diameter of stem 90 dap	2.1	2.0

Note : dap = day after planting.

Pest and Disease of potato

Generally, all the plants looked healthy in both treatments, with no severe pest and disease damage 90 days after planting. Apparantly, good selection of seed resulted the healthy plants,with no latent seed and with strong and big stem (more than 1 cm diameter). Late Blight observed at 60-70 days after planting was controlled by systemic fungicide, sprayed at 10 days intervals. Early Late Blight symptom were mechanically (cut with disinfected scissors dipped in soap solution).

Thrips palmi, Pthorimaea operculella and *Myzus persicae*. was controlled using an integrated pest management (PHT-SDT/SDR Rintisan 1993), with an insecticide recommended by Balitsa (RIV). Cooler weather has reduced these pest's population.

Fungy wilt caused by *Fusarium oxysporum* was noted in fields managed by farmer's conventional pratice and was eradicated, a farmer found it difficult to isolate dry rot when it became associated with an earlier infection by potato tuber moth (PTM) in the same place on the surface of seed potato.has found in farmer way and eradicated. Probably the farmer found difficulty to select the disease caused by dry rot togather and associated with PTM infected earlier in the same place on the surface of seed potato.

Generative growth of potato.

Yield production from both treatments (Improved and farmer's practices) resulted in tuber size variations. Tuber size classified into six grade according to weight: Super AL = more than 250 g/tube, Al = more than 200 g/tuber, A =: more than 150 g/tuber, B =: more than 60-100 g/tuber, C:= more than 50-60 g and D = less than 40-40 g. Data on tuber sizes, yield and grade are shown in Table 6.

Table 6. Yield of tubers from 10 plant samples from researcher's and farmer's selection practices

Treatment	***Yield/kg/plant***	***Total of tuber***	***Percentage Grade of tuber***				
			AL	L	A	B	C
Seed selection resulting by researcher practices	1.72	23.9	2.3	1.15	17	40	39
Seed selection resulting by farmer's practices	1.53	23.5	1.7	1..0	11	33	56

Notes: Al = more than 200 g/tuber, A = more than 150 g/tuber, B = more than 60 -100 g./tuber, C = more than 50-60 g

Yield from sample tuber (10 plants) showed several disease symptoms caused by *Ralstonia solanacearum* (Brownrot), *Erwinia carotovora* (soft rot), *Fusarium oxysporum* (dryrot), *Grylotalpa spp.* (Table 7) and Potato Tuber Moth caused by *P.operculella* was found to have damage at most two tubers from the total sample(Table 8).

Table 7. Diseases Infecting tubers with seed selection by researcher and farmer's practices

T Treatment	***Percentage of infected tuber caused by***			
	Dry rot	**Nematode**	**Soft rot**	**Brown rot**
Seed selection resulting by researcher	0.1	0.0	1.5	0.1
Seed selection resulting by farmers practices	0.1	0.0	2.1	0.2

Table 8. Pests infecting tubers with seed selection by researcher and farmer's practices.

Treatment	**Percentage of infected tuber caused by**	
	Ptheromaea. Operculella	***Gryllotalpa spp***
Seed selection resulting by researcher	0.0	0.3
Seed selection resulting by farmers	0.0	0.4

Population of Ralstonia solanacearum in the soil.

The population of *Ralstonia solanacearum* in the soil was recorded before and after planting (Table 9). Initial population of the virulent group before planting was 0.30 x 10^7 cfu/g, while that of the avirulent group was 2,70 x10^7 cfu/g soil. The population of virulent group increased 90 days after planting of potato. Perhaps , exudates from plant metabolism nourished the pathogen, and favored bacterial wilt survival and development in the rhizosphere of potato (Johnson and Curl ,1972)

Table 9. Population of Ralstonia solanacearum (10^7 cfu) g. soil before and after planting with potato.(2001).

Treatment	***Rastonia. solanacearum* population (10^7 cfu) in the soil**							
	Before planting.		**30DAP**		**60DAP**		**90DAP**	
	.V	**AV**	**V**	**AV**	**V**	**AV**	**V**	**AV**
Seed selection resulting by researcher	0.30	2.70	1,30	3.80	1.70	3.50	2.20	3.90
Seed selection resulting by Farmers practices	0.30	2.70	1.40	2.50	1.80	3.75	2.50	3.60

Note: cfu = colony form unit; dap =day after planting. V= virulent, AV= avirulent.

Effect of time frequency and kinds of rotation plants.

In three month maize rotation applied with *Pseudomonas fluorescens* a month after planting potato, the virulent population had a lower rate of disease development than the avirulent population and shown in table 10. Probably the root system of maize releases toxins for bacterial wilt

Table 10. Population of Ralstonia solanacearum (10^7 cfu) in the soil planted with maize.

Treatment	**Population of *Ralstonia solanacearum* (10^7 cfu) in the soil**							
	After potato		**30dap with maize**		**60dap with maize**		**90dap with maize**	
	Virulent	**Avirulent**	**Virulent**	**Avirulent**	**virulent**	**Avirulent**	**virulent**	**Avirulent**
Maize+ Pf	1.20	2.60	0.05	7,75	0.02	1.75	0.01	9.50
Maize+Pf	1.56	2.30	0.04	9.50	0.02	8.00	0.00	10.00
Maize+Pf	1.90	1.70	0.02	9.50	0.01	7.55	0.01	10.50
Maize+Pf	1.10	3.50	0.02	5.50	0.01	7.75	0.04	7.75
Maize+Pf	1.35	3.50	0.03	10.50	0.04	9.50	0.03	10.50
Maize+Pf	2.00	2.90	0.04	10.50	0.03	8.65	0.03	10.50

The bacterium's population decreased following three month each of beans and cabbage rotation (Table 11) The three months beans rotation and three months cabbage

Table 11. Population of Ralstonia solanacearum (10^7 cfu) in the soil, planted with beans and cabbage as rotation crops

Treatment	Pop.of Vir and Avir BW after maize		Virulent population of BW(10^7 cfu)/g soil			Avirulent population of BW (10^7 cfu)/g soil		
	90dap	90dap	30dap	60dap	90dap	30dap	60dap	90dap
Potato	0.10	9.50	0.01	1.50	2.00	10.70	12.00	11.50
Cabbage	0.00	10.00	0.02	0.05	1.50	22.30	22.50	21.50
Beans	0.10	10.50	0.02	0.04	0.04	20.20	28.00	37.50
Potato+Pf	0.04	7.80	0.03	0.04	0.03	10.50	21.50	20.20
Cabbage+Pf	0.03	10.50	0.03	0.04	0.04	20.30	22.00	21.50
Beans +Pf	0.04	10.50	0.03	0.03	0.04	20.20	.40.40	55.20

Note: Vir=virulent, Avir+ avirulent, CFU= colony form unit., g= gram, BW= bacterial wilt. Population of Bacterial wilt recorded from the average from two petri dish

rotation, applied with the antagonistic microorganism *P fluorescens*, reduced the population of *R.solanacearum* at 30, 60 and 90 day after planting. It is probable that the population of beneficial microorganism was supported nutritionally the rotation crop, as reported by Johnson and Curl (1972).

Field sanitation and weed control by mulching

Weeds collected in the plots were *Drimaria cordata, Galinsoga perfoliatum, Bedens pilosus, Ageratum conyzoides, Aranthus spinosus, Oxalis sp, Popygonum sp, Datura stramonium, Cyperus sp* and *grasses*.

Generally vegetative growth of potato has shown good appearance. Its was shown 115 cm height and 51.8 cm diameter of canopy (using black silver plastic mulch) but its was 100 cm height and 40.5 cm canopy diameter (2 times hand weeded was used, one month intervals). Differences of heigh and canopy diameter on untreated,probably caused by nutrition competition penetrated with weeds has grown surrounded main crop (potato) was applied to the soil. Important weeds control of potato has caused competition of space.(Abidin, *et al.,* 2000).

The use of mulch suppressed weed growth and development, eliminated space competition, and allowed the soil nutritients to be solely taken by the crops. Abidin et al (2000) observed that weed used more nutrients than main crop, resulting in low yield for the crop. The use of mulch maintains soil relative humidity and helps roots penetrate the soil, among other things (Cortbaoui 1997) The differences of yield between treated and untreated of mulch and there were several pests and diseases in the plot where BSP mulch was used shown in Table 12

Organic manures decomposed with *Trichoderma spp.* and *Lactobacillus spp.* included chicken manure, sheep manure, cow manure, horse manure and paddy straw compost. Height of plants applied with the EM – decomposed organic manure varied from 95-102 cm while canopy varied from 40-45 cm. The untreated plants had heights and canopy diameters of 75-80 cm and was 40-43 cm. respectively, 90 days after planting. All plant looked healthy, and plants treated with manure showed more vegetative growth (Table 13). Yield of tuber tretaed with organic manure was higher than from untreated plants(Table 14). Probably the organic manure decomposed with EM has improving the nutrients intake by plantsand has utilized for it photosynthetic. .

Table 12. Effect of black silver plastic mulch (BSP)treated and untreated on yield pest and disease on tuber.(2001)

Treatment	**Tuber yield/plant(kg) and percentage of infected plant**						
	Healthy yield/kg	**Percentage of infected tuber**					
		R.sol.	***E.car.***	***F.oxy.***	***P.oper.***	***Gryl.***	**Nem.**
BSP mulch	1.70	0.30	0.5	0.4	0.2	0.2	0.2
Without BSP mulch	1.00	0.20	0.7	0.3	0.5	0.1	0.2

Note: *R.sol = Ralstonia solanacearum, E.car = Erwinia carotovora, F.oxy= Fusarium oxysporum, P. oper= Ptheriomaea operculella, Gryl= Gryllotalpa,* Nem= nematoda

CONCLUSIONS

1. *Ralstonia solanacearum* collected from the soil and weeds belonged to Race 1 Biovar 3 and those collected from infected tuber and stems of potato belonged to Race 3 Biovar 2. All the samples showed high virulence.
2. Pathogenisity test showed that all the bacterial wilt isolates were virulent to tomato and potato and less virulent to pepper, ginger and eggplant.. All isolates were positive using NCM ELISA.
3. Seed selected four times in a monthly interval in the store and once before planting resulted in plant with strong and healthy vegetative growth no latent infection.
4. Sprouts of seed when placed in Diffuse Light Store showed was improved quality
5. Black silver plastic (BSP) mulch reduced the development of weeds, pest and disease.
6. Virulent *R.solanacerum* population declined following 3 month maize rotation. Avirulence was increased. in the rhizosphere of maize.
7. The rate of disease development was lower following a 3 month rotation each of maize, beans and cabbage, that was applied with *Pseudomonas fluorescens*. Soil management, land sanitation, and weed control with BSP mulch were also employed. Compared with hand weeding the use of BSP increased plant health and produced clean tubers. The BSP mulch suppressed weed growth, smoothened soil structure, made potato harvesting easier, showed cleaner potato yield, maintained relative humidity, and prevented soil erosion.
8. The IPM method lowered the intensity of pests and diseasesSanitation using plastic mulch suppresed of weed, was smooth of soil struture, harvested of potato more easier, cleaned yield of potato was maintained of relative humidity and soil erosion.
9. Using manure decomposed with *Trichoderma spp* dan *Lactobacillus spp* resulted healthy plants .

Table 13. Vegetative growth of potato plants after using organic manures decomposed with Effective Microorganisms (EM)

Treatment	Plant height (cm) and canopy (cm)					
***Trichoderma spp* applied to:**	**30 dap**	**60 dap**	**90dap**	**30 dap**	**60 dap**	**90 dap**
Chicken	25.5	60.5	105.0	21.2	35.0	42.0
Sheep	25.0	64.0	107.0	22.2	34.0	45.0
Cow	25.0	65.0	98.5	21.2	32.4	43.0
Horse	25.0	63.0	95.0	21.4	30.2	44.5
Paddy straw compost	26.0	65.0	110.0	21.4	33.5	44.5
Lactobacillus spp applied to:						
Chicken	25.0	62.5	101.0	22.2	30.2	40.2
Sheep	25.0	60.2	100.5	23.0	33.2	42.0
Cow	26.0	65.0	91.0	22.6	32.0	40.2
Horse	25.5	60.0	90.0	22.4	30.5	40.2
Paddy straw compost	25.5	60.0	105.0	22.5	30.5	40.0
Untreated						
Chicken	23.5	55.5	85.2	20.0	30.0	35.0
Sheep	25.0	53.4	83.2	21.0	29.0	39.0
Cow	25.0	52.0	85.0	20.5	29.0	39.0
Horse	25.0	49.7	80.0	22.0	30.0	36.0
Paddy straw compost	25.0	50.0	83.3	20.2	30.0	35.5

Table 14. Production comparative among *Trichoderma spp*, *Lactobacillus spp* treated and untreated.

	Rate of Yield of Potato using different manures of (Kg)				
Treatment	**Chicken manure**	**Sheep manure**	**Cow manure**	**Horse manure**	**Paddy straw Compost**
Trichoderma spp	0.80 -1.10	0.80-1.10	0.90- 0.95	0.75-1.00	1.00- 1.10
Lactobacillus spp	0.90 -1.00	0,95-.0.95	0.80-.0-90	0.75–0..80	0.90- 1.00
Untreated	0,80-1.00	0.70-1.00	0.80 -0.85	0.75-0.80	0.90-.0.95

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INTEGRATED FARMING SYSTEM AT VARIOUS AGRO-ECOSYSTEM IN CENTRAL KALIMANTAN

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ABSTRACT

Upland area in Central Kalimantan mostly cultivated for estate crops, and upland rice and corn. This climatic condition is favorable for upland rice; however, the soil condition in upland area is mostly marginal and rice productivity low due to: (1) low chemical and biophysical capacity of the soil, (2) High rainfall causing high loss of nutrition through erosion and leaching, and (3) most farmers practiced shifting cultivation that need minimum inputs.

The family income from applying the cropping pattern at Tidal swampland, soybean - vegetables in the dry season, and rice – soybean in the rainy season are Rp. 9.873.500 and 8.887.000, respectively. The family income gained from raising cattle is Rp. 816.000. Therefore, total family income due to applying the cropping system is Rp. 19.586.000,-. The result of the assessment indicated that introduced Rice – fish – cattle integrated system at Irrigated lowland increases farmers' income from Rp. 8.548.000 to Rp. 22.986.500. Higher income caused by increases rice yield at the second planting than the first, since the fish is harvested at the second season and rice damage is lower at the second season. Rice productivity are 3.4 t/ha and 5.3 t/ha, respectively; while that in the traditional farmer practice rice productivity are 2.7 t/ha and 4.3 t/ha respectively. The result of this study of rice/ corn – cattle integrate system in upland areas indicated that. The corn adaptive variety is Semar-10 and the best fertilizer was P2 = 200 kg urea + 100 kg SP36 + 100 kg KCl + 1.500 kg compost; which gave corn seed yield increase as much as 6.83 ton/ha with R/C ratio 2.72. The rice adaptive variety is Situpatenggang and the best combination of fertilizer is P2 = 200 kg urea + 50 kg SP 36 + 50 kg Kcl + 1.000 kg compost ; which gave rice seed yield increase as much as 4.65 ton/ha with R/C ratio 2.12. The average body gain for female and male cow were 0,28 kg/cow/day and 0,48 kg/cow/day respectively, fed with grass and cow straw application. The lack of vigorous male cow caused the reproduction activity was disturbed. The cows cared in stable make easer to collect the faces and their productivity reached average 7.5 kg fresh weight/head/day.

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INTRODUCTION

Central Kalimantan province covers an area of 15 million ha of which 11.080.360 ha is potential for agriculture and fisheries. Potential upland areas for agriculture are 4.781.210 ha, and only 1.794.955 ha has been cultivated. The tidal swampland that potential for agriculture is 4.131.350 ha; however, food and horticultural crops ha have cultivated only 133.091. Agriculture production planted in the rain fed and irrigated lowland areas that covers an area of 104.411 ha and 89.091 ha, respectively.

Upland area in Central Kalimantan mostly cultivated for estate crops, and upland rice and corn. Rainfall depth in the upland area ranges between 2500 – 3000 mm with 2 – 3 dry - month a year. This climatic condition is favorable for upland rice; however, the soil condition in upland area is mostly marginal, rice productivity low. This low productivity might be due to: (1) low chemical and biophysical capacity of the soil, (2) High rainfall causing high loss of nutrition through erosion and leaching, and (3) most farmers practiced shifting cultivation that need minimum inputs due to most upland area degraded after several years of cultivation.

Soil condition in the tidal swampland is also marginal. Swamp land classified into type A, if they are directly influenced by sea tides and flooded during spring and neap tides; type B if they are directly influenced by sea tides, but only flooded during spring tides; type C if they are influenced by sea tides only trough water infiltration in the soil; and type D if they are not affected by sea tides at all. On the other hand, based on their constraint for agriculture purpose tidal swamp land can be classified into (1) potential soil, if their surface layers range between 0 – 50 cm, pyrite content is about 2 % and has not yet been oxidized and acidified. (2) acid sulfate soil if the pyrite layers or sulphidic within 0 – 50 cm below soil surface and all soil that have sulfuric horizon even if their pyrite layers found at more than 50 cm below soil surface, (3) peat soil are those that have peat layer at various thickness ; and (4) coastal or saline soils are those that are affected by sea water intrusion more than 4 month a year and soil Na content between 8 – 15 %.

Rice and secondary crops can be planted in tidal swamp type B and C that dominated by actual acid sulphate soil. This type of soil contain pyrite layer at < 50 cm below the soil surface. Drainage that lowers the water level below the pyrite layer will create aerobe condition. The pyrite will be oxidized and released sulfuric acid and ferric iron. This will create acid condition in the soil that pushes the mineral clay to release aluminum, which becomes toxic to plants. In the acidification process, cation such as Ca, Mg, and K leached therefore, this type of soil are very acid and have low nutrient.

In irrigated lowland areas, less biophysical constraints are found. Water can be controlled, and most irrigated lowlands have been cultivated for rice successfully. Rice cultivation in irrigated lowland planted twice a year. However in irrigated lowland of Central Kalimantan, rice have been planted once a year with productivity 2,6 t/ha lower than the national average rice productivity up to 4,3 t/ha. This low productivity is due to the low skill of local farmers on rice cultivation in irrigated lowland and less intensive technology application.

Having both biophysical and socio-economic constraints in the three agro ecosystem, we need to introduce proper farming system that minimize the constraints, increase productivity of some commodities, lessen the external input and use local resource as much as possible, and at the end increase farmers income and welfare. In this paper, we introduce the assessment of three farming systems in the three agro-ecosystems in Central Kalimantan. The three farming systems are: (1). Rice – soybean/ vegetables – cattle system at tidal swamp areas, (2). Rice – fish – cattle system in irrigated low land, and (3). Rice/ corn – cattle system in upland.

Rice – Soybean / vegetables – Cattle System, at Tidal swampland

The core technologies in the system are (1) land preparation for optimal land-uses and water management purposes, and (2) cropping pattern, which was combined with cattle to improve better farm management practices at farmer's backyard. The two technologies are synchronized in order to optimizing land uses, maximize farmers' income, and reduce external input.

The tidal swamplands in the areas classified as C flooding type i.e., not directly influenced by both spring and – neap tides. They are influenced by sea tides only through water infiltration in the soil that increase the water levels. The rainfall has more effect on the water levels than the tides. The best land preparation methods for such type of tidal swampland is the so-called "sorjan" system that is by constructing raised – and sunken – bed. The sunken bed used for rice, while the raised bed for other crops that need dry – land such as soybean, vegetables or pasture. Having such a land construction we could diversify or mixed the crops planted at raised bed in such a way that the land uses are optimized and farmer's income increase. The crops include pasture will be used as feedstuff for cattle. This is a way that cattle farming enter the farming system.

The manure produced by the cattle used as organic fertilizer for the vegetable crops. We have conducted a two – year experiment to assess the suitability of the system in Bungai Jaya village, Basarang sub district of the Kapuas district. There are 20 farmer is participating in the study each owned 0.5 – 1.0 ha of land. Total area for the experiment is 13 ha planted with rice at the sunken bed are those that tolerant to high soil acidity, i.e., Margasari and Martapura. These two varieties are specifically developed for tidal swampland. At the raised bed, lowland vegetables such as eggplant cucumber and long-bean are planted. At the edge of the raised bed is planted with pasture such as setaria grass for cattle feed.

Due to high acidity at the sunken bed external input needed such as lime. However, the amount of lime applied is substantially reduced since the rice varieties that were planted are those that tolerance to soil acidity. At dry season, the sunken – bed were also planted with acid tolerant soybean varieties, i.e., lawit and manyapa. Inorganic fertilizer application was also reduced after applying organic fertilizer such as cattle - manure. Most farmers participating in the study raise cattle in their lawn. To feed the cattle, they cut grass from other location. Usually, woman farmers bring their fresh vegetables to the nearest market in Kapuas, on their way back home they bring the cutting grass to feed their cattle. This as however, will limit the amount of grass for cattle – feed. By incorporating pastures such as setaria in their cropping pattern, the amount of grass for cattle feed will substantially increased and the need for organic manure is covered. The details of the introduced technology are presented in Table 1.

No comparison is made between the family income of participating and non-participating farmers, since the location have long been abandoned by farmers due the degradation of the soil fertility in the area. In the early years after its opening (1963 – 1968), rice productivity in the area ranges between 3 – 3,5 t/ha. Since 1969, the productivity decrease, and in the 1990-iest the productivity is only 0,5 t/ha. This low productivity is due to high soil acidity caused by peat layer burning so that the pyrite layer come up to the surface. This low productivity caused many farmers abandoned their land and seek other job in nearest city or cultivate other land far away from their home. The purpose of this experiment is to introduce the farming system, which is expected to be sustained in the area.

We have record on the income gained by participating farmers. Before this technology introduced, farmers planted cassava on their land, and their family income as much as *Rp*. 6.000.000,. The family income from applying the cropping pattern soybean - vegetables in the dry season, and rice – soybean in the rainy season are *Rp*. 9.873.500 and 8.887.000, respectively. The family income

gained from raising cattle is *Rp*. 816.000. Therefore, total family income due to applying the cropping system is *Rp*. 19.586.000,-.

Table 1. Technology component for each commodity applied in the Rice – Soybean/ Vegetable – Cattle System at Tidal swampland.

No	Commodities	Technology Components
1.	**Dry season** : *Soybean* (planted at the sunken – bed)	▪ Minimum tillage and herbicide application for land preparation ▪ Lime application, dolomite 1 t/ha ▪ Lawit variety ▪ Fertilizer application : urea 50 Kg/ha, SP-36 100 kg /ha and KCl 50 kg/ ha ▪ Seed treatment with rhizogen 15 gr/ 10 redd ▪ Planting distance : 40 cm x 20 cm
	Vegetables (planted at the raised – bed)	▪ Variety : cucumber (*mustang*), eggplant (*venus*) and or long – bean (*sainan*) ▪ Liming 1,0 t/ha ▪ Fertilizer: urea 100 kg/ha, SP-36 100 kg/ha, KCL. 200 kg/ha, manure 5 t/ha.
2.	**Rainy Season** *Rice* (planted at the sunken – bed)	▪ Minimum tillage ; cleansing of some soybean remains ▪ Liming urea 150 kg/ha; SP-36 150 kg/ha; KCl. 100 kg/ha . ▪ Transplanting at 21 days after seedling ▪ Planting distance : 20 cm x 20 cm
	Corn (at the raised – bed)	▪ Fertilizer : urea 200 kg /ha ; SP-36 kg /ha ; KCl 100 kg /ha ▪ Direct planting, two seed/ hole ▪ Planting distance : 75 cm x 20 cm
3	**Cattle Raising**	▪ Cattle race : *Bali* ▪ Duration of cattle raising : 4 month ▪ Feedstuff : concentrate 1 kg ▪ Bio plus 0,5 kg

Rice – Fish – Cattle Integrated System, Irrigated Lowland

In irrigated lowland, water depth can be controlled so that fish can be cultivated at paddy – field. By planting rice at regular distance, we have enough space for culturing fish within the rice stand. Fish can be raised by constructing fish – pond at the middle of paddy field. This system, called the "mina – padi" (Rice cum fish) has been practiced in many areas and was introduced at irrigated lowland in *Barito Utara* District in Central Kalimantan. Cattle was incorporated into the system, fermented Rice straw used for cattle – feed, while the cattle produce manure and used for organic fertilizer. In addition fish food left – over and their faces are an organic fertilizer for rice field. In details, the technology components for the system are shown Table 2.

Table 2. Component technology for rice- fish-cattle integrated system in irrigated lowland.

No	Commodities	Technology Components
1.	**Rice**	• Variety : Ciherang • Seeding : wet seeding • Land preparation : using hand – tractor • Planting distance : 20 x 20 cm ; at each four rows, the border rows are planted with distance 20 x 10 cm • Fertilizer : Based on soil analyses and leaf – color chart
2.	**Cattle**	• Feedstuff : greenery, fermented rice straw and concentrate • Cage : cleaning regularly ; good sanitation
3.	**Fish (*Nila* Gift)**	• Cultured at the drainage canals at 40 – 45 cm wide and 25 – 30 cm depth • Commercial feedstuff given twice a day • Density : 50000 fish/ ha, broadcasted 2 weeks after rice planting

The system was assessed at Trahean village, central Teweh sub district of Barito Utara Districts, At this village an irrigation dam was built in order to irrigate 600 ha rice – field in rainy season and 200 ha in dry – season. This village is expected to be the rice production center in the Barito Utara district. Most farmers in this village are transmigrated farmers. They have experiences in rice farming. Some local farmers have gained experiences in farming from the transmigrated farmers as well as develop their own experience. Inter-ethnical assimilation process runs very well in this village.

Most farmers in the area practiced monoculture farming, i.e., they plant rice in the field, raise cattle and fish in the fish – pond in their backyard. They planted local rice varieties with irregular planting distance, and land is prepared with hand – tractor, while the rate of fertilizer application ranger between 50 – 100 kg/ ha for urea, 50 – 75 kg of SP-36 and 25 kg of KCl. These fertilizers broadcasted over the field. Cattle raise are mostly for additional income or saving purposes and the cattle are mostly feed with local grass.

There are eight farmers participating in the assessment process. Each of them has about 0.25 – 0.75 ha of land and one head of cattle. Four out of the eight farmers raised fish in their rice-field at density 5000 fish per ha. To compare the introduced technology and the traditional one, 5-8 non-participating farmers in the area where chosen. Financial analysis, especially the Marginal Benefit Cost Ratio used to compare the two technologies (on farming system).

The result of the assessment indicated that the introduced farming system increases farmers' income from Rp. 8.548.000 to Rp. 22.986.500. Higher income caused by increases rice yield at the

second planting than the first, since the fish is harvested at the second season and rice damage is lower at the second season. Rice productivity are 3.4 t/ha and 5.3 t/ha, respectively; while that in the traditional farmer practice rice productivity are 2.7 t/ha and 4.3 t/ha respectively.

The higher income of the participating farmers in the introduced system) is also contributed by the cattle raise and fish culture. The sale of cattle give Rp. 709.000 after three month and give additional family income is only Rp. 478.000. The fish culture gives additional family income Rp. 9.476.500 for the introduced system

Rice/Corn – Cattle Integrate System in Upland Areas

The problems of farming system in dry land area of Central Kalimantan were caused by unfertile soil, low organic matter, and high acidity. Organic fertilizer or compost is very important in this area, while the excess of using inorganic fertilizer is not only increase production cost, but also decrease soil productivity. The organic fertilizer stock is still limited and supplied from other provinces. This problem might be solved by introducing crops – livestock integrated farming system, which also can increase livestock as well as food crops production in Central Kalimantan.

Smallholder farmers that traditionally practice integrated crop and livestock production systems applied minimum inputs on their farm. Crop production is the main farm activity, usually as the main source of food, while animal production is more for savings proposes. Majority of farmers grow rice as main crop during the wet season, and during the dry season, corn is the dominant crop.

Integration of crop and livestock system has been intensively developed in recent year; it was improved existing technology and being developed for agriculture sustainable purpose. The principle of the system was using technology which able to utilize local resources efficiently, i.e.: crops residue and manure. The model was implementing Low External Input Sustainable Agriculture (LEISA) approach. Crops and its by-product being used as feed and animal manure as fertilizer. In another word, the synergism of this pattern was that output (by-product) from one subsystem of production becomes an input in other subsystem.

A study conducted in dry land areas of *Rodok* village, *Dusun Tengah* sub district, *Barito Timur district*. In this location, farmers previously have never used compost (organic) fertilizer for their crops, and straw of paddy used as feeding for their cattle.

The purposes of the study were :

1. to know the adaptation of high yielding varieties of paddy and corn in dry land rain fed areas,
2. to introduce and adapt improved feed production for ruminants,
3. to introduce manure processing and empowering the farmers to produce available compost year round and adapt applicable compost,
4. to find out the technology component of paddy or corn - livestock integration system in dry land rain fed areas.

The fertilizer application rates technology, which has been introduced on adaptive test of corn varieties (*Sukmaraga, Lamuru, Semar* 10) and rice (*Towuti, Situbagendit, Situpatenggang*):

1. P1 = 100 kg urea + 100 kg SP36 + 100 kg KCl. + 3.000 kg compost,
2. P2 = 200 kg urea + 100 kg SP36 + 100 kg KCl. + 1.500 Compost,
3. P3 = 250 kg urea + 125 kg SP36 + 75 KCl.
4. and for paddy
5. P1 = 100 kg urea + 50 kg SP36 + 50 kg KCl. + 2.000 kg compost,
6. P2 = 200 kg urea + 50 kg SP 36 + 50 kg KCl. + 1.000 compost,
7. P3 = 250 kg urea + 150 kg SP 36 + 100 kg KCl.

The other technologies introduce are: farm manure processing, straw fermentation processing for cattle feed, and stable group management. The observed parameter to evaluate the study covered: soil, crops, livestock and integrated resources management system.

The result of this study indicated that the soil fertility was low due to low macro element and high soil acidity. The corn adaptive variety is Semar-10 and the best fertilizer was P2 = 200 kg urea + 100 kg SP36 + 100 kg KCl + 1.500 kg compost; which gave corn seed yield increase as much as 6.83 ton/ha with R/C ratio 2.72.

The rice adaptive variety is *Situpatenggang* and the best combination of fertilizer is P2 = 200 kg urea + 50 kg SP 36 + 50 kg Kcl + 1.000 kg compost ; which gave rice seed yield increase as much as 4.65 ton/ha with R/C ratio 2.12.

The average body gain for female and male cow were 0,28 kg/cow/day and 0,48 kg/cow/day respectively, fed with grass and cow straw application. The lack of vigorous male cow caused the reproduction activity was disturbed. The cows cared in stable make easer to collect the faces and their productivity reached average 7.5 kg fresh weight/ head/ day.

Financial analyses not calculated yet, since the application of the system is still ongoing processes. However, by using high yielding rice and corn varieties and applying compost (organic fertilizer), expected that production and income of the farmers increase significantly. Manure of cattle, which previously has never used as fertilizer by farmers, could give big contribution toward higher production and increasing their income. The impact of the technology intervention could be seen in a farmers group (Bali I). They process the manure from their cattle and used as fertilizer or sold to other farmers. The processing of manure was conducted together and the profit of selling manure was used for farmer group spending which are decided in a meeting.

he problems on applying integrated farming system were the reluctance of some farmers to raise their cattle in a stable group. They prefer individual stable, although they recognized the advantage of raising cattle in the stable group such as: easy to manage cattle in term of disease, feeding, reproduction, etc and manure collection.

CONCLUSION

The three integrated farming system introduced above have three things in common : (1) They lessen the external production input by synergized the commodities cultivated in the system in term of by-products and feedstuff or fertilizer ; (2) They optimize the use of land, and (3) They increase farmers income by increasing the productivity and diversifying the commodities. In principles, many choices of commodities are available depending on the market availability. Hence farmers participation is needed in choosing what kinds of crops or livestock to plant or raise in their farming system. Our assessment begins with Participatory Rural Appraisal to accommodate farmers' choices of crops and livestock for their farming system.

The adoption of the introduced technology needs about two to three years of dissemination, extension and trainings. Several problems might hamper the adoption process. The three systems still required external support on production input such seeds, fertilizer, fish seedling or livestock. The availability of such inputs might still problem in some area in Central Kalimantan. They also need capital support to implement the system that they will used. In addition, the system also requires intensive farm management guidance that might not be favorable for local farmers. They used to have non-farm or off-farm job, and farm management. Therefore government intervention, in term of providing, loan, infrastructure construction and extension are still needed.

AGROBUSINESS SPATIAL LAYOUT BASED ON AGROECOLOGICAL ZONE (AEZ) IN CIWIDEY HIGHLAND

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ABSTRACT

Detailed information on land resources was necessary to develop an agribusiness-based farming system. AIAT at West Java conduct research on agribusiness spatial management for the Ciwidey highland based on agro ecological zone (AEZ). Methodology used was field survey for soil and social economic aspects, and laboratory analysis. Soil mapping used to give detailed information of land resources. The information collected was used to identify the alternative agribusiness farming system in the highland of Ciwidey. The Output of this research are : Ciwidey soil map as main source for soil land resources analysis; the evaluation of land suitability and potentiality for selected commodities; agriculture spatial layout of Ciwidey, and land use recommendation for agribusiness development in the highland, in the scale of 1:35.000.

Key words: Spatial soil layout, agro-ecological zone, highland agro-business,

[1] Researchers and Extension's in West Java AIAT.

INTRODUCTION

Conversion of productive agriculture land into industrial estate, shown as an ineffective policy to support food security in Indonesia. Agriculture development planning and policies should be oriented on agriculture development vision and mission, and various constraints (Karama, 1999). The agricultural development vision is to create modern, strong, efficient, and sustainable agriculture, whereas, farmers as an actors in agribusiness. The agriculture mission was to empower agricultural community towards self-reliance, prosperous, and civilized community.

The availability of land resources information is required to support the achievement of agriculture development vision and mission. The detailed data on land resources information can be collected through soil mapping research. Detailed soil and land resources information was important factor for preparing agribusiness and farming system project plan. AIAT in Lembang has conducted an agribusiness agricultural layout in the high land based on agro ecological zone (AEZ) in Ciwidey, Bandung district.

The objectives of the research are 1) to conduct identification, characterization, and evaluation of land resources for highland agribusiness farming development, 2) to provide Ciwidey soil map as source of land information, 3) to conduct land suitability map for selected commodities, 4) to provide agricultural layout map for Ciwidey area, and 5) to recommend Land-use for highland agribusiness, on the scale of 1:35.000.

METHODOLOGY

Methodology in this research was to collect on soil/land resources data through soil mapping. The mapping was based on the previous related study, Survey and Semi detailed soil mapping for priority area (CSAR, 1996). The approach used were *landscape mapping*, delineation of land unit based on landsatelite photograph interpretation. The research consist of 5 phases, namely: 1) preparation, 2) field verification, 3) analysis of soil sample,4) data processing, and 5) reports.

Preparation

The activities covered collecting materials and tools, photograph interpretation, and other supporting maps. Landsatellite photograph interpretation was conducted in order to determine land unit that consists data on landform, lithology, relief, steepness. Delineation of land unit was based on surface image differences that affected by relief, litology, erosion, density, and drainage (Goosen, 1967). The classification of landform unit was based on technical report LREP II no.05 verse 2 (Marsoedi et.al., 1996).

Land use delineation on the land satellite photograph was based on tone, density, pattern, and intensity. The division was based on technical report LREP II no.04 (Wood *et.al.,* 1995).

Field Verification

Field verification was conducted within 15 days by soil team and social economic team. The task of Soil team was to obtain distribution, potential, constraints, and the possibility of land resource development, soil fertility, climate and hydrology. Social economic team was to obtain information on agricultural activities, and farming.

Soil morphology was based on *Guidelines for Soil Profile Description* (FAO, 1978) and *Soil Survey Manual* (Soil Survey Division Staff, 1993). Soil classification was determined to the Family category of *Soil Taxonomy* (Soil Survey Staff, 1998).

Soil analysis method followed *Soil Survey Investigation Report No.1* (Soil Conservation Service, 1985), TOR of technical report No.3 LREP II (1994).

Data Processing

Land unit description was filed on land unit (LU) data. Mapping was conducted through *Geographic Information System* (GIS), Land suitability for selected vegetable was based on *A. Framework for Land Evaluation* (FAO, 1976). For accuracy and speed of land suitability evaluation, an expert system was used, *Automated Land Evaluation System* (ALES) verse 4.65 (Rossister *et al.,* 1997), that evaluated physically and economically. The land suitability evaluation classified as class and subclass. There were four classes, very suitable (S1), suitable enough (S2), marginally suitable (S3), not suitable (N). Subclass considered constraints for crop growth, written as symbols beside the class.

DISCUSSION

Land Resources

Soil analysis showed that Ciwidey soil developed from pyroplastic material containing volcanic glass. Secondary mineral formation was not perfect, resulted in instability of mineral structure and water. Ciwidey soil characterized as andic, dominated by alofan imogolit, known as amorf materials, has less than 25% organic carbon.

Soil dominated by alofan and imogolit has the benefit of high surface density, high fine pores in mineral structure, and high mineral preserve. The disadvantages were it was reactive to anion phosphate, resulted in high P retention (> 70 %). This type of soil has low volume weight (< 0.9 g/cc), rapid permeability, and flocculation, resulting in irreversible character.

Land resources in Ciwidey were potential for highland crops, horticulture or estate crops. The constraints can be eliminated with organic fertilizer and phosphate. The field observation showed that the use of organic fertilizer/manure (chicken litter) was very high (15-20 tons/ha/season), inaccurate of inorganic fertilizer, unwise pesticide application for its residues, (pesticide has many anions) that decreased the farmers income. Soil sample showed that it has high organic matter content and other macronutrient, but high P retention, so that the soil management was aimed to suppress reactive mineral of alofan and imogolit. At present farmers' use of manure, theoretically this was right solution, since organic manure reacted with Al and Fe to form chelate, reducing its reactivity, and increased P availability. However, the animal manure dosage was too high.

Soil analysis for upland and lowland for the 'old and new cultivated' gave significant differences on soil nutrient availability. For the new cultivated at upland, the animal manure dosage was 10-15 tons/ha for every planting, but after three years of cultivated, the dosage decreased to 3-5 ton/ha /planting. For the lowland and irrigated land, the dosage of animal manure was 2-4 tons/ha/planting. The animal manure application was to inactivate Al and Fe, but activate microorganism decomposing organic matter content.

The dosage of inorganic fertilizer depends on the crop type. Highland vegetable required different fertilizer dosage, therefore it needed special research for inorganic fertilizer dosage for top commodities in Ciwidey. Soil sample showed that micronutrient Ca and Mg classified as medium to high, no need for additional fertilizer. Nitrogen was necessary even though N content was medium, because the crop cultivated by farmers were vegetables which biomass was consumed. Nitrogen was not stable; therefore, its availability in the soil must be maintained.

Phosphate fertilizer was necessary for every planting even though only in small amount and not washed in the soil, due to amorf materials. The use of rocky phosphate was beneficial for upland that

had high P retention constraint; therefore, further detail research is needed in Ciwidey. Rocky phosphate release P slowly and effective on acidic soil with ph < 5.5. The dosage of rocky phosphate equals to 2-3 dosage of SP 36. The information of land resources presented in figure 1.

Agriculture Spatial Management

The management of spatial location was the effort to optimize the use of the area considering environmental friendly due to development.

The segmentation of agriculture spatial management in Ciwidey was based on the 'Rencana Tata Ruang Wilayah Kabupaten Bandung' or the Spatial Management Planning of Bandung District (scale: 1:50.000), Map of Perambahan Hutan G. Tambak Ruyung, (scale 1:25.000), Topographic map (scale 1:25.000), detailed soil map (skala: 1:25.000), and land-use map *(Present Land-use)* which were overlaid each other.

Based on the overlaid maps, Ciwidey sub district divided by 5 zones, namely (1) Agriculture production area; (2) Conservation production area, (3) Conservation area; (4) Estate area; and (5) Protection area. The agriculture spatial lay out for Ciwidey presented in Figure 2.

Agriculture Production Area

Production area suitable for high land horticulture crops. such as Potatoes, Carrot, cauliflower, leaf onion, Long-bean, Celeries, and Tomatoes. The communities had intensively developed this agriculture production area. Ciwidey flat area is the one of vegetable production centre. In this area, farmers have applied soil and water conservation technique such as terraces and irrigation system for paddy. This vegetables production area located in Eastern North part of Ciwidey covering of Panyocokan, Ciwidey, Panundaan, Alam Endah, Suka Wening, Rawa Bogo, and Lebak Muncang villages with total area of 5.436 ha or 27.85 %.

Conservation Production Area

This conservation production area planted with Pine forest. Surrounding community did cultivation in this area, however, from land resources aspect, this activities was risky to environmental degradation. Considering in the steep land with alofan and imogolit, this area easily eroded by water flow. Soil in Ciwidey has great potential of erosion since it has irreversible character in maintaining water content. The possibility of erosion increased with changing of single forest commodity into agriculture crops cultivation and with high rainfall intensity. Therefore, conservation efforts were important specially in the area that already cultivated by the communities. Based on the degree of management, this area was dividing into two region, namely conservation area with conservation model I and conservation area with conservation model II. Conservation model I was small terraces and bed as alley cropping such as King Grass, with small terrace spacing of 10 m and reforestation trees such as rasamala, pine, and kayu putih. While in conservation model II, was small terraces and bed, with small terrace spacing of 4.5 m and with reforestation trees such as rasamala, pine, and kayu putih covered 1.283 ha or 6,57 %.

Conservation Area

Conservation areas were located along the rivers and steep land; conservation method need to apply to keep its land-resources functioned. This area was to keep the function of the protected area, to control cultivation activities, and to observe hydro-orology conservation norms. This area was obtained in the very steep land (> 40 %) with shallow and rocky soil, usually used for tea plantation estate or bushveld. It was necessary to enrich biodiversity in the bare land or bushveld to optimize the area function. The total conservation area was 1.843 ha or 9.44%.

Estate Area

The estate area consists of smallholder estate and company estate, such as tea and quinine. Tea estate has been cultivated for many years and several rejuvenation. The distribution area covered villages Patengan, Indragiri, Sukaresmi, and parts of Cipelah with the area of 7.564 ha or 38.75%.

Protection Area

This area has natural resources, soil, water, plants, and animals that cultivation was not allowed. The protection area in this experiment was based on the Ministry of Agriculture decree No. 837/KPTS/Um/11/1980 that this area must be maintained for hydrology for its surroundings. These areas have steepness more than 40% and registered as conserved area. The protection area in Cowhide located in hilly / mountainous area of M. Patuha, M. Kelotok, M. Tikukur, M. Tambagruyung, M. Bengbreng, M. Batu, Pasir Ciparay, Situ Patenggang. The area covered 2.547 ha or 13.05 %.

Land Use Recommendation

Land-use recommendation arranged based on the agriculture layout towards cultivation and conservation zone. The objective of land-use recommendation was to optimize the land-use considering land suitability, economic feasibility, and environmental friendly.

The land-use recommendation was divided to several Land Utilization Type (LUT) with the most economic cropping pattern choices from land productivity and yield aspects. Economic analysis from input output calculation made for every crops and shown in Tables 2 and 3.

Table 2. Financial Analysis For Various Cropping Pattern in Ciwidey.

Land Utilization Type (LUT)	Cropping Pattern	Income/ha/year (RP)
LUT-1	Rice-Rice	4,489,000
LUT-2	Rice – Leaf Onion	10,427,000
	Rice – Celeries	15,067,000
LUT-3	Leaf Onion-Celeries	21,005,000
LUT-4	Leaf Onion-Cauliflower	17,000,000
	Leaf Onion – Tomatoes	16,082,500
	Leaf Onion – Carrot	13,547,750
	Leaf Onion – Long bean	18,060,500
	Celeries-Cauliflower	21,640,000
	Celeries – Tomatoes	20,722,500
	Celeries - Carrot	18,187,750
	Celeries – Long bean	22,700,500
LUT-5	Cauliflower – Tomatoes	16,717,500
	Cauliflower – Carrot	14,182,750
	Cauliflower – Long bean	18,695,500
	Tomatoes – Carrot	13,265,250
	Tomatoes – Long bean	17,778,000
	Carrot – Long bean	15,243,250
	Cauliflower – Potatoes	17,775,000
	Tomatoes – Potatoes	16,857,500
	Carrot – Potatoes	14,322,750
	Long bean – Potatoes	18,835,500
	Potatoes	8,957,500
	Potatoes + Kons.I	8,957,500
	Potatoes + Kons.II	8,957,500

Table 3a. Financial Analysis for Selected Commodities in Ciwidey (Input)

Commodity	Input														Total input
	Fertilizer					Pesticides			supporting material	Labor		Seedling	Land rent	Other costs	
	Urea	ZA	TSP	KCl.	Manure	Herb	Fungi	Insect		Man	Woman				
Rice	0	0	382,500	0	0	33,000	0	0	0	1,275,000	350,000	240,000	200,000	25,000	2,505,500
Leaf Onion	660,000	0	0	0	2,625,000	0	45,000	0	0	712,500	350,000	5,400,000	200,000	25,000	10,017,500
Celeries	840,000	0	0	0	2,012,500	330,000	225,000	0	0	1,200,000	1,000,000	320,000	200,000	25,000	6,152,500
Cauliflower	480,000	550,000	255,000	180,000	0	0	225,000	250,000	0	937,500	450,000	330,000	200,000	25,000	3,882,500
Tomatoes	330,000	330,000	552,500	0	1,925,000	165,000	67,500	50,000	1,300,000	1,875,000	700,000	180,000	200,000	25,000	7,700,000
Carrot	240000	0	170000	0	1312500	66000	11250	0	0	840,000	1,150,000	120,000	200,000	25,000	4,134,750
Long bean	210,000	0	212,500	135,000	1,312,500	99,000	45,000	0	2,015,000	900,000	750,000	468,000	200,000	25,000	6,372,000
Potatoes	900000	0	1E+06	270,000	3500000	660000	0	0	0	1,762,500	450,000	7,200,000	200,000	25,000	16,242,500

Table 3b. Financial Analysis for Selected Commodities in Ciwidey (Output)

Commodity	Output			
	Prod	Price	Income/ha/season	
			Value of Production	Margin
Rice	4,750	1,000	4,750,000	2,244,500
Leaf Onion	14,000	1,300	18,200,000	8,182,500
Celeries	23,000	825	18,975,000	12,822,500
Cauliflower	12,700	1,000	12,700,000	8,817,500
Tomatoes	19,500	800	15,600,000	7,900,000
Carrot	19,000	500	9,500,000	5,365,250
Long bean	13,000	1,250	16,250,000	9,878,000
Potatoes	21,000	1,200	25,200,000	8,957,500

Based on the figure on Table 2 and Table 3, we can derive the analysis for instance in LUT-2 with the cropping pattern of Rice – vegetable I, the margin of farmer income is the sum of Rice + vegetables group I, therefore, the LUT-2 has the range of margin between RP. 10,427,000 -/ha/year, and RP. 15,067,000,-

Land-use recommendation in Ciwidey was divided into nine LUTs with various commodity choices in each LUT, namely:

- LUT-1 with the cropping pattern Rice-Rice
- LUT-2 with the cropping pattern Rice-vegetable I (leaf onion or Celeries)
- LUT-3 with the cropping pattern vegetable I-vegetable I
- LUT-4 with the cropping pattern vegetable I-vegetable II (cauliflower /Tomatoes/ Carrot/ Long bean)
- LUT-5 with the cropping pattern vegetable II-vegetable II
- LUT-6 with the cropping pattern vegetable II-vegetable III (Potatoes)
- LUT-7 with the cropping pattern vegetable III
- LUT-8 with the cropping pattern with the cropping pattern vegetable III + conservation model I (bed as alley cropping planted with King Grass, spacing of 10 meter) and reforestation trees (rasamala, pines, 'kayu putih')
- LUT-9 with the cropping pattern vegetable III + conservation model II (soil bed, bed spacing 4,5 meter) and reforestation trees (rasamala, pines, 'kayu putih')

Beside biophysical factor (soil and environment), economic factor was very important to be considered in Land-use recommendation. The determination of Land-use recommendation depends on respective input and output of the farming. Changes in input and output that determine Land-use recommendation (LUT) needs further assessment of ALES program. All research data was compiled properly subject to input and output changes to obtain fast and update LUT.

Information on Land-use recommendation shown in the Land-use Recommendation map (Figure 3).

CONCLUSIONS

The experiment area formed from rich mineral pyroclastic and good physical properties but with high P retention. Soil in Ciwidey sub district (USDA, 1998) classified to the Ordo Entisols, Inceptisol, and dominated by Andisols.

The use of inorganic and organic fertilizer (chicken waste), and pesticide was beyond soil holding capacity and resulting in less support for plant growth. The use of litter was beneficial to chelate not only Al and Fe, but also it has high P content.

The use of Phosphate rocks to supply P in the upland was promising due to P slow release and the cost was cheap compared with TSP and SP36, even though this analysis needed to be further calibrated for exact dosage.

The use of pesticide in the experiment area was unwise. The use resulted from keeping high production based on farmer's experience. This was the challenge for the researchers to convince farmers in the use of environmental friendly pesticides and even the use of organic agriculture to begin in the experiment area.

Land cultivation system mainly on the new cultivated land did not concern on soil and water conservation norms. The research results on Dieng high land can be tested in this area. The results that showed no significant production differences of applying conservation techniques in the steep land, needed further research.

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DEVELOPMENT OF INTEGRATED CROP AND RESOURCE MANAGEMENT OPTIONS FOR HIGHER YIELD AND PROFIT IN RICE FARMING IN INDONESIA

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ABSTRACT

Since the mid of 1980s Indonesia's rice area has remained almost constant or even decreased. To maintain rice production in this country, currently available technologies have been fully exploited and further intensification of rice production has conducted. This led to over-exploitation and degradation of soil and water resources in many areas. Therefore, it is difficult to sustain the annual production growth rate of 2.5 - 3.0 % to fulfil its demand. IRIR developed systems of rice intensification (SRI) and then it was scaled-up in 8 Provinces for local adoption and evaluation through a linked IRIR-AIAT research and development framework. To meet the location-specific needs, the IRIR-generated SRI technologies have been augmented by seven additional components to create a 12-component set of Integrated Crop and Resource Management (ICM) options. Lessons learnt from scaling up of ICM technology options were: (1) reducing production cost is a significant way of improving profit for rice farmers; (2) training of regional extension and development staff and farmers on the proper adoption of ICM technology options is critical for its success; (3) the farmers should understand not only the economic advantage of adopting the ICM technologies, but also their impact on resource base, environment quality, and livelihood; and (4) adoption of ICM technologies will increase the rice yield, promote the efficient use of inputs, reduce the cost of cultivation, and enhance net profit to farmers in intensively managed small farms.

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INTRODUCTION

Indonesia is the world's third-largest rice producer. During 1992-2002, the average annual rice production was about 50 m t from a harvested area of 12 m ha; the averages yield was 4.5 t ha-1. Rice production increased from 45 m t in 1992 to 51.8 m t in 2003 (BPS Indonesia statistics, various years). The declining trend in global and Indonesian rice production during 2001-2003 may be ascribed to a slackening consumer demand, crop failures, and particularly to declining rice price (FAO, 2002). Low price of rice implies low gross margins and unfavourable terms of trade. Low gross margins in rice farming are further aggravated by rising cost of cultivation due to high price and inefficient use of inputs - particularly N fertilizers (Balasubramanian et al., 2000, 2002; Zaini *et al.,* 2003).

Indonesia imported about 2 m t of rice every year during 1994-2001 (Sudaryanto *et al.,* 2001). With the low price of imported rice, Indonesian farmers lost their competitiveness due to declining domestic rice price, rising wages, and higher input (fertilizer and pesticide) costs.

Indonesia's rice area has remained almost constant since the mid-1980s. As yield gains from currently available technologies have been fully exploited, further intensification of rice production has led to over-exploitation and degradation of soil and water resources in many areas. Under these conditions, it is difficult to sustain the annual production growth rate of 2.5 - 3.0%. Given the importance of the rice sector in Indonesian economy, food security, and rural poverty alleviation, we need to find ways to further improve farm-level rice productivity and farmers' income and profit. This paper elaborates the system of rice intensification (SRI) program developed by IRIR, and then it scaled-up in 8 Provinces for local adoption and evaluation through a linked IRIR-AIAT research and development framework.

System of Rice Intensification (SRI) Initiative

As a part of an international SRI program, combinations of selected irrigated rice production technologies were investigated in research plots on vertic isothermic tropaquept soil at the Indonesian Research Institute for Rice (IRIR) at Sukamandi during four seasons (1997-1998). This research developed five options to increase rice yield: 1) use of young (15 d) and healthy seedlings; 2) basal incorporation of organic fertilizer at 2 t ha-1; 3) intermittent irrigation; 4) soil test-based application of P and K fertilizers; and 5) nitrogen fertilization guided by leaf color chart. These options were then verified in a 1-ha block of rice fields at IRIR during five successive seasons, commencing at the 1999/2000 wet season (WS). Package A combined the first 4 SRI practices plus N application as per national recommendation, and package B consisted of the first 4 SRI practices plus N application as guided by LCC. Compared to farmer's practice, the SRI Packages A and B increased the rice yield and returns/costs (R/C) ratio consistently and appreciably - by about 30% for Package A and 50% for Package B (Table 1).

As a follow-up to this research at IRIR, the SRI options were transferred to the Assessment Institutes for Agricultural Technology (AIATs) in eight provinces for local adaptation and evaluation through a linked IRIR-AIAT research and development framework.

Table 1. Results of 1-ha field trials of the System of Rice Intensification (SRI) package at IRIR, Sukamandi, Indonesia, 1999-2002.

Season	Farmer practice		Package A		Package B	
	Yield (t ha^{-1})	Returns / Costs ratio	Yield (t ha^{-1})	Returns / Costs ratio	Yield (t ha^{-1})	Returns / Costs ratio
WS 1999/2000	5.95	1.32	7.30	1.93	9.6	2.29
DS 2000	5.82	1.42	7.67	2.03	8.67	2.39
WS 2000/01	6.29	1.64	7.72	2.01	9.06	2.56
DS 2001	5.96	1.52	8.12	1.99	8.28	2.11
WS 2001/02	6.10	1.60	8.47	2.39	10.08	2.55
Mean	6.02	1.50	7.86	2.11	8.92	2.44
% Increase over farmer's practice	-	-	31	34	48	56

Package A = Four SRI practices + N application based on national recommendation
Package B = Four SRI practices + N application based on LCC-4
WS = Wet season; DS = Dry season

Research and Development of Integrated Crop and Resource Management (ICM)

To meet the location-specific needs, the IRIR-generated SRI technologies have been augmented by seven additional components to create a 12-component set of Integrated Crop and Resource Management (ICM) options. The seven additional components are: (1) selection of locally adapted high yielding rice varieties; (2) use of quality seed; (3) transplanting of 1-3 seedlings per hill; (4) square (20 x 20 cm to 25 x 25 cm) or paired row (legowo) geometry for transplanting; (5) mechanical weeding by rotary weeder; (6) integrated insect-pest management; and (7) threshing by a power thresher. Farmers are encouraged to try all twelve ICM components so that they can select the options that suit their biophysical, social, and economic circumstances and the availability of resources and component technologies. The ICM technology options are thus location-specific and dynamic.

Table 2 presents rice yield and returns/costs ratio of ICM options evaluations in 13 villages during 2001/02. In 10 out of 13 villages, rice yield in ICM fields increased by more than 10% compared to non-ICM fields in both dry and wet seasons. In addition, the returns/costs ratio for ICM fields was two times and a half as that of non-ICM fields. Other evaluations of ICM options in the vicinity of IRIR (West Java) during different seasons showed similar results (Table 2).

Table 2. Rice yield, yield increase, and returns/costs (R/C) ratio for ICM and non-ICM fields in 13 villages

Province	Village	Yield (t ha^{-1})		% increase in yield	R/C of ICM/ R/C non-ICM
		ICM	Non-ICM		
North Sumatra	Tj. Kubah	6.1	5.0	22	2.7
	Aras	6.0	5.0	19	2.5
West Sumatra	Ps. Pakandangan	4.7	3.8	21	1.9
West Java	Sukasenang	5.0	4.6	9	3.4
	Bojong Jaya	5.9	6.1	- 3	2.5
Central Java	Sugihan	7.5	7.0	7	3.1
	Kliwonan	6.4	4.8	33	2.9
East Java	Gunungrejo	9.1	6.9	33	2.4
	Tembalang	8.1	6.9	17	2.5
	C. Kandang	8.9	4.9	81	2.3
Bali	Tunjuk	7.7	5.5	39	2.4
West Nusa Tenggara	Jenggala	7.4	6.5	13	2.4
South Sulawesi	Mattoangin	6.5	5.8	14	2.4
Average	1st season (t ha^{-1})	6.9	5.3	29	2.6
	2nd season (t ha^{-1})	7.1	5.7	25	2.7
IRIR - West Java	WS.99/00-DS.01	6.8 - 8.5	4.7 - 6.7	14 - 56	2.4 - 2.6
	WS.01/02-DS.02	6.4 - 7.1	4.7 - 5.7	12 - 51	2.7 - 3.0

Scaling-up and Delivery Strategy for the ICM Options

Starting from 2002, evaluation of ICM technology options started as a pilot project in 14 provinces (33 districts), with a compact block area of 100 ha per location. In 2003, the pilot project was extended to 22 provinces (44 districts). Depending on farm size, the number of farmers per block of 100 ha ICM evaluation site varies from 160 (out side of Java) to more than 800 (in Java).

Strategies followed for large-area ICM evaluation are: (1) a Participatory Rural Appraisal (PRA) to characterize the target location in terms of bio-physical, social, economic, and cultural aspects; (2) training of the local extension staff and key farmers; (3) selection and adaptation of the ICM technology options to local farming conditions and farmers' needs; and (4) local evaluation of the ICM components through locally conducted trials. The staffs of national agricultural research institutes (NARIs), AIATs, provincial agricultural office (DINAS), extension workers at village office and farmer groups collectively conduct these sets of activities in each location.

Table 3 presents the outcome of ICM scaling-up that was conducted in 33 districts in 14 Indonesian provinces. Farmers adopting the ICM (ICM farmers) used 40% less seed, 60% less number of seedlings per hill, 15% less urea, same amount of P, 77% more K, and 0.9 t ha-1 more organic fertilizer, compared to non-ICM control farmers. On an average, ICM farmers obtained 20% higher yield and income, and 35% higher net benefits than non-ICM farmers. Overall, ICM farmers obtained US$115 ha-1 additional profit, compared to non-ICM farmers.

Table 3. Mean rice yield, input-output, and changes in income for ICM and non-ICM farmers in 33 districts (14 provinces) of Indonesia, DS 2002

Item	Non-ICM farmers	ICM farmers	% change (+/-)
Seed rate (kg ha^{-1})	40	24	- 40
Seedling age (days)	25	18	- 28
No. of seedling per hill	5	2	- 60
N applied (kg urea ha^{-1})	255	216	- 15
P applied (kg SP-36 ha^{-1})	83	83	0
K applied (kg KCl ha^{-1})	26	46	+ 77
Organic fertilizer (t ha^{-1})	0	0.9	NA
Highest yield (t ha^{-1})	6.08	7.29	+ 20
Lowest yield (t ha^{-1})	4.25	5.10	+ 20
Average yield (t ha^{-1})	5.24	6.27	+ 20
Total income (Rp.'000 ha^{-1})	6,297 ($768)	7,532 ($919)	+ 20
Total benefit (Rp.'000 ha^{-1})	2,659 ($324)	3,591 ($438)	+ 35
Increase in benefit due to ICM (Rp.'000 ha^{-1})	-	940 ($115)	NA

NA = not applicable
1 US$ = Rp8,200

Lessons Learnt from Scaling up of ICM Technology Options in Indonesia

In addition to increasing grain yield and improving market value of harvested grain, reducing production cost is a significant way of improving profit for rice farmers. In rice cultivation in Indonesia, fertilizer cost ranked the 2nd highest input cost (28%), after the labor cost (48%). Thus, it is critical to use the fertilizers as efficiently as possible to minimize the fertilizer cost. In addition, appropriate mechanization (e.g. power thresher) can help reduce the labor cost in rice farming.

Training of regional extension and development staff and farmers on the proper adoption of ICM technology options is critical for its success. The NARIs staff train selected trainers in each province and they in turn train other local staff and key farmers on how to evaluate and extend the ICM technologies to farmers.

The farmers should understand not only the economic advantage of adopting the ICM technologies, but also their impact on resource base, environment quality, and livelihood. For example, the increase in rice-production efficiency (and in gross margins) would release resources (land, water, capital, and labor) for diversification of farming system and income generation (on-farm, off-farm, and non-farm), leading to better livelihood for smallholder families (Budianto and Zaini, 2003). Such improvements in livelihood will benefit smallholder families in both irrigated and rainfed rice production areas of Indonesia.

In short, adoption of ICM technologies will increase the rice yield, promote the efficient use of inputs, reduce the cost of cultivation, and enhance net profit to farmers in intensively managed small farms. In addition, well-trained and experienced ICM farmers will contribute greatly to higher national rice production and food security in Indonesia.

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CLOSING REMARK

By

DIRECTOR GENERAL, THE AGENCY OF AGRICULTURAL HUMAN RESOURCE DEVELOPMENT
THE MINISTRY OF AGRICULTURE OF THE REPUBLIC OF INDONESIA

Distinguished participants, Ladies and gentlemen,

First of all, please allow me to thank Allah SWT for His blessings by which we can have this Training Workshop on Agricultural Technology Transfer and Training. After 4 days of intensive discussion, finally we have come to the end of this important event. It is a great honor and pleasure that Indonesia has been selected as Organizing Committee of the Training Workshop.

Ladies and gentlemen,

To evaluate the success of the Training Workshop let us see the expected benefit of the Workshop as: First, exchange information on the efforts made for promotion of efficient technologies for agicultural production and value added agricultural products and lesons learned from them. Second, to look for the effective and efficient strategies to strengthen extension services, for agricultural technology transfer and training

To achieve those expected benefit, several topics that related and supported the objectives have been discussed intensively with in twice half-days in the classes and two days in the field training during 4 days of the training workshop. Several farmers activities that related to the topics being discussed have been visited0 and we agreed that intensive discussions during the training workshop have remarkable enriched the content of the papers and I am sure that we have gained fruitful result from the workshop and have successfully taken another one step closer to the ultimate goal of "increasing farmers' income and self- reliance"

Ladies and gentlemen,

From the benefit of the first and the second seminar, and the third gathering in the form of this training workshop we found out that experiences, methods and strategies on reducing agricultural production cost and strengthening the extension services should be shared and examined deeply among researchers, extension personnel and farmers' leaders of the APEC member economies. We do hope and we propose that this lessons learned' will be followed-up by each participant to disseminate all the technology and extension metodology in respective country. The experience in implementing of the extension, technology transfer strategy and methods resulted from the training workshop, in respective APEC member economies, will become important information to be further discussed in 2005 seminar. The propose topics for latter seminar is on how to promote agribusiness in the village, reduce distance between farmers and consumers, and how to build efficient network among research institutions, extension services, and farmers' organization, and businessman in order to achieve the ultimate goal.

Ladies and gentlemen,

Finally, I gratefully appreciate all of you for actively participating, sharing experience and contributing your brilliant ideas during the TRAINING WORKSHOP in Indonesia. Without your support, the Workshop will not be a success. Let me congratulate also the Organizing Committe for successfully organizing this Workshop. On behalf of the Steering Committee, I officially declare this Training Workshop close.

Thank you and see you next year in the fourth ATT&T Seminar.

Director General for Human Resource Development,
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