REPORTS FROM THE EIGHT ASIAN COUNTRIES

1. "It might be on the internet- but at Uluru, we have a problem". Agricultural information for Aboriginal land managers in Australia

Lynette E. LIDDLE

As we ponder if our current land use in Australia is sustainable, we face a fundamental question : "Is the way we think innovative enough to cope with the challenges that enable us to evaluate the impact of past decisions and to make better future decisions on Australian land use?"

This paper takes on the central question : how do we best provide agricultural information for Aboriginal land use for the future?

It finds that there are a number of ways to do this. Most of these ways involve a change in the paradigm by which Australian agriculture provides it today.

In exploring the wants of Aboriginal land holders it is apparent the growing concerns of the wider society has focused on information technology for improving the management of rural agricultural lands in Australia. In less than 200 years, Aboriginals now have title to 20% of the Australian land mass, and this is increasing. This reality challenges the 'information gatekeepers' in agricultural institutions. It requires a fundamental shift in power by those who control access to agricultural and environmental information to look at how Aboriginals are using and have managed their lands for over 40 000 years.

Agricultural and education has been poorly targeted in meeting the requirements to support agricultural and environmental land use by Aboriginal people. This research is based on applied and theoretical work in rural Australia. Taking examples of Agricultural education in Australia, this paper looks at the way the professionals can become better educated and informed themselves.

There are ethical and economic reasons as to why Aboriginal knowledge and their decisions about land management should be incorporated into the present process of Australian land administration. Aboriginal people are the key stakeholders for the future of land including parks and rural land in Australia.

The needs of Aboriginal land users for information is uniquely different to that of other landholders. However, their needs are often suppressed in the complexity of information provided by others on Australian rural and agricultural lands.

It is suggested that these problems are not unique to Aboriginal Australians, and could be relevant to other Asian- Pacific countries.

Theme : Application of global and regional information for the innovation of agricultural and environmental education in Asian Pacific countries

Text for slides :

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This paper considers the needs of Aboriginal people to utilise information technology, and the significance of those needs. To do this it is we must first ask ; what information of their own they are able to incorporate into the agricultural / land use paradigm of current Australian agricultural and environmental practices. My focus is on Aborigines in rural Australia.

What Aboriginal people do on their lands dictates their need for agricultural information- the things they do are varied, but determined largely by the environment and what is on their lands. Good environmental conditions are vital for good maintenance of the land. Without these, we would not hunt, gather, make use of fire, or maintain water resources. Aboriginals use of the environment in an industrialised country, centres around a land based existence-the harvesting of turtles, the farming of yams, the maintenance of soakages and waterholes, the harvest of wild rabbits, and the management of kangaroos. All of which is vital to the future of Australian agricultural land use.

Significantly, Aboriginal peoples have managed to do that to date, without the use of global or technological information, and the status is that Aboriginal people appear less interested in its use compared to other groups of the community such as farmers, scientists, and researchers, despite having access to the same types of land.

But of wider significance, it is imperative that Aboriginals have good access to the land and agricultural information - so that they do not compromise the future benefits of that land. The fact that Australia is suffering from environmental degradation of its lands from European occupation in little more than 200 years, makes it a priority for them as custodians of 22% of the Australian continent. In most regions of Australia to varying degrees agricultural ecosystems are under environmental pressure.

There is now an accelerated need for Aboriginal people to have access to agricultural information. This goes hand in hand with technology. But at the present time, there are too few Aboriginal people in agricultural education to allow us to benefit from it. The agriculturally rich people are not who you think they are - wealth is not based principally on economics.

In the context of rural Australian agriculture ;

Research focuses largely on monoculture and increasingly joint ventures.

Extension services are highly specific and accessible to farmers and provide for the needs of economic agricultural farmers such as rice farmers ; sheep ; cattle ; and grain producers.

What exactly Aboriginal people do on their land, and how they use their knowledge to manage it is largely unknown and poorly understood by others.

This means that Aboriginal people's needs are largely un-met. Few scientists are prepared to take the risk to consider the changes that Aboriginal people need to be absorbed into scientific institutions if their view of the land and its resources are to be accepted. There is no reasonable balance between many alternative sources of agricultural information and nor is there an active supportive offering of Co-operation in managing land. Ultimately as a result of scientists not undertaking research into Aboriginal land practices there is no educational feedback of agricultural information to enhance traditional Aboriginal land practices.

Where and why do the differences in using information (technological or otherwise) become apparent in Australian land use?

- In planning what needs to be done to manage land (eg CLC mapping)
- In site visits to remote areas where we assess biological resources and what traditional owners know about a particular species. (eg

Leannes example of black footed wallaby)
- In how people on the land managing fire, and what little information scientists have of this.
- In managing water resources on Aboriginal lands.
- In assessing country for future land use - we have no information on most Aboriginal lands.
- In scientific field visits- scientists tend to get tied up with the means of delivery eg computers instead of asking for the recipients understanding and knowledge of the issue.

Its one thing to recognise such a broad need for more information. Its another to use what we already have. (LEANNES EXAMPLE)

Technological information has in some circumstances become an ally in offering perspectives to agricultural educators and making them conscious of our environmental problems.

The whole process of applying new information with Aboriginal people requires a willingness to communicate in settings and educational ways that differ from the Australian norm. Technology can only provide part of the answer.

Here are two examples :

1- (LEANNE'S EXAMPLES)

2. Aboriginal knowledge of mammals in the central deserts of Australia- a specific biological theory question. Where scientists needed information on the biota of the region. Primarily for conservation reasons, they needed information on the animals range ; habitat ; biology ; and reproduction.

The knowledge of the traditional owners was immense. Particularly of species range and movement. Correlations were able to be made with the timing of forced movement of Aboriginal people to 'settlements' thereby leaving their nomadic lifestyle as well as the change in fire regimes, and competition from introduced cattle and other predators. Aboriginal people often blamed themselves for the disappearance of the species because of ;

1) Aboriginal people becoming alcoholics
2) Loss of land
3) Removal of Aboriginal people off their traditional homelands.

Aboriginal people were concerned and deeply 'saddened' by the loss of the animals which were an integral part of the Aboriginal lands.

Analysing the information that is between both sets of Australian land users, highlights the point that knowledge is rarely shared between them. Aboriginal knowledge of the land and environment deserves to be given special consideration. Yet it is apparent that knowledge, is confronted by an ethic that says 'the wealth of information is in information technology'. This paradigm discounts opportunities for Aboriginal involvement in research and education. As these examples demonstrate, their lands and environmental systems have now become a proprietary resource for studying complex biological dynamics.

In order to make Australian agricultural education more attractive, we've got to look at the facts that Agricultural information and institutions are much weaker in providing assistance to Aboriginals and their lands, than for example in the field of health. Historically Aboriginals have received no information, nor have been recipients of research information. Now, through our goodwill, we are making a valuable contribution to professional's understanding of the environment.

In the right circumstances and with the goodwill of educators this has been overcome by partnerships with Aboriginals, such as those by the Conservation Commission of the Northern Territory and the University of Adelaide at Roseworthy.

These partnerships have worked best where government agencies have been prepared to accept that the interface between Aboriginal landholders and agricultural 'providers' is a direct result of dialogue and social interactions. It is often assumed that issues of biodiversity and conservation are the sole concerns of Aboriginal people. In actual fact Aborigines are vitally involved in all aspects of agricultural production.

What can we learn from this?

- Not all information is appropriate to transfer.
- Aboriginal people and scientists have significant obstacles to overcome before they are able to offer any prospects for information sharing.
- Aboriginal people need the chance to adjust information to their own circumstances
- There needs to be checks and balances to ensure the appropriateness and relevance of regional information.
- There are plenty of ways in which Aboriginal people can be involved in the planning and development of information for agricultural and environmental education.
- Shared interests in the environmental resource necessitates specific Aboriginal input into the process.
- Where Aboriginal people have been removed or lose control of their land, environmental degradation or species loss follows

In summary ;

1. In context, it has to be asked who is to say innovation has to be machinery or technological based. It can be a way of thinking, but it only works where there is similarity of circumstance. Even then, if there is similarity of geographical and climatic circumstance, it can not be guaranteed. In Australia we have ample opportunities for this to happen.
2. Education is not just literacy. In Australia it has to be a way of thinking if information technology is to have any place in Aboriginal society.
3. Aboriginal Australians require unique and special attention to have agricultural information facilitated into their current land use.
4. Let Aboriginal people be a source of information to involve others on environmental issues.
5. Aboriginal people can provide information based on sound environmental reasoning and not on political or technical grounds, for species and environmental/ land management.

Finally, it is imperative that Aboriginal people be involved in providing information for education about the environment, since they are so often left with the responsibility of environmental degradation. Equally important is that students, academics and govt. be educated about environmental information (not pertaining to technology) such as Aboriginal attachment to land and their choice to remain on it and utilise it **WITHOUT** global information.

These present challenges of the highest order for Australian environmental and agricultural practitioners. Ones that in Australia necessitate its accommodation before application. It is Aboriginal peoples hope, in Australia, that we are given that opportunity.

2. The Sustainable Development of Agriculture and Environmental Education of Agriculture in China

Zhigang WANG and Xuanrui HUANG

Abstract :

This paper is concerned about what is the sustainable development of agriculture in China ; "why" and "how" the concept has to be adopted in reforming agricultural education. Based on the implication of the sustainable development of agriculture, an analysis is conducted in regard to the social and economic problems faced by Chinese agriculture and the current situation of resources and ecological environment, concluding that sustainable development is the only choice for Chinese agriculture. At the same time, an outline and approach to the sustainable development is also drawn. Finally, the paper discusses the general trend of agricultural education in relation to agricultural science and technology and the sustainable development.

Key words :

Chinese Agriculture, sustainable development of agriculture, agricultural education, protection of agricultural environment

1. Introduction

In the theoretical system of the sustain -able development, the concept of "development" is defined as the process to constantly satisfy human needs and optimize the natural environment. In addition to the improvement of the material living standard of human beings, the aim of development should also include enlargement of environmental capacity and per capita niche, and the improvement of environmental quality. The environmental resources, on which human beings exist and develop, should not only satisfy the needs of contemporary people to develop, but also create the necessary conditions and possibilities for the sustainable development of generations to come.

Looking through the history of agricultural development, human beings have never been able to properly solve the ever-lasting contradiction between food production and environmental protection. Increasing problems have formed bottlenecks restricting agricultural development. Those bottlenecks include the pollution of agricultural chemicals to under-ground and surface water, the hazard of farm chemicals to human beings and animals, the loss of living varieties, soil erosion and the degradation of soil productivity, and over relying on the non-recycle resources, and the far-reaching negative effect of aggravated environment, economy and society, the defects of agricultural system and policies, the sluggish development of agricultural education, as well as the inefficiency in agricultural scientific extension, all of which make the situation worse. And all those set the background against and research focus on which the strategy of the sustainable development is formulated. China has a population of 1.3 billion, of which nearly 1 billion are farmers, therefore as an important part of the strategic system of sustainable development, the sustainable agriculture is of vital significance to the country. The study on sustainable development of Chinese agriculture can be summed up in three questions: (1) what is

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sustainable development of agriculture? (2) Why does Chinese agriculture has to adopt the approach to sustainable development? (3) How to carry out the strategy in practice? This paper gives our own point of view concerning these questions.

2. Views of Sustainable Development of Agriculture

To sum up the research achievements, both domestic and abroad, the concept of sustainable agriculture can be generalized as follows: it is a development, environmentally non-degenerating, technologically feasible, economically sustaining and socially acceptable. Under the premise of satisfying the regional grain demands, it is expected to promote the sustained and steady increase in agricultural economic output and farmers' income, to improve the living and cultural standard of rural residents, at the same time to ensure the coordination and balance within the regional agricultural production systems, and to align with the local conditions, socially, economically and ecologically. The role of the sustainable development of agriculture in the course of the sustainable development is special. The realization of its objective needs not only the management mode compatible with the specific condition of the natural ecological environment and with the overall objective of the regional sustainable development, but also with the technological systems conforming to the development principle, as well as personnel trained with sustainable thoughts. In practice, the particular attention should be given to the reform in agricultural education, which can make the agricultural education meet the needs of the sustainable development of agriculture. The reason is that whether the objective can be realized or not depends on whether people's social behavior is in line with the basic principle of the sustainable development, and the reasonable behavior is fostered through a set of certain value systems and social restraints. Agricultural education is just the most effective means to improve the overall quality of farm workers and managers. Meanwhile we must have a clear understanding of the social and economic conditions, and resources and ecological environment in agricultural development in China.

3. The Motivation for China to Adopt The Strategy of the Sustainable Development in Agriculture

To adopt the strategy of the sustainable development is our fundamental national policy, and the sustainable development of agriculture is an important part of this strategy. This is determined by the current situation of Chinese agriculture, rural areas and farmers, the natural resources, the agricultural ecological environment and the history of development in the past five thousand years. A correct understanding and analysis of the society, economic condition, resources and environment of the country is bound to be of great help in understanding why there is no other choice in developing Chinese agriculture but to carry out the strategy of sustainable development.

3.1 Analysis of The Social And Economic Condition of Chinese Rural Areas

Since the founding of the People's Re-public of China, especially since 1978, twenty years of reform in rural areas has gained remarkable achievements. Reform in economic system of agriculture pushed forward the reform in industrial structure of agriculture and the reform in agricultural technology including scientific research, education, and extension system of agriculture. All these reforms gave impetus to the rapid development of agriculture and rural economy, and greatly promoted the rapid increase of the national economy. As a result, the production of grain, cotton and meat have been greatly increased. In 1998, with 110 million hectare of grain farm land, the total output of grain reached 490 million tons, meat 55.7 million tons and aquatic products 38 million tons. Township enterprises rose up with a mighty fore, and in 1998, its tax amount totaled 715 billion-yuan RMB. The

total output value of agriculture and per capita income of farmers got a steady increase, and the population under poverty line greatly decreased. In 1998, the average per capita income of farmers reached 2150 yuan RMB. As a result of the development, infrastructure in transportation and communication were fundamentally improved, and agricultural education was promoted with the number of illiterates and semiilliterates being greatly reduced.

As it is, we have to be fully aware of the social and economic problems imposed on Chinese agricultural sustainable development in the 21st century. That is tough points in implementing the strategy of the sustainable development, which can be summed up as the following:

(1) Overpopulation

Overpopulation has long been a factor not only affecting the development of agriculture, but also restricting the development of the whole national economy. Expectedly, there will be three baby booms in succession, it is estimated that by 2030 the population will have reached 1.5 billion at least. This will inevitably lead to a long time employment pressure, in particular increasing the difficulty in transferring the surplus labor force in agriculture and further increasing the grain demands, which will result in low quality of the people.

(2) High total output of agricultural products but low per capita

The total output of grain, cotton and meat has leaped to the first place in the world, and per unit area yield of cultivated land has also moved to the front rank. However, per capita amount of grain, meat and milk takes up only 1/2, 1/3 and 1/50 of the developed countries respectively. With the increase in population and the continuous improvement of people's living standard, the effective supply of agricultural products will become more and more difficult.

(3) The leading position of traditional agriculture with staggering pace of modern agro-development

Presently, traditional agriculture still occupies a leading position in China, featured by semi- manpower and semi-machine, semi-self-reliance and semi-commercialization, and semi-experience and semi-scientific technology. Agricultural productivity is only 1/70 that of America, therefore we still have a long way to go towards agricultural modernization.

(4) Low profits of agriculture as a weak industry

Agriculture is overall a weak industry, whose profits are far lower than those of other industries. In suburban areas of some big cities, the income of farming is even less than if renting out land to enterprises for piling up wastes. Many farmers turned to business instead of farming and consequently farmlands were left uncultivated and even given up. It is obviously difficult for farmers to stay on farmland if they can't get back reasonable economic returns. On the other hand, through various forms of policies by the government in the past years, such as state purchase, ordering through contract, taxation, price scissors between industrial and agricultural products, volunteer labor and various forms of fund raising, agriculture and farmers have made huge contributions to the industrialization of the country. Nevertheless, the direct or indirect economic return from the industry is far less satisfying, leading to the widening of the distance between other industries and agriculture, and urban residents and farmers.

(5) Farmers simply having enough food and clothing, but still far away from a relatively comfortable life

In 1998, per capita income of farmers were 2150 yuan RMB, which is about 250 $ US, slightly higher than 200$US-- the internationally adopted poverty line. There are still about 60 million farmers living under the poverty line. Actually, only about 5% of the counties reached The level of a relatively comfortable life, most of which are in the eastern areas and areas along the coastline.

(6) The system of agricultural policies incompatible with the needs of sustainable development of agriculture

As far as agricultural production and the economic pattern of farmers are concerned,

the most influencing factors are: the land property right, the organizing form of agricultural production, the system of profits distribution, the relationship between farmers and the government, and the historical and cultural tradition and behavioral habits accumulated and prevailing in the rural societies. The problem of ecological environment in agriculture has always resulted from a certain behavioral patterns interacting between farm managers and those connected with farming profits. Therefore, what is important is to create a system that can direct farmers towards rational economic action. The current land system is based on the system of family contracted responsibility linking remuneration to output, but the property right of this land system is vague and incomplete. This incompleteness played a misleading function in farmers production pattern, especially in the rationalization of ecological environment, and resulted in ecologically short-term behavior by farmers. The system of family contracted responsibility did play a very important role in motivating farmers' enthusiasm, nevertheless, during a long time period after carrying out this system, no attention was ever paid to the construction and maintenance of water conservancy facilities, farmland and forest belts, leading to the problem of ecological environment in agriculture. In addition, in many cases, due to economic concerns and selfishness, some local governments more often than not became protectors of some township enterprises with serious problems of pollution and high consumption in resources, instead of shouldering the responsibility of protecting agricultural interests.

3.2 Understanding of ecology of resources in agricultural development in China

With 5000 years of history and 1 billion rural populations at present, Chinese agriculture has produced profound impact on natural resources and ecological environment. China has supported 22% of the world population with 7% cultivated land. This fact itself is undoubtedly a huge contribution to the world agriculture and even to the whole mankind. However, because agriculture is a typical resource--restricting industry, a natural reproduction process as well as a social reproduction process, the contradiction between the resources consumption and resources environment protection in the agricultural development has long existed. Since the founding of the People's Republic of China, Chinese government has attached great importance to the improvement of ecological environment of agriculture. Big rivers like Yellow River, Huai River and Hai River were given large-scale harness, and therefore, flood-protected and irrigated fields were redoubled. The supply of machines, fertilizers and energy was greatly increased. The ten construction projects of ecological environment including " the three north" shelter forest are playing a more and more important role in protecting environment. In spite of this, the sustainable development of Chinese agriculture is still facing a critical challenge. Seen from the resources environment, which is fundamental to the development of agriculture, the challenge is mainly reflected in three aspects, namely land resources, water resources and ecological environment of agriculture.

(1) Insufficient and irrational distribution of land resources

Land is fundamental to the development of agriculture. The present and potential land resources in China has determined the specifics of Chinese agricultural development. The hilly area covers 69% of the total land area. The average height of land above sea level is 1435 meters, while that of the world is only 875. As a result, the average cost for development in China is 1/4 higher than that in the world. Specifically, the cost for agricultural development, for the development of animal husbandry, for pulling farmers out of poverty and for natural protection is 8%, 2%, 25%, and 31% higher than the average cost respectively in the world. The pace of soil erosion and ecological deterioration, the degree of land fragility and the frequency of natural disasters are respectively 40%, 29%, 21% and 17% higher than those in the world.

At present, the total land resources for

Table 1 Distribution of water and land resources in the main river valleys

River	per capita water amount		per land water amount		cultiveted land density		per cultiveted land water amount	
	m^3/person	%	thousand m^3/km^2	%	hm^2/km^2	%	m^3/km^2	%
Hai River	351	15.1	132	45.2	33.3	337.8	3960.0	13.4
Yellow River	742	32.0	96	32.8	15.3	155.4	6261.0	21.15
Huai River	500	21.6	292	100.0	43.9	444.6	6657.0	22.49
Yangtse River	2356	101.7	531	181.8	12.4	125.7	42822.0	144.7
Zhujiang River	3370	145.5	808	278.7	2.6	26.4	310768.5	1050.1
Nation-wide	2317	100.0	293	100.0	9.9	100.0	29593.5	100.0

agriculture in China are 717.667 million hectares, of which 646.667 million hectares have been utilized. The cultivated land area is 130 million hectares, ranking the fourth in the world, but its per capita area is only 43% that of the world ; the woodland area is 226,667 million hectares, and its per capita area is 0. 1067 hectare, only 1/6 that of the world ; the grassland area is 400 million hectares with only 0.22 hectare per capita. Besides, the distribution is also uneven. 94% of the total population, 45% of the land, 86% of the cultivated land, 80% of the woodland and 66% of the water are in the southeast of China, while 78% of the grassland, 77% of the unutilized land in the northwest. In addition, the overall land quality is relatively low, affected by thickness of soil layers, soil quality, soil erosion, hydrology and low temperature. 69% of the cultivated land belongs to medium or low productive lands. 1/3 of the woodland is secondary forest, brush-wood, scattered woodland. 87% of the grassland is that of low quality and low yield. Moreover, with the increase in population and the development of social economy, the agricultural resources are bearing more pressures. According to statistics, within twenty years from 1978 to 1996, the total cultivated land area decreased from 99.39 to 94.91 million hectares.

(2) Inadequate water resources and over -extraction of ground water

Water is the lifeblood of agricultural development. The extraction and utilization of water resources not only directly affect the sustainable development of agriculture, but also influence the sustainable development process of the whole national economy. In 1980s, because of the rapid development of economy, the improvement of people's living standard and the continuous drought, there appeared the shortage of water resources in some areas and the dropping down of groundwater level. The contradiction between water supply and water demands has become obvious and aroused general concern.

The total quantity of water resources in China is 287 billion m^3, occupying the six in the world. Its per capita is only 2317m^3, ranking the 109th. Because of ill distribution, water resources is not compatible with population and cultivated land. The situation of water resources can be reflected in the following table.

The huge amount of water channeling in the up and middle reaches of the major rivers has caused seasonal water shortage in the lower reaches, and led to a pressure of water consumption in the lower reaches where the cultivated land is much concentrated. For instance, in the past ten years, there occurred water cut-off several times in the Yellow River, 122 days and 600 kilos in length in 1995, 133 days in 1996 and 226 days in 1997, producing a serious effect on agricultural production. To resolve the contradiction between supply and demands in water resources, a great deal of groundwater has been extracted in the north, causing a big dropping of groundwater level in many areas and forming funnel areas in many places.

(3) The critical situation of ecological environment of agriculture

A good ecological environment is essential to the social and economic development and a necessary condition to realize the strat-

egy of the sustainable development of agriculture. Yet, we are now facing a critical situation of ecological environment.

● **Soil erosion**

At present, the area of soil erosion reaches 1.74 million km^2, covering 18.6% of the total land area. Every year, more than 5 billion tons of soil has been washed away, fertility loss equivalent to 40-50 million tons of chemicals.

● **Accelerating decertification of land**

In 1997, the land which had been decertified amounted to 837,000 hectares, covering 8.7% of the total land area, and at the same time, is increasing at the rate of 2100 km^2 every year. In other word, as much as a whole county's cultivated land is being lost every year.

● **The problems of acid rain and salinization of land**

The acid rain covering area has reached 25% of the total land area and that of salinized land is 8.6% of the total, seriously affecting the agricultural development in irrigated areas. Because of the rapid increase of land using in non-agricultural construction, the cultivated land area has been greatly reduced, with an average of 300,000 hectares in reduction every year.

● **Weakened function of forest ecology and deteriorated grassland resources**

The deteriorated grassland area is 87,000 km^2, amounting to 1/3 of the total usable, and is still increasing at a speed of 2,000 km^2 every year.

● **Serious pollution of ecological environment in rural areas**

In 1997, the discharging volume of sulfur dioxide, smoke and dust, waste water and solid waste matter from factories by township enterprises amounted to respectively 23.9%, 50.3%, 44.3% and 37.3% of the total discharged by industries in the whole country. The total consumption of fertilizer was increased from 78,000 tons in 1952 to 33.13 million tons in 1994, with an average of 15.5% in increase every year. In 1994, the output of fertilizer reached 22.759 million tons. But meanwhile, the irrational use of fertilizer has led to a series of problems in the ecological environment of agriculture. The remaining amount of plastic film in soil is about 60 kg per hectare and the yearly average remaining rate of plastic film is as high as 20%. In addition, the breeding of domestic animals and aquatic added to the pollution in rural areas. Up to 1995, the excrement and urine by domestic animals reached 248,500 tons, most of which were emptied to rivers, lakes and seas without any treatment.

4. An approach to The Sustainable Development Strategy of Chinese Agriculture

Based on a reconsideration of the traditional agriculture, research and attention have been given to how to promote development and at the same time optimize the environment, and how to ensure the coordination of population, resources, environment and economic development. Synthesizing the existing achievements in research both domestic and abroad, we try to put forward a framework attempting to guide the research and practice of the sustainable development in agriculture.

4.1 Regional comprehensiveness is the foundation for the sustainable development of agriculture

Because of the lack of a systematic and a comprehensive study, the concept, method and discipline system of the sustainable development in agriculture have not fallen in pattern. Developing countries including China in particular, should strengthen the research on theoretical and regional comprehensiveness, because the research and practice of the sustainable development in agriculture involve many fields in natural and social economic sciences. Moreover, with the constant economic development, the dynamic change in the system of natural resources environment and requirements of the society to agriculture (including farming, forestry, animal-raising and fishery) are experiencing changes. This is to say that the sustainable development of agriculture must construct its system on the basis of practical and potential bearing capacity of the ecological system in

specific areas, aimed at satisfying the constantly increasing and changing needs of regions, nations and the world in social economic development for agriculture. The developing mode of the sustainable development should be ecologically rational, economically feasible, socially acceptable and in line with the basic principle of the sustainable development. In addition, a comprehensive ensuring system of policies, economy and society and the system of scientific research and teaching in agriculture need also to be constructed. The regional comprehensive study on agricultural sustainable development should include the following contents:

(1) study on the relationship of every element of natural resources with another within the system

There are four major components of natural resources, namely, climate, water, land and living things. Study on the interaction between different resources is important and necessary to promote the sustainable development of agriculture. A comprehensive study on the interaction between the growing process of economic crops and the resources of living things, land, water and climate is the foundation to determine the objective, mode and approach of the agricultural sustainable development.

(2) A comprehensive multi-discipline study

The agricultural sustainable development is a systems project, and it needs the collaboration of different branches of learning to realize its final objective. The most urgent at present is to conduct a comprehensive research combining the sustainable development of agriculture with the social, economic, ecological, population, environmental and management science and the relevant application technology. This horizontal research among different disciplines will continuously widen the research sphere in agricultural theories and application, making the research work more capable of solving practical problems. The current research emphasizes mainly on problems concerning social economy and resources environment within agricultural field, while the comprehensive study on the relation between the sustainable development of agriculture and regional industrial structure, employment, public participation, social economic system and regional economic development is rather weak. This has affected the smooth going-on of the agricultural sustainable development.

(3) A comprehensive study on regional scale.

Comprehensive study on regional scale refers to the research on the relation between the structure, function, and ecological process of regional agricultural resources and a systematic, sustained and coordinated development of regional social economy. Regional comprehension should be the main body of the research on the sustainable development of agriculture. There are three reasons for this:

- Any ecological system in agriculture has a certain regional distribution. An overall revealing of the regional differences and characteristics of agricultural resources is sure to be of great help in regional development and national land treatment.
- Everything on the surface of the earth is defined within the concept of "region". "Region" crosses the systems of nature, economy and humanity and is the compound epitome of every system.. Therefore regional comprehension is foundation, and only on the basis of "region", can other forms of comprehensive study achieve better results.
- The regional comprehensive study of agricultural resources is an important component of the higher level of regional comprehensive study on the people and land relation. This level of research aims at coordinating the relation between human beings and the environment and has a practical significance in resolving worldwide problems concerning population, resources and environment.

4.2 The basic guideline of the sustainable development of agriculture

Seen from a regional angle, the sustain-able development of agriculture involves

problems in three aspects:

- The inter-related operation and management in regional agriculture.
- Various links connecting operation and management in regional agriculture with regional social economy and resources environment such as land utilization structure, public consciousness of environment, cultural and spiritual needs, construction of ecological environment and poverty elimination.
- The relation between the sustainable development of regional agriculture and the national macro-strategy including not only the economic structure as a whole such as the industrial structure, institution structure but also the operating system of the agricultural sustainable development functioned as a whole, and the macro regulation and control policies in agriculture.

The sustainable agriculture is affected and restricted by many specific factors, and under specified time and space conditions, the overall trend of agricultural development is the result of the comprehensive function of the various relevant factors. However, over a long period of time, the lack of a systematic study on main factors affecting the agricultural sustainable development has led to the separation of agricultural management objective from the demands of the social and economic development. Therefore, it is difficult to form a clear and rational understanding of the operation and management in agriculture and even of the agriculture development.

In particular, the attitude and method of pursuing to solve sole agricultural problems, the thinking mode such as discussing sole

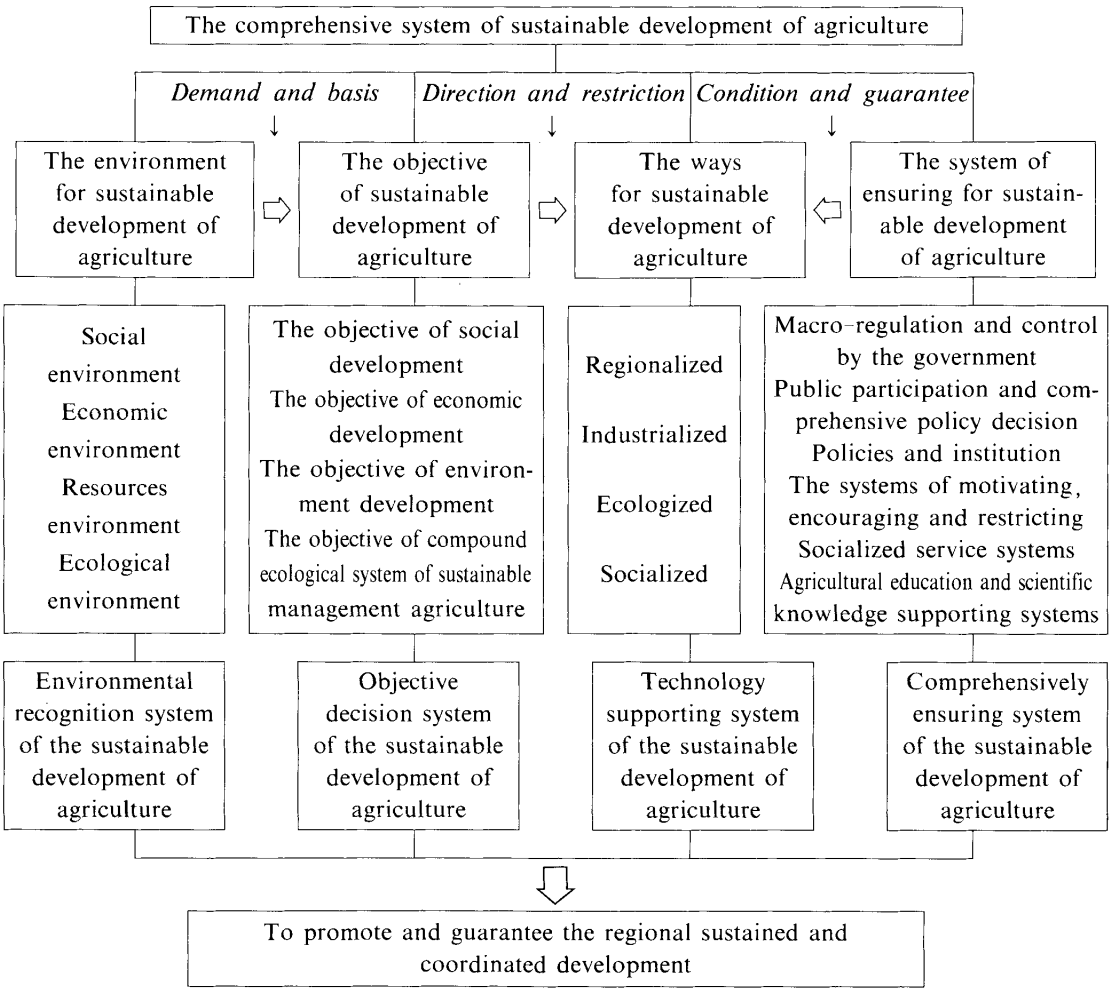

Figure .1 the framework of research and practice on sustainable development of agriculture

agricultural problems without dealing with other agriculture-related problems, and many so-called non-agricultural factors have caused the inaccuracy and defects in theory and, consequently, it is hard for agriculture to extricate itself from the difficult position. For example, the previous study on agriculture seldom dealt with regional industrial structure, public awareness of environment and regional ecological demand, etc.

It leading to the defect in the objective of agricultural development and management channel.

To the sustainable development of agriculture, the essential task is to set up the ecologically rational, socially and economically feasible operating system in management. It has four specific tasks :

- To determine what natural basis for agricultural management is needed in the process of sustainable development of agriculture.
- Combining the above social demands with natural basis, to determine the social, economic and ecological environment objective, and the compound ecological systematic objective in the sustainable management in agriculture which can guarantee the realization of the three objectives.
- To determine the means of realizing the objective of sustainable development in agriculture, including the strategy, the special means, the technological system of the agricultural sustainable development and its operating system.
- To improve the guarantee system of sustainable development of agriculture, including the system of macroregulation and control by the government, the system of public participation, management system, the system of rational disposition of interests based on the property right system and the system of the scientific research and education in agriculture. A framework is thus put forward with the hope of directing the study and practice of the sustainable development in agriculture.

5. The Sustainable Development of Agriculture And Agricultural Education in China

With the strengthening of public aware -ness of the sustainable development and the high attention given by the government to high-tech agricultural technology, the agricultural educational system in China is facing new chances as well as challenges. The current situation of agricultural development is satisfied : the high-tech zones of agriculture and modern agriculture demonstration zones are just beginning to take shape ; factorization of agriculture has taken its initial step ; facility gardening is developed at a high speed ; agricultural high-tech enterprises has showed up quickly ; environment-pollution-free production technologies are widely extended into application ; technologies of tissue and quick breeding are gradually moving towards industrialization ; information technology has also walked into agriculture. With the increase in the need of farmers for agricultural scientific technology, the out-dated curriculum, the backward means in teaching and materials, the stagnancy in teacher's overall quality and knowledge structure, and the teaching system irrelevant to scientific research and production, can no longer meet the need of the social economic development and the construction of ecological environment. It is imperative for China to construct a multi-level and multi -channel system in agricultural education system, which caters to the nation's conditions and agriculture's condition, and is geared to the agriculture, the market, the world and the future.

5.1 discipline development

The agricultural sustainable development is a completely new development strategy concerning areas of society, economy, resources and environment. Therefore, in the aspects of courses development, curriculum system, teaching contents and teaching methods, higher agricultural education should aim at satisfying the needs of the social economic development of agriculture, rural areas and farmers, and the needs of the estab-

lishment of a good agricultural ecological environment. The educational system constructed under planned economic system should be abandoned. The starting point of agricultural education, in adjusting discipline system and propelling the scientific technological system, is as following: in curriculum establishment, under the pre-condition of widening the specialties caliber and enlarging knowledge range, to establish different specialty directions and train students according to talent types of technology application, and of scientific technology development, as well as of operation and management. In teaching contents, to combine the general application of high-tech with specific application, the high and new tech with conventional technology, scientific research with transfer and extension of technological achievements, biology and engineering technology with management technology, the highly effective utilization of resources with coordinated management in environmental protection, and also the new ideas in industry with industrial innovation. Of these, the focus should be given to the application of bio and info technology in agriculture and the construction of curriculum related to agricultural ecological environment and technology in handling wastes.

5.2 construction of teaching staff

The construction of teaching staff is the key factor in realizing the reform of the system of agricultural education. The rapid development of social economy, especially the appearance and practice of knowledge economy will definitely make still greater demands on the agricultural education in China. The higher learning institutions should not only train students with profound professional knowledge and educate competence, but also require teaching staff to caters to needs of educational development in their career qualification. What is needed most at present in achieving all these is to introduce a system of encouragement and competition, and at the same time provide good living and working conditions for teachers and to train cross- century academic leading scholars

5.3 To Perfect the Chinese educational system of Agricultural ecology with information technology

As far as the Chinese educational system of agricultural ecology is concerned, two factors should be put into consideration: 1, how is information technology made the best use of in developing and perfecting teaching contents so as to satisfy the demands for personnel and expertise in the process of agricultural development and ecological construction; 2, how is information technology effectively engaged in developing distance education for agricultural purpose, thus the farmers' demands are met for technical know-how, specific skills, management and ecological improvement.

The introduction and development of high-tech, important part of the 21st agricultural action plan in China, plays a vital role in the industrialization, commercialization and modernization in agriculture, which guarantees the realization of the sustainable development. Among others, RS, GPS and GIS hold a special attention as new technical means propelling the sustainable development in agriculture. For example, 3S was successfully employed in land survey, investigation of soil erosion, monitoring of water resources, dissertation, biological resources, monitoring and evaluation of production and disasters, evaluation of the adaptability of land resources, land planning and protection planning for biological diversity, etc. Especially, emergence of precision agriculture based on high-tech will undoubtedly bring about a new technological revolution in agriculture at the turn of the century. The components of precision agriculture consist of RS, GPS, GIS, computer technology, technology of communication and net-work, automation in combination with geography, agronomy, ecology, plant physiology and soil sciences. It serves to instantly monitor crops and the natural resources situation where they grow, thereby, to make production plan on the basis of acquired knowledge about the crops' growth, diseases, water and fertility. The process is assisted with GIS system in diagnosing and

decisionmaking as well as information attainment and its dynamic analysis. Evidently, it is a modern information agriculture. The core of precision agriculture is to realize a balanced utilization of potential resources through the process to find the land environment where the crops grow and expected yield distribution difference in space, and on the basis of the findings adjustment and control measures are taken.

The future development of Chinese agriculture will inevitably demand a contingent of farm managers equipped with information technology. The current agricultural education system, however, re-mains a distance to the goal even though the first step has been taken, courses of GIS being offered at some schools and precision agriculture being listed in curriculum. The urgent need in teaching and research include: 1, RS technology to be used in precision agriculture, 2, design and construction methods of basic information system of agriculture, 3, extraction of warning information and research on diagnosis sys -tem supported by GIS, 4, modeling and calculation of decision-making system supported by MIS, 5, DGPS dynamic positioning and commanding, 6, control and establishment of information service network, etc.

As far as teaching methodology and aids are concerned, new technology is felt as a driving force, technology of multi-media, graphic interface, three dimensional pictures, digital intelligence, all of which brings about changes not only in teaching environment and concept but teaching means. Judging from the virtual schools using network for distance education in China, four categories can be seen: one, network teaching simultaneous to classroom teaching such as Wanheng Distance Teaching Net (mainly in the fields of primary education); two, off-class network, which has yet to take shape; three, education of higher learning network, only four universities in the country have got the permission to set up the net responsible for undergraduate and post-graduate for MA; four, vocational training network. Characterized by practicality and career-orientation, this form is promising in distance education at present time when frequent personnel exchange and rapid tech renovation take place. Attention is paid to the fact that the bulk of distance education in developed countries is formed with education of higher learning, adult education, continuous education and vocational education, which is surely a helpful reference to us. In order to train personnel demanded by the social and economic development, the Chinese government attach much importance to distance education, stating at the 3rd National Educational Conference that an open educational system based on information technology, covering the whole country, must be established to render services of all levels and diversity. In comparison, distance education in agriculture is left far behind in this regard. Such issues have to be placed on research agenda as basic research on network teaching, research on agricultural education network, research on teaching platform and on demonstration network, etc. Innovation achievements in information technology have to be employed to transform the talent, costly, walled and teacher-centered education into popular, inexpensive, open and student -centered education, to direct test-oriented education to self-fulfilled and self-amused education, to replace the traditional knowledge pass-on educational mode to the renovated mode focusing on exploration, discovery and cooperation. At the same time, the improvement of farmers' scientific quality and awareness of ecology should be included in the list so as to keep up with general trend of the world.

6. Prospect

Higher agricultural education is closely related to the national social and economic development and the guarantee for social progress and sustainable development of agriculture. "The Program for Science and Technological Development in Agriculture" which is being formed by the Chinese government is bound to produce far-reaching impact on the future agricultural education in China. Seen from production practices in agriculture, vari-

ous agricultural forms have appeared such as factorized agriculture, sightseeing agriculture, facilities agriculture, white micro-organism agriculture, urban agriculture, blue ocean agriculture, green ecology agriculture, and foreign currency earning agriculture. The international education is also developing towards diversification, division in power, multimedia, industrialization, market, popularization and internationalization. All these will surely produce profound impact on the educational system of Chinese agriculture. We have only one earth and so the tendency of economic unification and the reality of the globalization of environmental safety have determined that problems in Chinese agriculture are not solely that of grain, but also problems related to society, economy, resources, environment and the sustainable development of China and even the whole human society. Based on self-reliance, we have to absorb and make use of all advanced agricultural technologies, management methods and achievements in agricultural education according with our national conditions in the sustainable development of Chinese agriculture and the reform of agricultural educational system. Faced with the rapid development of knowledge economy, it is our strong will to have wide range of cooperation and academic exchange with those who dedicated themselves to agricultural development and agricultural education of higher learning. Let us strive together towards the realization of the sustained and coordinated development in population, resources and environment.

China : Discussion

Q : How is the attractiveness of the agricultural related field of studies among the young generation in China.

A : Actually the young generations in China have no interest in agricultural studies, the reason is that the agricultural related field is a weak industry. I think with the development of scientific technologies in agriculture and combining the biological and information technologies with the traditional technology the field of agriculture will eventually be more attractive.

Q : How is the environmental education conducted with Chinese farmers in order to have sustainable development in Chinese agriculture?

A : At present conditions, most of the Chinese farmers are either graduates from middle and primary school and the overall quality of education is not that high, so it is difficult to teach them how to have awareness regarding environmental protection and sustainable development. In their point of view the most important thing is to get economic returns. But agriculture is still the most effective means of improving the quality of life of the farmers. Another effective way of inculcating into the minds of the students the importance of taking a great care for the environment is by educating them starting from the middle vocational school. In this way ten or maybe twenty after, they will have imbibed the importance of sustainable development of agriculture.

3. Acquisition, Use and Management of Information on Biological Resources: Indonesian Experience

Setyo PERTIWI

Introduction

Indonesia has an extraordinary diversified biological resources. The biological diversity of Indonesia is among the highest in the world. Although its area just about 1.3% of the world land area it has at least 47 distinct natural ecosystems containing up to about 15% of the world species (Sumardja, 1998). This estimates include at least about 12% of the world mammals species, 17% of the world birds species, 16% of the world reptiles and amphibians species, and 10% of the world flowering plants species (National Development Planning Agency, 1993). The Indonesian rain forests are biologically rich, with more than 10,000 species of trees, 500 species of mammals of which 200 are endemic, and 1,500 species of birds of which 430 are endemic, all of which play a vital role in regulating the ecosystem (Parkinson, 1993). The country which covers more marine territory than terrestrial concurrently has an outstanding range of coastal and marine ecosystems which includes various types of wetlands, mud-flats, mangroves, sea grass beds and coral reefs which are recognized as internationally significant. The Indonesian waters contain some 37% of all fish species in the world. This vast national asset represents a natural resource of significant value to the country and the world, i.e. a genetic resource for agriculture, pharmaceutical, and industry, as well as one of global scientific importance. Biological diversity is more than just the sum of species numbers. Solow, et. al. (1993) defined biodiversity as "the totality of genes, species and ecosystems in a region. Genetic diversity refers to the variation of genes within species. Species diversity refers to the variety of species within a region. Ecosystem diversity refers to the variety of systems of living things in relationship with their environment, within a region".

Biological diversity, in all of its meanings, provides humanity with many economic values. These range from the exploitation of genetic material for pharmaceuticals, crop breeding, and industrial chemicals to gaining economic return from ecotourism and debt -for-nature swaps through biological diversity conservation.

National Economic Development and Its Impact on Biological Resources

Indonesian economic development has been very dependent on utilizing its natural resources. For centuries the people of Indonesia has utilized its forest as well as marine biodiversity richness for their livelihood. There are at least 6000 species of flora and fauna from the terrestrial and 700 species of inland water and marine living species are utilized for food, feed, clothes, shelter, medicine and so on. Nowadays there are at least about 12 millions of indigenous people living directly from forest biodiversity and about 1. 2 millions from coastal and marine biodiversity. The state also utilizes forest resources for foreign exchange earnings. It is possible to point to some very tangible gains that have been obtained from the resources other than

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wood available in the forest. Many common products, rubber for example, are of forest origin, so also are various fruits. Indonesia's export of fauna, for example, was estimated to have a value of about US$320 millions in 1989, while those of non timber forest products (mostly rattan) at US$ 30 millions in the same year (Silitonga, 1994). Furthermore, various widely used medicines were originally discovered by analysis of forest plants, often those traditionally used by forest dwellers. The British Council (1996) estimated that the value of Indonesia's biodiversity for pharmaceutical uses could be as high as US$ 45 millions per annum. In the mid-1990s, Indonesia annually exported about US$ 36 millions worth of jamu (native plant-based medicine) products.

The agriculture sector, the sector that intensively utilizes biological resources, although declining in relative term, is still playing a significant role in the national economy, since most of other developments are based on agriculture and majority of the people are still living on farms or depend on the agricultural activities for their livelihood. At present about 17.78 millions households involving about 46% of Indonesian are engaged in agricultural activities with its share to GDP is about 17% (Suryana and Bachri, 1998). Within the agriculture sector, food crops accounted for 62% of the value of production, tree crops for 16%, livestock for 10%, and fisheries and forestry for the remaining 12% of agricultural production.

Economic development has been achieved largely at the expense of the country' s rich natural resources. As a result of the economic growth, conflicts over land use and access to other natural resources are increasing, causing environmental and biological resources degradation. Human activities, directly or indirectly, are the main causes of the degradation. These are including over -exploitation of natural resources, depletion of natural habitat due to tight pressures on land for the purpose of development and agricultural activities, river pollution as well as wetlands and marine pollution, and introduction of exotic species.

More than half of the Indonesian territory is still covered with forests, but this proportion is continuously decreasing. Currently, the most intense deforestation is occurring in the larger Outer Islands, for in Java the state of the forests has been precarious for a long time. On this island, agricultural expansion, especially since the beginning of the nineteenth century, has been carried out at the expense of forest land. Nowadays, the transmigration program is having much the same effect in the Outer Islands. As the results, the nation has the world's longest list of species threatened with extinction including 126 birds, 63 mammals and 21 reptiles. Some of the more well known include the Javanese and Sumatran rhinoceros, Asian elephant, Sumatran tiger, clouded leopard, orangutan, and Sulawesi macaque. Two birds, the Javanese Wattled Lapwing and Cerulean Paradise Flycatcher have become extinct in the past decade and the Bali Starling is seriously endangered (Ministry of Forestry, 1991).

But the commercial exploitation of the forest still goes on, despite the limitations brought by numerous laws and even by the slow disappearance of the forest itself. Wood is still widely used as a combustible, whether for domestic purposes or as an energy source in small scale industry. Tree cutting to supply these needs appears as the most important and perhaps ultimate cause in the retreat of the Javanese forest.

The emergence of these issues has led to a growing awareness of the need to consider the environmental consequences of economic development. The main challenge will be to integrate environmental issues and concerns into the economic development process. In this regard, the acquisition, analysis and dissemination of information has a critical role to play.

Policies Concerning Biological Resources Conservation

Maintaining biodiversity is fundamental to the integrity of Indonesia's environment and to the continued economic output and

prosperity of the Indonesian people. Considering the necessity of biological resources for sustainable development in 21st century, the government of Indonesia has taken coordinated and integrated policy and effort, which can support sustainable and integrated preservation of biodiversity and its utilization.

Several important policies which include letter of authority or government regulations concerning biodiversity include Act No. 05/1992 concerning Conservation of Living Resources and Their Ecosystems, Act No. 24/1992 concerning General Plan of Land Use, Act No.05/1994 concerning Ratification of UN Convention on Biological Diversity, and Act No.23/1997 concerning Environmental Management. Moreover there are approximately 30 regulations in the field of biological diversity and wildlife conservation, including the ratification of the Convention on International Trade on Endangered Species (1978), the Wetlands Convention (1991), and various ministerial decrees on protected flora and fauna.

Acquisition of Information on Biological Resources

Documentation on biodiversity in Indonesia, at either genetic, species, or ecosystem levels, is vital for the protection and sustainable utilization of biodiversity itself. The availability of biological resource information is essential to decision-making and development planning, since there are so many economic sectors dependent on knowledge about the sustainable management of biological resources and about environmental resources.

Research on biodiversity has been encouraged among Indonesian intellectuals. The National Priority on Research and Technology Program that has been first formulated on 1992 by National Research Council and was reviewed every year put the research on natural resources, including biodiversity, in the highest priority together with some other disciplines. It is including researches and studies on socio-anthropology of the societies living in the forest and surroundings, inventory/stock assessment of floras and faunas that occupy the natural ecosystems, resource mapping, bio-prospecting, studies on habitat requirement, life cycle and physiology of floras and faunas that have been known its economical values, and research on in-situ as well as ex-situ conservation.

Bogor Agricultural University (BAU) is one among other institutions that pays great interest on research and education on biological resources and environmental management. The research umbrella at BAU in 1996-1998 is concentrated on bio-resources and environmental related topics, i.e. human basic needs in food, health and nutrition, energy and natural resources, and biotechnology. In 1996-1998, there were 247 research activities, from which 171 (69%) of them are bio-resources related topics (Saefuddin, 1998). Those researches were carried out by researchers in the seven faculties as well as in the research centers such as Center for Environmental Studies, Center of Studies for Tropical Biodiversity, Center of Studies for Bio-pharmacology, Primate Study Center, Center for Coastal and Marine Resource Studies, Inter-university Center for Biotechnology and Inter-university Center for Life Sciences.

Following the researches and studies, attempts have been made to organize existing data and information, either by respective data holders or groups of stakeholders. According to the investigations carried out by ARD (1999), at present there are at least 89 databases and other data resources residing in 46 different organizations in Bogor, Jakarta and Bandung areas, as well as in the Provinces of Central Java, Yogyakarta, North Sumatra, West Sumatra, North Sulawesi and West Kalimantan. The biodiversity data and information holdings documented include different levels of data and information on living things : molecular and genetic, species, and ecosystems levels. Data might include specimen collection data, such as those held in museums and herbariums, biodiversity data on particular subjects from field surveys or laboratory research, or bibliographic or reference data such as those found in libraries.

The latter can be considered directories to biodiversity data and information.

However, the data and information available in these organizations were found to vary widely in quantity, quality and accessibility. Many organizations keep their biodiversity data in "flat-file" databases. Such databases have no relational structure. A few organizations have developed or are in the process of developing relational databases. These databases were developed using Microsoft Excel or Lotus software, Microsoft Access software, dBase, Fox Pro, GUPTA, IMAGINE, Card Box, Oracle an so on. Such biodiversity data and information are usually also available in hard copy. Table 1 shows a list of some organizations with their data and information holdings.

The capabilities of the various organizations to effectively manage, share, and use the available data were also found to vary widely. At the same time, there was confusion about the intrinsic commercial value (or, often, the lack of value) of data as a commodity, as well as confusion about the legal and policy constraints for information sharing.

Use and Management of Information on Biological Resources

The use of biological resource data and information are wide-ranging, and include many levels and types of planning and management, policy making, investment and scientific research. For example, on planning, management and policy making, the landscape-based information is used for decision making on resource utilization, land use planning, integrated area development, environmental monitoring and management, and natural resource conservation. On investment, the landscape-based information as well as species-based information is used mainly for product development and product diversification. Researchers and scientists use biological resource information for scientific as well as educational purposes.

Yet while there is widespread appreciation of the importance and value of information on biological diversity, there have been few systematic attempts to organize and coordinate information about biodiversity nation-wide. The biodiversity-related information currently available in Indonesia are of very different kinds and quality and, in general, are divorced from policy applications. For instance, ecosystems data, where they exist, are rarely accompanied by information about these system's functions and economic value. Data are typically not geo-referenced, making it difficult to enhance their usefulness through the use of GIS. No formal framework currently exists for deciding what type of information ought to enter the public domain or which are the most valuable for policy, scientific, or commercial use (ARD, 1999).

In Indonesia, at least eight government agencies share responsibility for biodiversity management. These are the Ministry of Forestry and Plantations, the State Ministry for Environment, the Ministry of Industry and Trade, the Ministry of Agriculture, the Ministry of Health, the State Ministry of Research and Technology, the Ministry of Education and Culture, and the Ministry of Home Affairs. However, the linkages among these agencies in the area of biodiversity had not been effective, despite establishment of several committees and working group. While information sharing took place in an informal and ad hoc manner, they had little experience in sharing information in a more systematic, transparent way. Furthermore, they developed independent data and information resources. The situation worsened as gap, overlap, and incompatibilities between data and information resources multiply. Until then, in November 1991, these and other agencies and organizations met at a National Biodiversity Database Workshop in Jakarta and resolved to establish a national biodiversity database network to share information on biodiversity. However, because of lack of consensus on the type of network to use, deficiencies in the telecommunication system, and lack of domestic resources, the database network did not proceed at that time. Two year later, in 1993, the Biodiversity Action Plan for Indonesia recognized that the conservation of biodiversity is fundamental to In-

Table 1 Organizations and their biodiversity data holdings (ARD, 1999)

No.	Organization	HC	DB	GIS	Bib	OM
1	RDC for Biology LIPI	yes	yes	yes	no	no
2	RDC for Biotechnology LIPI	yes	yes	no	no	no
3	RDC for Geology LIPI	yes	no	yes	no	no
4	RCD for Oceanology LIPI	yes	yes	yes	yes	yes
5	RDC for Applied Chemistry LIPI	yes	no	no	no	no
6	RDC for Applied Physics LIPI	yes	no	no	no	no
7	Center for Scientific Documentation and Information LIPI	yes	no	no	yes	yes
8	Nature Conservation Information Center	yes	yes	yes	no	no
9	Forest Inventory and Monitoring Project-EU-INTAG	yes	yes	yes	yes	no
10	Forest Research and Development Center	yes	no	yes	yes	yes
11	Gunung Gede-Pangrango National Park	yes	no	no	no	no
12	Bunaken National Park	yes	no	no	no	no
13	Sub Balai KSDA for West Kalimantan	yes	no	no	no	no
14	Research Institute for Spice and Medicinal Crops	yes	yes	no	no	no
15	Research Institute for Veterinary	yes	yes	no	yes	no
16	Research Institute for Animal Production	yes	no	no	yes	no
17	Research Institute for Vegetable Crops	yes	yes	no	no	no
18	Research Institute for Food Crops Biotechnology	yes	yes	no	no	no
19	Research Institute for Rice	yes	yes	no	no	no
20	Pharmacy Research Center, Ministry of Health	yes	yes	no	no	no
21	Health Ecology Research Center, Ministry of Health	yes	yes	no	yes	no
22	Library Information Center (PIP)	yes	no	no	yes	no
23	BAKOSURTANAL	no	no	yes	no	yes
24	Dept. of Forest Resource Conservation, IPB	yes	no	yes	no	no
25	Dept. of Biology, FMIPA ITB	yes	no	no	no	no
26	Dept. of Biology, FMIPA UNPAD	yes	no	no	no	no
27	Herbarium FMIPA UNAND	yes	yes	no	no	no
28	Faculty of Biology UGM	yes	no	no	yes	no
29	Museum of Biology UGM	yes	no	no	no	no
30	Faculty of Forestry UGM	yes	no	no	yes	no
31	Birdlife International-IP	yes	yes	yes	yes	no
32	The Nature Conservancy	yes	no	yes	yes	no
33	Wetlands International-IP	yes	yes	yes	yes	no
34	WWF - IP	yes	yes	yes	yes	no
35	CIFOR	yes	yes	yes	yes	no
36	PROSEA	yes	yes	no	yes	no
37	SEAMEO-BIOTROP	yes	yes	yes	yes	no
38	Insect Museum and Butterfly Park TMII	yes	no	no	no	no

Note :

HC : Hard Copy
DB : Computerized Database
GIS : GIS format database
Bib : Computerized Bibliographic
OM : Directories to Biodiversity Data set

donesia's development, and again stressed the need to make biodiversity information more accessible to the users. In 1996, the Asian Development Bank (ADB) fact-finding mission reached an understanding with the Government of Indonesia to formalize the objectives and scope of National Biodiversity Information Network (NBIN), and in 1998 funded a project preparation technical assistance to design an investment program to establish NBIN as a legal entity.

The investment proposed for NBIN is intended to establish a practical and sustainable computer information network for providing geo-referenced biodiversity information in a format, quality, and accessibility suitable for planning and decision making which will promote wise use of natural resources. This national network will link existing initiatives, and bring in additional organizations not currently included in these initiatives, in a comprehensive nationwide system for sharing, integrating, using, and communicating information about biological diversity. The project will be designed to establish a national reference center for biodiversity conservation, studies, and utilization ; participate in the establishment of a global biodiversity information network to accelerate the flow of information to researchers, planners, and decision makers ; bring about a transformation in the biodiversity information community from the traditional slow, tedious system of peer-reviewed scientific papers to effective utilization of instantaneous communication ; and facilitate structured identification of and efficient response to users' needs in the field of biodiversity (ARD, 1999).

The ADB-funded projects First and Second Land Resources Evaluation and Planning (LREP) and Marine Resources Evaluation and Planning (MREP) gave a strong impetus to the development of natural resources information system in Indonesia and have addressed many aspect of networking, hardware and software selection, data formats, data exchange formats, and legal issues such as intellectual property rights. These projects will be followed by Marine Resources Mapping Project (MAREMAP) and Coral Reef Rehabilitation and Management Project (COREMAP) under ADB's Country Assistance Plan for Indonesia (1999 -2001) which, together with the proposed NBIN project, will build on their pioneering work. In addition to these Bank-funded projects, other biodiversity information project in Indonesia, e.g. Global Environmental Facility (GEF) Biodiversity Collection Project and JICA Biodiversity Conservation Project carried out within the Research and Development Center for Biology of Indonesian Institute of Sciences, have increased the content of databases for potential inclusion in NBIN.

Information and Information Technology for Education

The information necessary for education is available in various media, including in the internet. However, in general, Indonesian educators, including agricultural and environmental educators either in the elementary, middle and higher education levels, use information on traditional fashion, i.e. by using printed materials such as books and periodicals. Some educators utilize the latest information available in the CD-ROMs or in the internet to enhance their teaching materials, but still this is not the trend. Due to this situation, the fast and continuous development of science and technology formally will not be able to be brought to the class immediately. Because, even in the developed countries, the process from laboratory invention up to the printed and distributed materials will take at least five years of time (Rifai, 1994) while in Indonesia the delay could be as long as fifty years (Redjeki, 1997). Therefore there is a strong need to implement information technology for educational purpose to increase the quality of education.

An attempt to implement information technology for higher education has been promoted by Bandung Institute of Technology (ITB) (Ahmad, 1998). Since October 1996 up to now, in its capacity as research partner of WIDE (Widely Integrated Distribute Environment) Project and JSAT (Japan

Satellite System, Inc.) in the Asian Internet Interconnection Initiates (AI3), ITB in cooperation with several universities and research institutions has been developing internet gate in each institution along with human resource training. The universities and research institutes which have been on the link are 20 institutions. Web hosting to educational and research institutes, link to several national discussion group in the internet (mailing list) from many fields of science, and video conference facility through internet in scientific society are the services, among others, available from AI3-ITB link.

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Indonesia : Discussion

Q : It is undeniably true that Indonesia is endowed with rich biological resources. This means that the country attracts a lot of scientists from other countries who earn their PhD's in their home countries. Is there a way in which the government is able to capture some of the information collected by foreigners (foreign scientists), so that the information will be available locally?

A : Indonesia signed and ratified the United Nations Convention on Biological Diversity in 1994. The contracting parties agree to facilitate exchange of information that also includes repatriation of the information to the country of origin. From that point, we may expect to have some of the information collected by foreigners to be available locally. For that purpose, there are some regulations for foreigners doing research in Indonesia including the obligation of declaring research objectives and having local counterparts. All of these are documented to enable the tracing back of information for future use.

Q : What can be done to ensure easy and rapid access to research information? Information hidden from the public domain is not likely to enrich curricula in schools and extension programmes. Can't the information so generated be put in simple -and easy to use or understand - manner?

A : There are two ways to ensure easy and rapid access to information. First is to encourage researchers and scientists to write their research results in popular articles (besides their scientific publication), and then publish it through newspaper, magazines or internet web pages. Second is to encourage universities to take an active participation on extension activities. In Indonesia, especially in the Ministry of Education (before : Ministry of Education and Culture), Directorate General of Higher Education, there are some programs that encourage university staff to apply their research activity results directly to the society, such as Voucher program, Service and Industrial Unit Program, etc.

Q : How do you encourage locals to participate in biodiversity conservation in Indonesia? Is it by employment or royalties or return of the information results?

A : Unfortunately there is still no scheme of giving royalties to the local community. However, there is a significant return to them whenever they participate in biodiversity information collection and management, i.e. in terms of conservation program. The conservation program ensures the sustainability of the resources they use for their livelihood.

Q : You mentioned that there are nine (9) agencies in the Indonesian government in charge in bio-diversity conservation. Are there no overlaps in their functions?

A : Besides their specific functions there are overlaps in their functions and this is the reason why there is a need for coordination. For that purpose we have three coordinating ministers, i.e. for economic, finance and industrial affairs ; welfare affairs ; and politics and security affairs.

Comments from New Zealand delegate:

Intellectual property rights-loss for indigenous peoples should set at least royalties to assist indigenous development, to contribute to local sustainable development.

Protection of knowledge is very difficult with modern high technological communication systems. Knowledge always tends to "leak".

Research findings need to be transferred into "common language"

4. Information Network for Agricultural and Environmental Education in the Republic of Korea

Yeo-Chang YOUN

Introduction

The cyber networks are rapidly expanding as the information and telecommunication technology advances in many countries. The Republic of Korea is one of such countries experiencing a rapid range in the information technology. The changing environment of the society provides challenging opportunities to accommodate the new information technologies in the education systems, whether it is formal or non-formal. In this paper the author sketches the current situation of Korean agricultural and environmental education information network at the moment. Due to the limited information landscape open to him, it should be acknowledged that the coverage of this paper is not complete.

Information Network for Agriculture in Korea

There are basically two kinds of information needs for agricultural sector in Korea: One is needfor research information by agricultural scientists in universities and research institutes while the other is for farmers' need for technical and market information related to agriculture.

Although the information network based on Internet is rapidly developing in nearly every sector of the society, Korean farmers still heavily rely on other sources such as publications and mass media in the collection of their information for their business. About five percent of Korean farmers utilize computer-based system in the search of information for their business even though about one fifth of rural households are equipped with personal computers. Among these households with PC only 15 percent utilize computer for their work related to agriculture and other related works while the other for education of their children.

The government of Korea has initiated the development of information infrastructure in rural communities by establishing a public information company called Korea Information Center for Agriculture, Forestry and Fishery in 1992. Prior to this, the Government supported the collection and distribution of marketing information related to agricultural and fishery products.

The center develops databases for production technologies, management systems and marketing information of agricultural sector and distributes the information to anybody who needs the information. The center has an education program for farmers' information skill development.

The Rural Development Administration of Korean Government operates its own information center, which keeps databases on agricultural technologies, climate information for farmers and cyber extension services. There are other organisations, which offers information services on agriculture. Among them are Korea Agricultural Cooperatives Federation and Seoul National University's Agricultural Library. Korean Agricultural Cooperatives Federation provides marketing information to farmers and consumers of agricultural products.

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The Seoul National University Library's Agricultural Branch has developed an information center on agricultural and life science research information supported by Korea Science and Engineering Foundation since 1995. This center provides research information to member scientists and research institutes on line based on computer systems. The Library of Rural Development Administration has played a key role in the dissemination of research information along with the SNU Library system.

Information Network for Environmental Education in Korea

The social demand for environmental education is increasing reflecting the deteriorating quality of environment in the Republic of Korea. According to a survey done myself on the need for information of environmental education in Korean schools, the teachers collect information for environmental education from mass media in most cases. The Government of Korea has initiated the expansion of electronic information infrastructure for schools by providing PCs in every school equipped with telecommunication networks. The electronic information infrastructure in schools will be completed by the year 2002 by the national plan.

The Ministry of Education has created a special bureau of education information services, which implements the national plan for education information systems. The Ministry has also created a number of supporting agencies, which provide information services for researchers, educators, students, and the general public. Among the information services is the EDUNET, which is run by Korea Education and Research Information Service and provides a wide range of information for educational systems. (http://www.keris.or.kr/indexnew.htm)

The information for environmental education is mainly provided through the information network of Ministry of Environment (http://www.me.go.kr) and NGO (non-governmental organizations) working for environmental protection. One of NGOs providing information for environmental education is KSDN (Korean Sustainable Development Network (http://www.ksdn.or.kr).

KSDN will develop information sources and help the environmental organizations to manage their own information systems and educate the general public how to use computer-based information. Its primary goal is to make the domestic information for sustainable development accessible to any ordinary person in our society. KSDN make efforts in enhancing the circulation of domestic environmental information and also try to exchange the environmental information with other countries.

Korea Federation of Environmental Movement, the largest environmental NGO in the Republic of Korea is also provide a cyber information network for the general public while there are many private information providers are entering the environmental information market. There are also many cyber education units, which are being established by universities as well as private companies and pubic institutions.

Conclusion

The education environment is changing rapidly as the information technology advances in many industrialized countries including the Republic of Korea. More information can and will be provided to educators, students and the general public via telecommunication systems. There will also be more opportunities for one country to share her experiences with other nations once the information technology spreads out.

Korea : Discussion

Q : Regarding the Seoul National University (SNU) information system : How is the information system being maintained and updated?

A : The SNU Library has an interest in keeping the information services on agriculture and life sciences for the benefit of its own faculty and students' research and education. With regards to the financial resources for maintaining and updating the information systems on agricultural and life sciences, funds come from internal budgets and external sources. One of the external financial sources is the membership fee of the information services on agricultural and life sciences.

Q : What kind of information is usually required by farmers in the Republic of Korea and how do they make efforts in searching for the information they needed?

A. Korean farmers demand for marketing information in most cases, they seek information on production technologies of newly emerging commodities.

Q : How about the government, what kind of information do they require from the agricultural sector for their policy making activities?

A : The government of Korea makes an open statement on their policies in each sector in January every year. Newspapers and journals transmit the policy statements into reports in the media. The government also puts the policy statements on the Internet homepage.

Q : Kindly shed some light on the economics of information dissemination i.e. the use of information technology viz. a viz. use of extension officer.

A : The extension services via internet should be more efficient in terms of economics in the area of marketing and policy information related to the farming sector. While the field operation of extension services through extension officers can be more informative in the area of technical information in agriculture and forestry.

Q : Do you find farmers requesting information and seeking from the Korea Information Center? How accessible is the information?

A : The Korean farmers are keen in searching for better information on marketing and technical information for their business in agriculture and forestry. Some of them make use of the information provided by the Korea Information Center for Agriculture, Forestry, and Fisheries. But majority of the farmers is not yet able to access information via telecommunication systems due to limited physical infrastructure available to them in rural areas. The Korea Information Center for Agriculture, Forestry, and Fisheries provides training course for farmers on the utilization of computer based information systems.

Comment from New Zealand delegate :

Farmer access to data bases-made easier and attractive if designed from the point of view of the farmer end user. New Zealand has privatized agricultural extension services-now serviced by consultants. Government does not have a direct involvement in agriculture decision-making. Driven by the market-with environmental safeguards-monitoring outcomes.

5. New Best Practices and Changes in Agricultural and Environmental Education in New Zealand: a review of the 1990s

Bruce W. J. TREEBY

Abstract

This paper discusses the main factors that have contributed to changes in agricultural and environmental education in New Zealand during the 1990s. The part played by central and regional government, the strategies, applications and new initiatives that include the measurement of environmental performance are also discussed.

As the 1990s have progressed, there has been an increasing focus on

- sustainability
- the need for greater environmental protection and more effective environmental education
- community based action on land-care issues
- market driven eco-certification
- the accelerating accessibility and application of Internet-based technology to obtain global and regional information.

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New Best Practices and Changes in Agricultural and Environmental Education in New Zealand: a review of the 1990s

Terms

In this paper, best practice indicates a process of continuous improvement in environmental management. Agriculture refers to pastoralism and cropping, including horticulture, tree crops and forestry. Education includes the formal and informal transfer of knowledge and technical information.

Introduction

The single principle that dominated agriculture and resource management generally in New Zealand up until the late 1980s was that *economic development is a good thing*. This had little consideration for the wider impact

of associated environmental damage, for example, continued loss of indigenous biodiversity. In the late 1980s and early 1990s there was a growing change of attitude to *development is a good thing provided it is ecologically sound*. As the 1990s progressed, more people began thinking *development is not a good thing unless it is environmentally sound*[1] and recognised the need to rationalise a lot of separate legislation that related to the management of the environment.

In the restructured New Zealand economy, government advisory services were privatised and local communities were encouraged to take responsibility for their agricultural investments. Research has shown that farmers have an extensive information network and that there is a clear distinction between production and sustainable/environmental advice.[2] Farmers have to integrate both production and sustainable practices to be economically and ecologically sustainable. It is critical that the benefits of this integration are made clear if environmental improvement measures are to be adopted by land users.[3] It is equally important that the people advising farmers make that connection too.

Over the past decade, leading rural producers have become aware that a good environmental understanding is essential if they are to optimise sustainable production.[4] The range of reasons includes

- having to meet international, national and regional environmental regulations and standards, for example, for biodiversity and food safety
- consumer demand for products to meet environmental quality assurance criteria
- better market access and the potential for products with a verifiable 'clean green' label to achieve a market premium
- the desire to operate more efficiently and intelligently in order to minimise waste.

This awareness has led to a focus on the application of sustainable management to resource use. The meaning of sustainability and what it applies to is continually debated. Simply, it means economically and ecologically sustainable. The change of focus to sustainable management of resource use in New Zealand occurred because of the implementation of the innovative Resource Management Act 1991, which helps promote environmental best practice.[5]

The Resource Management Act (RMA) 1991

The RMA has a holistic ecosystem approach and consolidates most of New Zealand's resource management legislation in conjunction with two other principle pieces of environmental legislation: the Environment Act 1986 (environmental policy-making role), and the Conservation Act 1987 (conservation of protected Crown-owned lands). In practice, the application of the RMA has demonstrated that some areas of the Act need amendment. An amendment of the Act occurred in 1997 and another review is under action at this time. It includes discussions of definitions of environment, concern over how people are affected by various processes and the values that people ascribe to the world they live in.[6]

The RMA provides the legislative framework in which agriculture producers operate. The purpose of the Act is 'to promote the sustainable management of natural and physical resources'. This evolved from the concept

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[1] Cocks, Doug., *Future Makers, Future Takers*, Adelaide: UNSW Press, 1999.

[2] Bradshaw, K, and P Williams. 'Information and communication needs to assist the adoption of sustainable land management practices in North Island Hill Country, *MAF Policy Technical Paper 99/5*, Wellington: Ministry of Agriculture and Forestry, 1998.

[3] Nimmo-Bell, 'Evaluation of sustainability behaviour change projects' *MAF Policy Technical Paper* 99/6, Wellington: Ministry of Agriculture and Forestry, 1999.

[4] 'The role of on-farm quality assurance and environmental management systems (QA/EMS) in achieving sustainable agriculture and sustainable land management outcomes.' *MAF Policy Technical Paper* 98/2. Wellington: Ministry of Agriculture and Forestry, 1998.

[5] *Resource Management Act* 1991.

[6] Ministry for the Environment. *Proposals for amendment to the Resource Management Act*. Wellington: Ministry for the Environment, 1998.

of sustainable development promoted at the World Commission on Environment and Development 1987, and further developed at the 1992 Rio Earth Summit. The RMA also requires consideration of the indigenous Maori cultural view of sustainable resource management, involving kaitiakitanga (guardianship), an ethic of stewardship, and account must be taken of the principles of the Treaty of Waitangi (Te Tiriti o Waitangi).

The RMA has an effects-based approach. This provides incentives for resource users to come up with efficient and creative ways to achieve good environmental results. While the central government develops national policy statements and environmental standards to address issues affecting the whole nation, district and regional councils apply the RMA locally, and responsibility for this lies with the local community through the implementation of the district plan.

The RMA requires local authorities to monitor

- the state of the environment in their area
- whether their policy statements or plans are working as intended
- whether resource consents and related conditions are carried out properly.

The next most significant initiatives relevant to this paper are contained in the 'Environment 2010 Strategy',[7] released in 1995 and developed for central government by the Ministry for the Environment (MfE). The MfE has responsibility for policy-making formula on environmental issues nationally and also manages the Sustainable Management Fund that supports practical initiatives to help achieve sustainable management of resources.

Environment 2010 -A National Strategy for Change

The objective of Environment 2010 was to coordinate, evaluate and monitor a range of environmental initiatives to meet a wide range of environmental goals. The strategy included the need to benchmark the current state of the environment. This enables the identification of priorities in resource management and the measured environmental effects of actions taken, using environmental indicators. A national Environmental Indicators Programme (EPI) is being developed and refined to assess the health of the environment.

The objectives of the EPI[8] programme are to

- systematically measure the performance of environmental policies and legislation illustrating trends over time and space
- better prioritise policy and improve decision making, for example, respond to trends
- systematically report on the state of New Zealand's environmental assets, describing the risks to or pressures on the environment.

In 1996, central government funded a Green Package[9] to implement the medium term goals of Environment 2010. Goals and outcomes to date are

- **better environmental information and understanding and new education initiatives**. Outcome — publication of *The State of New Zealand's Environment* 1997,[10] *Our Chance to Turn the Tide : New Zealand's Biodiversity Strategy*, 1998[11]
- **more sustainable resource use**. Outcome — development of the Sustainable Land Management Strategy
- **less pollution**. Outcome-development of

[7] Ministry for the *Environment. Environment 2010 strategy : a statement of the government's strategy on the environment*, Wellington : Ministry for the Environment, 1995.

[8] Ministry for the Environment. 'Confirmed indicators for air, fresh water and land', and 'Summary of proposed indicators for terrestrial and freshwater biodiversity.' In *Environmental performance indicators*. Wellington : Ministry for the Environment, 1998.

[9] Green Package, 1996 Government Budget. Wellington : Published under the authority of the New Zealand Government, 1996.

[10] Ministry for the Environment. The state of New Zealand's environment 1997. Wellington : Ministry for the Environment, 1997.

[11] Ministry for the Environment. *Our chance to turn the tide : New Zealand's biodiversity strategy*, Wellington : Ministry for the Environment, 1998.

national standards under the RMA, voluntary domestic and municipal waste minimisation initiatives,[12] greenhouse gases reduction Kyoto Protocol 1997

- **reducing pest and disease risk**. Outcome — Hazardous Substances and New Organisms Act 1996, establishment of the associated Environmental Risk Management Authority[13] (ERMA New Zealand), and the Biosecurity Authority[14] (established in 1999).

It is important when considering these goals to realise that while central government develops the overarching policy guidelines, the implementation and development is done by local authorities (district and regional councils). They recognise that they have a key role in educating their communities. Regional councils are innovative in agricultural and environmental informal education. I will now look briefly at recent changes in formal education and sustainable land management, the first two goals of Environment 2010.

Changes in Formal Education

From the 1996 Green Package, the government adopted a national strategy on environmental education and a discussion document, *Learning to Care for Our Environment* was published in 1996,[15] Education was clearly seen as the key to providing people with the knowledge, awareness, attitudes and values that would help them play their part in sustaining the environment throughout their lives. To support the strategy in schools, the Ministry of Education in 1999 produced *Guidelines for Environmental Education in New Zealand Schools*.[16] This shows how environmental education can be undertaken within each of the essential learning areas of the curriculum for primary and secondary levels.

In 1995, 28 universities and polytechnics became signatories to a national programme called Environmental Responsibility in Tertiary Institutions,[17] The three key areas were the sustainable management of the institution including annual environmental performance reporting, the promotion of environmental education across all curricula, and encouraging sustainability in research programmes. The programme for 1999-2000 includes a Web site to aid communication between institutions.

While local authorities have a key educational role in their regions, other non-government organizations, such as environmental groups like the World Wide Fund for Nature,[18] have education as part of their core business. Their education facility in Wellington will offer curriculum-based primary, secondary and some tertiary programmes to 12,000 students in 1999 as well as 3000 students from the United States of America under the People to People programme.

The Sustainable Land Management Strategy (SLMS)

The SLMS extended the coordination with other government agencies, in particular the Ministry of Agriculture and Forestry,[19] which manages the Sustainable Agriculture Facilitation Programme. Innovative outcomes include

- funding the New Zealand Landcare

[12] Target Zero, a waste minimisation and recycling scheme for business and industry adopted by a range of New Zealand businesses, which encourages them to cut down on waste, and emissions, and save money through industrial auditing or processes.

[13] ERMA assesses the risks and makes decisions on the use of hazardous substances or the importing, development or release of new organisms, including genetically modified organisms. www.mfe.govt.nz

[14] www.maf.govt.nz

[15] Ministry for the Environment. Learning to care for our environment : a national strategy for environmental education. Wellington : Ministry for the Environment, 1998.

[16] Ministry of Education. *Guidelines for environmental education in New Zealand schools*. Wellington : Ministry of Education, 1999.

[17] 17. Environmental Responsibility in Tertiary Institutions, programme co-ordinated by the New Zealand Natural Heritage Foundation, Massey University, Palmerston North.

[18] www.wwf.org.nz

[19] www.maf.govt.nz, and publications on resource management such as the RM Update series

[20] www.landcare.org.nz

Trust[20] to train a national network of land care and community group facilitators and help and set up land care groups

- publishing best management practice guidelines for land users[21]
- coordinating land management research, including the development of environmental standards and guidelines for water and soil quality and sustainable land management indicators
- promoting voluntary and market incentives for sustainable management
- developing sustainable agriculture education kits for schools.[22] By 1996, a cross -curricula resource had been developed and delivered to all secondary schools in New Zealand by the Ministry of Agriculture and Forestry. There are three parts to the series, *Living with the Land, Changing People in a Changing Land, and Our Land, Our Future*. The material includes text, videos and software. Teachers use it widely in a range of curricula.

Land care Groups - Community Based Change

The key principle of the government's Sustainable Land Management Strategy is that *the primary responsibility rests with the individual user*. The best results have been achieved where communities work together to address rural issues. There are now more than 200 Landcare groups in New Zealand and many more aligned groups. For example, the New Zealand Landcare Trust cooperates with the NZ Dairy Board's 450 Livestock Improvement Groups, which while having a major focus on production, are also looking at applying an integrated sustainable approach. Another example of a 1990s innovation in best practice is the Monitor Farm Resource Kit.[23] This was developed by the agriculture industry, and involved farming families and community groups. The Ministry of Agriculture and Forestry has Focus Farm and Focus Orchard initiatives promoting environmental sustainability. These have been very successful in reinforcing changes in attitude and the uptake of new ideas particularly when a local farmer can demonstrate success in sustainable management.

The New Zealand Landcare Trust has four main strands to its operations: to support and encourage; assist with training; to be involved in research; and to be effective in technology transfer. In giving support and encouragement to land care groups, it is very important that the Trust does not appear to dominate. There must be a strong local base to the operation so that the local people have actual ownership of the problems and the solutions.

Farmers in general do not like training programmes. In response, the Trust has called its training programmes group action programmes (GAP), and these have been acceptable. GAP has a people focus, develops conflict resolution skills, communication and strategic planning, and to a lesser extent technical application, such as the basics of tree planting. Often the problem is not primarily technical but is rooted in social issues. Having worked past that, and gained community support, communal action is possible. It is important that members of the groups can monitor and evaluate the progress of their operations. There are also higher level professional training programmes for members of agencies who work with rural communities.

The Trust acts as an interface between research providers and end users. A land care group commonly identifies an issue and the Trust assists them to find a suitable research provider, ensuring that the research is targeted, relevant and participatory (in accordance with the community's requirements) and is supported by environmental effectiveness

[21] www.mfe.govt.nz

[22] www.maf.govt.nz/MAFnet/index - see under Schools

[23] www.meatnz.co.nz/FILES/Monitor/monitor

[24] Blakeley, J, M Rush, and R Callaghan. *Environmental education: a guide for programme providers* Wellington: Ministry for the Environment, 1999.

research.[24]

Most significantly, the Landcare Trust promotes the coordination and collaboration of information and knowledge between landcare groups, organizations and communities. It maintains a database on land care and raises the awareness of the land care ethic and promotes it to the wider community. It actively promotes sustainable land management through seminars and workshops. Land care groups are often beneficiaries of Sustainable Management Fund projects.

Financing Change - The Sustainable Management Fund, (SMF)

The SMF[25] is managed by MfE and funded by central government and provides support for practical initiatives, which help achieve the sustainable management of resources. The Fund focuses on projects that are practical, have national benefit, are active in consultation with stakeholders and demonstrate community demand. The focus is also on information transfer to end users, such as agricultural communities, rather than pure research. Project outcomes include resource kits, guidelines, reports, training programmes, databases, and decision support programmes. Examples of the outputs from the Fund are noted below.

The Land and Water Management Seminar - June 1999

Land-focused programmes

- North Otago Sustainable Land Management (NOSLaM) Project :[26] promotes a range of sustainable land management systems for different land uses and ISO 14001 accreditation. Includes dairying, intensive horticulture, and sheep farming.
- Franklin Sustainability Project :[27] intensive horticulture, minimisation of soil loss, nitrification of ground water from fertiliser, and integrated pest management.
- Sustainable Environmental Management for Dairy Farmers : an integrated on -farm quality management system, safe methods of effluent disposal, and two manuals, '*Managing Farm Dairy Effluent*'[28] and '*Farm Management Issues*'.

Water-focused programmes

- Stream Sense :[29] an action research programme developed for use by schools to monitor the environmental quality of streams in their area. Experience has shown that if you involve the school, you get the whole community involved.
- Stream Health Monitoring and Assessment Kit, SHMAK :[30] developed by scientists in consultation with landowners to enable them to self-monitor the environmental effects of their actions. The methods are simple and scientifically valid, and are able to support quality assurance programmes.

The Need for More Effective Environmental Education Delivery

In 1998, the MfE set up a project called Guidelines and Case Studies on the Development, Implementation and Evaluation of Environmental Education Programmes. A major output was a manual called *Environmental Education : A guide for Programme Providers - how to develop, implement and evaluate strategies and programmes*[31]. The associated review of the literature is of major value.[32].. It is significant that the core principles of developing an effective environmental

[25] www.mfe.govt.nz

[26] Waitaki District Council, PB 50058, Oamaru

[27] Agriculture New Zealand, PO Box 8, Pukekohe

[28] Heatley, Phil, et al. *'Dairying and the environment : managing farm dairy effluent'*, Palmerston North : New Zealand Dairy Research Institute, 1996.

[29] Environment Waikato, PO Box 4010, Hamilton East

[30] Biggs, Barry, et al. *Stream monitoring and assessment kit (SMAK).* Christchurch : NIWA ; and NZ Federated Farmers, 1998.

[31] Blakeley, J, M Rush, and R Callaghan. *Environmental education : a guide for programme providers*. Wellington : Ministry for the Environment, 1999.

strategy programme and activities on analysis match the successful community-based rural initiatives. To be effective they must

- respect the values, perspectives and rights of all those involved
- be developed as a partnership.

A supporting project, a national directory of environmental education resources was published in 1999.[33] This was designed for practical use by teachers, local government, community groups and individuals.

Below are three examples of the regional application of agricultural and environmental education in New Zealand, where local government authorities play a major role : Environment Waikato,[34] Taranaki Regional Council,[35] and Otago Regional Council.[36]

Three Regional Government Examples

Environment Waikato (EW)

EW is responsible for 25,000km^2 of land and 350,000 people in the central North Island. It has the most dairy farms in the country and one of the largest concentrations of dairy cattle in the world graze outdoors all year round.[37] The agricultural waste from animals in Waikato is equivalent to the body waste of 10 million people and the safe disposal of animal waste is a major issue. It must be kept out of waterways and ground water systems. Fertilisers applied for grass growth are also an environmental risk.[38] The community perception of the most important environmental issues puts water pollution and waste disposal well above other issues.

EW has identified a series of significant environmental resource issues concerning land and soil and they have sustainable land management initiatives in place. A major concern involves the design and delivery of an environmental education programme to land users. Activities include

- establishing and assisting land care groups, supporting land care education in all schools, especially with respect to water quality and how to carry out monitoring
- promoting sustainable land management services to landowners. This includes publication and distribution of newsletters, information sheets and displays, facilitating educational workshops and field days.
- assisting with the development of industry codes of best practice and environmental guidelines.

Other activities include soil, water, and vegetation conservation, pest control and promoting a catchment-based approach to land and water management. Research has shown that farms involved in a community/district approach place a higher priority on environmental outcomes compared with single farms that tend to have a production focus.[39]

EW makes Farm Environment Awards[40] each year publicising how landowners have combined sustainable farming for profit with good environmental management. Increasingly, computer modelling is used to assist

[32] The Open Polytechnic of New Zealand and Agriculture New Zealand. *Towards a set of principles for effective environmental education strategies and programmes and their evaluation : a review of the literature*. Ministry for the Environment, 1999.

[33] Ministry for the Environment. Environmental education directory : New Zealand. Wellington : Ministry for the Environment, 1999. www.eednz.org.nz

[34] Email : inforeq@wairc.govt.nz. Web site under construction.

[35] Email : info@trc.govt.nz. Web site under construction.

[36] www.orc.govt.nz

[37] *Waikato State of the Environment Report 1998*. Hamilton : Environment Waikato, 1998.

[38] UNEP, *Global Environment Outlook 2000*, United Nations Environment Programme, 1999. www.unep.org/unep/eia/geo2000/ov-e/index , nitrate pollution a major environmental problem.

[39] Nimmo-Bell, 'Evaluation of the focus farm and orchard programme'. *MAF Policy Technical Paper* 99/6, Wellington : Ministry of Agriculture and Forestry, 1999.

[40] Farm Environment Award Trust, PO Box 4464, Hamilton East. Email : farmenvironment@clear.net.nz, publishes the annual farm environment award and description of the environmental management

farmers to make decisions about farm management, the management of different soils and aspects, the timing and selection and rates of fertiliser application and to factor in indicative climate information. This lets farmers make decisions months in advance with far greater accuracy than does simply responding to weather changes or product prices to affect decisions. Soil and plant tissue tests determine what fertiliser needs to be applied. Applying fertiliser no closer than 40 metres from streams protects the streams and avoids waste run-off. Increasingly trees are being planted along fenced off riparian strips. This helps reduce run-off into the streams and the shade improves the stream habitat for aquatic life.[41]

Taranaki Regional Council (TRC)

The TRC is responsible for 72,361 km^2 of land, 110,000 people in the western central North Island, and is a major dairying area. It has embarked on an extensive riparian strip protection of streams to improve water quality and it is protecting an additional 140 km of streams per year.

Education promotes a better environment, and a newsletter called SITE, *Schools in the Environment*,[42] which discusses environmental issues and solutions, is sent regularly to all schools in the region. For landowners, a series of sustainable land management information sheets is available. Taranaki also includes some steep erodible lands, and farm-planning services are available including the use of forest crops on steeper lands.[43] Computer modelling is used to test the different land use and management options.[44] In the future, remote sensing and Geographical Information Systems (GIS) will be used for better environmental management.[45]

Otago Regional Council (ORC)

ORC[46] carry out similar sustainable land management objectives to EW and TRC. ORC is responsible for 32,000 km^2 of land and 188,300 people. Otago, near the bottom of the South Island, is subject to summer droughts and ORC has a very comprehensive Web site that has climate and pasture/crop management information that is regularly updated. This information assists farmers with forward planning to minimise potentially adverse climatic impacts. ORC buys the information from the National Institute of Water and Atmospheric Research (NIWA). NIWA accesses global information and combines it with regional weather stations to give land users environmental information. Farmers can also subscribe to a monthly more local detailed climate service from NIWA called Climate Now.[47] The subscriber is given an access code and can get relevant information from the NIWA website.

Topoclimate South

The Topoclimate South[48] project is a major Southland community initiative aimed at providing key information on the land resources in the southern part of New Zealand. It was launched in 1999 and is a New Zealand example of innovation combining climate and land information. It assists landowners to combine the soil and microclimate with the best crop match for a more

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[41] *Management of Riparian Margins in Taranaki - implementation strategy*. Stratford : Taranaki Regional Council, 1993.
Sustainable land management programme series, 23 to 28. Stratford : Taranaki Regional Council, no date. Waikato state of the environment report 1998. Hamilton : Environment Waikato, 1998.

[42] *SITE Newsletter*. Taranaki Regional Council, PB 713, Stratford. Email : Paul.Radich@trc.govt.nz

[43] Agroforestry Estate Model, www.fri.cri.nz/products/aem

[44] Knowles, L, and B Manley. 'FRI Modelling systems help evaluate profitability of agroforestry.' *What's new in forest research*? no.207. Rotorua : Forest Research, 1991. www.fri.cri.nz The example given shows how tree plantings on the Taranaki agroforestry study farm are expected to treble future farm net income, and protect the environment.

[45] MAF is developing a Geographic Information System (GIS) creating a land cover data base. Email : thompsons@maf.govt.nz

[46] www.orc.govt.nz

[47] *Climate now*. NIWA. www.niwa.cri.nz for climate information Climate update. NIWA, www.niwa.cri.nz/ncc

[48] www.topoclimate-south.co.nz

sustainable future. Automated thermal recording devices called data-loggers are used on agricultural land over a year to develop growing-degree-day maps of the landscape. Soil mapping information is collected and the combination of the technical interpretation of the soils and the climate allows a completely new look at land use options, the scope for new agricultural and tree crop ventures, and provides the real potential to revitalise rural areas by creating more employment opportunities.

Agroforestry and Forestry

With the removal of agricultural subsidies in the 1980s, marginal lands reverted to native forest or were available for establishing exotic forests. There was a rapid increase in new plantings up to the mid-1990s easing back in the late 1990s. The increase in tree cover has had environmental benefits and there has been an increase in agroforestry (farm forestry). An increase in tree planting for shelter will improve irrigation efficiency and animal welfare. The resulting increased exotic forest cover has raised debate over the environmental impact, and there has been useful research to address this.[49] [50]

Voluntary initiatives taken by the forestry industry that reflect environmental change include the two agreements between environmental groups and the forest industry, The New Zealand Forest Accord 1991 and Principles for Commercial Plantation Management in New Zealand 1995. There is also the New Zealand Forest Code of Practice 1991 and 1993, a voluntary code produced by the Logging Industry Research Organisation (LIRO). A major driving force in this change to an environmental focus was the desire of the forest industry to gain market access for sustainably-grown forest product that did not involve the destruction of rainforests. Market access is now being driven by eco-certification criteria.

Better sustainable management of indigenous forestry is the objective of the government's Forests Amendment Act 1993[51] involving regulatory plans and permits.

Current Changes and Trends

Signals from consumer-aware high-value markets will continue to promote sustainable land management practices, including the greater use of trees for soil and water conservation and for animal welfare. Producers will increasingly work with companies that process and market agricultural produce for export markets that want assurance that food is safe and that timber comes from sustainably managed forests that protect indigenous biodiversity. Importers of New Zealand's products indicate future requirements will be for accreditation and traceability (eco-certification) and this will require education of the producer. These market-driven changes will speed up the implementation of best practice in land management, which is at present moving slowly[52] because it depends upon voluntary initiatives in an economic environment of falling commodity returns.

The decline in the political power of the agriculture lobby that has occurred during the 1990s will continue. The agriculture lobby has become increasingly marginalised. Regional plans that include large urban populations will increasingly reflect the urban view of the

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[49] Maclaren, J P. 'Environmental effects of planted forests in New Zealand - the implications of continued afforestation of pasture', *FRI Bulletin* No. 198, 1996.

[50] Cody,Anna, comp. *Bibliography on the effects of forestry on the New Zealand environment*. Rotorua: Liro Ltd, 1997.

[51] Forests Act 1949 was amended in 1993 'to promote the sustainable forest management of indigenous forest land'.

[52] Bradshaw, K, and P Williams. 1998. 'Information and communication ceeds to assist the adoption of sustainable land management practices in North Island hill country', *MAF Policy Technical Paper* 99/5, Wellington: Ministry of Agriculture and Forestry, 1998.
Nimmo-Bell. 'Evaluation of the focus farm and orchard programme', MAF Policy Technical Paper 99/6, Wellington: Ministry of Agriculture and Forestry, 1999.

[53] Peter Hill, Fish and Game Council, communication about RMA and planning submissions: Regulatory systems ineffectual, political pressure undermines the intent. Market pressures now delivering. Urban views being reflected in better eco-delivery in regional government planning.

environment where conservation is given a higher value.[53]

Organic food production,[54] with environmental and marketing advantages, is increasing, (20-30% annually over the past four years).[55] There is a need for more innovation and education of current non-organic producers into organic systems, which also includes eco-certification. Consumer fears for food safety and environmental concern about the sustainability of conventional agriculture are also influencing the trend towards organic production and consumption.

New Zealanders are very interested in accessing global information. There is a close interchange of technical information between Australia,[56] North America and Europe and an exchange of visiting experts, so that global information can be applied regionally. This will continue to accelerate. Expertise is applied within New Zealand and externally through a range of aid projects in Asia[57] and the Pacific managed by the Ministry of Foreign Affairs and Trade[58] and by non-government organizations (NGOs), such as the World Wide Fund for Nature (WWF).[59]

Finally, New Zealanders readily adopt new technology as has been demonstrated by innovations such as Topoclimate South. The Department of Conservation is working on conservation estate computer modelling using a multi-layered GIS based approach with a range of data sets to establish benchmarks and monitor change. Innovation in environmental education will, for example, include the international Internet based Globe Program,[60] It is clear that new best practices and changes in agricultural and environmental education will be influenced greatly by the rapid development of the Internet. Human knowledge is doubling every 10 years and computer power is doubling every 18 months.[61] Research[62] indicates that by 1999 about 50% of farms will have computers, 30% will have Internet connection and a further 40% intend to connect within 2 years. The convergence of television and Internet services will speed up these changes. Thus individual landowners will have access to global and regional information and be able to interact with information providers and other land users as the information revolution creates global links on a scale unparalleled in human history.

Acronyms:

APEID
Asssociated Centre of Asia-Pacific Programme of Educational Innovation for Development
DOC
Department of Conservation
EPI
Environmental Performance Indicators

[54] www.organicsnewzealand.org.nz

[55] Organic Products Export Group, (OPEG) news release, 2 September 1999.

[56] www.publish.csiro.au , Environment Australia Online www.ea.gov.au , Landcare Australia Ltd www.affa.gov.au/landcare/org/landcare-australia

[57] New Zealand Asia Development Assistance Fund. *MIGIS Report : Incorporating the PRA reports for Xiashapu and Shangshapu, Luchun County, Honghe.* Wellington : Ministry of Foreign Affairs and Trade, 1999.

[58] New Zealand Official Development Assistance. *Environment strategy for the South Pacific : a policy framework to address global environmental issues in the South Pacific region.* Wellington : Ministry of Foreign Affairs and Trade,1996.
- New Zealand Official Development Assistance. Investing in a common future : a policy framework for New Zealand Official Development Assistance. Wellington : Ministry of Foreign Affairs and Trade 1998
- New Zealand Official Development Assistance. Programme Profiles 1999 - 2000. Wellington : 1999.
- New Zealand Official Development Assistance. Annual Review 1998. Wellington : Ministry of Foreign Affairs and Trade, 1999.
- Development Cooperation Division. Development cooperation.Wellington : Ministry of Foreign Affairs and Trade, 1999.

[59] www.wwf.org.nz

[60] www.globe.gov or email info@globe or help @globe.gov

[61] Kaku, Michio. *Visions : how science will revolutionise the twenty-first century.* United Kingdom : Oxford University Press, 1999.

[62] Nuthall, P, and C Benlow. 'Computer system uptake and use on New Zealand farms.' *Research report* 99/01, Lincoln : Lincoln University Press, 1999.

EW
Environment Waikato
GAP
Group Action Programmes
GIS
Geographical Information System
MAF
Ministry of Agriculture and Forestry
MFAT
Ministry of Foreign Affairs and Trade
MfE
Ministry for the Environment
MoE
Ministry of Education
NGO
Non-government Organisations
NIWA
National Institute of Water and Atmospheric Research
NOSLaM
North Otago Sustainable Land Management
OPEG
Organic Products Export Group
ORC
Otago Regional Council
RMA
Resource Management Act 1991
SHMAK
Stream Health Monitoring and Assessment Kit
SITE
Schools in the Environment
SMF
Sustainable Management Fund
SMLA
Sustainable Land Management Strategy
TASAE
Tsukuba Asian Seminar on Agricultural Education
TOPNZ
The Open Polytechnic of New Zealand
TRC
Taranaki Regional Council
UNESCO
United Nations Education Scientific and Cultural Organisation
WWF
World Wide Fund for Nature

New Zealand: Discussion

Q: It seems that the national strategy on environmental education in your country has worked very well. How do then translate the strategy into the curriculum in elementary, middle as higher educational level?

A: The Department of Education has produced in 1999 educational guidelines to be used in elementary, middle and secondary school. Sustainable Agriculture kits are available at all primary and secondary schools (produced by the Ministry of Agriculture and Forestry). At tertiary level, Polytechnic, and Universities, there is an agreement to implement sustainable management of the institutions, and to introduce environmental education into all curricula.

Comment/Suggestion :

I can arrange copies of the new ministry of education initiative.

6. Agricultural Engineering Education at the University of the Philippines Los Banos: Preparing for the Next Millenium

Delfin C. SUMINISTRADO

Introduction

The pursuit of development in the Philippines is strongly hinged on agro-industrialization. With an economy traditionally based on agriculture, the development of agriculture is still recognized as the country's most potent weapon for combating poverty. Government plans have therefore been expectedly formulated with food security, self-sufficiency and agricultural and rural development as top priorities.

Recognizing education as a key area within which these above goals can be attained, programs for the continuous improvement and reforms of formal and informal educational systems have always been instituted and pursued. Very recently, the government had enacted a law to modernize Philippine agriculture, the Agriculture and Forestry Modernization Act (AFMA) of 1998, which highlights among others the articulation and philosophical and conceptual framework of agricultural education, and the operationalization of a National Agriculture and Fisheries Education System (NAFES) to make it more responsive to the challenges and opportunities of the 21st century.

Agricultural engineering is at the center stage of the national education program of agriculture. It is one of the five subsystems along with agriculture, fisheries, forestry and veterinary medicine. It is also recognized as a forerunner in the development efforts of the government for countryside agro-industrialization.

This paper describes the development of agricultural engineering education in the University of the Philippines Los Banos. It discusses the history of the course as well as the more recent initiatives and innovations to make the course more relevant to the present era and to well-equip its graduate in facing the challenges of the coming century.

Definition and Scope of Agricultural Engineering

Agricultural engineering can be very briefly defined as 'engineering in the service of agriculture'. It is the application of scientific knowledge into practical use in the development and management of agricultural processes and systems. The following areas are the traditionally recognized scope of this branch of engineering:

1. agricultural machinery and electrification,
2. agricultural processing,
3. soil and water management, and,
4. agricultural structures.

These four areas enumerated above will lend truth to the perception that an agricultural engineer is partly a mechanical, an electrical, a chemical, and a civil engineer. Perhaps, even more. That an agricultural engineering graduate is a "jack of all trades, master of none" only refers to the variety of knowledge and skills he has to acquire. However, the choice, extent and depth of the

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College, Laguna 4031 Philippines

topics that a student undergoes during the five -year training truly find great relevance in the kind of challenges and tasks in an agricultural system. An agricultural engineer is therefore allowed a great flexibility of options in selecting career paths.

Very recently, the change of the name of the discipline has been proposed in the United States. The move was suggested to recognize the expansion of the discipline to include various emerging areas in alternative energy development, food processing and preservation, environmental waste management and aquaculture systems, among others (Cuello, 1992). The proposal has elicited many reactions both from the opposing sides. To date, some American universities have already adopted the change of 'Agricultural Engineering' to 'Bio-systems Engineering' or some similar titles.

History and Status of Agricultural Engineering Education in the Philippines

The earliest account which has direct reference to agricultural engineering education in the Philippines is the fact that the agricultural schools established in Manila as early as 1887 was administered by agricultural engineers with the help of skilled farmers. Agricultural courses were said to be offered in agricultural stations in many parts of the country. These schools, however, were all closed towards the end of the century during the war of independence which ended the 300 -year rule of Spain in the Philippines (CHED, 1998).

In the early years of the American regime, settlement farm schools were created. These were later transformed into provincial, agricultural or rural high schools to meet the needs of the new American colony. It was also within this period that agricultural and vocational education patterned after the American system was promoted. After the Second World War, these institutions were converted into state supported agricultural colleges and state universities.

The agriculture courses offered in these institutions shortly incorporated agricultural engineering as a major field. A major transition occurred in the 1950s when Gregorio Araneta University, a private institution in the outskirts of Manila started to offer Bachelor of Science in Agricultural Engineering (BSAE). In the early 1960s, its practice as a profession was also put under the regulation of the government and, since then, graduates had to take a board examination to obtain a professional license.

Although not a very popular option compared to the other engineering programs, its offering has spread all over the country. At present, a total of 34 state and private universities and colleges offer the course (See Figure 1). The proliferation of the program was brought about by the legislation which transformed agricultural high schools first into agricultural schools or state colleges and, later, state colleges into state universities (CHED, 1998).

To rationalize and improve the quality of agriculture education and other related fields such as agricultural engineering, the Technical Panel for Agriculture Education (TPAE) was created in 1977 through an order of the Department of Education, Culture and Sports (DECS). After a decade of work, the body proposed a plan to integrate the institutions offering agriculture education at the tertiary level into a structured network of state colleges and universities known as the National Agricultural Education System (NAES). In 1997, new policy reforms were recommended on the basis of the enactment of the Agriculture and Fisheries Modernization Act (AFMA). The law provides for the establishment of the National Agricultural and Fisheries Education System (NAFES), the revised version of the NAES.

While the AFMA of 1997 was expected to strengthen the program of agricultural engineering education in the country, another law, the Agricultural Engineering Law which was passed in 1998, was expected to upgrade the practice of the agricultural engineering profession.

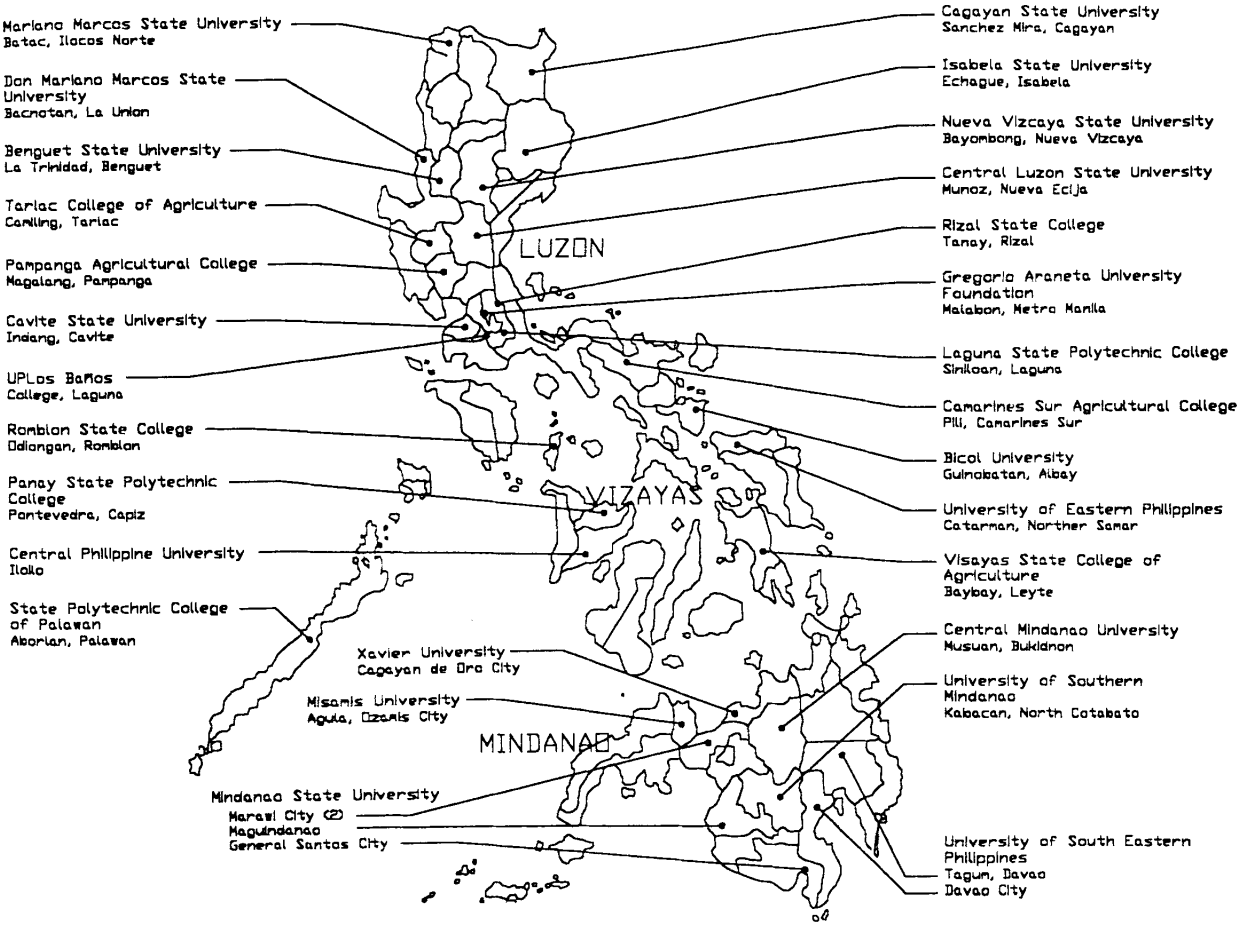

Figure 1. Higher educational institions in the Philippines offering Bachelor of Science in Agricultural Engineering

History of Agricultural Engineering Education at UPLB

With the establishment of the University of the Philippines in 1908, the governing board of the university also decided to undertake the creation of a national college of agriculture, the University of the Philippines College of Agriculture (UPCA). True to its original mission, UPCA, which was meant to become not only an educational institution but also a research experiment station as well, later grew to become the premier agricultural institution in the country and a leader in agricultural research. The reorganization of the whole University of the Philippines System in the 1970s made the UP Los Banos campus an autonomous unit. To this day the university has expanded to include ten (10) degree granting units which include the College of Engineering and Agro-Industrial Technology or CEAT.

The Institute of Agricultural Engineering (IAE)

As early as 1912, UPCA has established the Department of Agricultural Engineering to handle the instruction of the mathematical and physical sciences. The department also provided manpower and expertise for the maintenance of the university's physical plant office. Along with the other agricultural institutions in the country, UPCA also started to offer the BSAE course in the 1950s.

In 1976, the Department of Agricultural Engineering was elevated to become an independent degree-granting institute which offers only BSAE. With the further expansion of its course offerings, the institute was converted into a college which is now known as the College of Engineering and Agro-Industrial Technology (CEAT). In addition

to the BSAE curriculum, the college also offers many other engineering courses. Under the present umbrella of CEAT is an institute which takes care of the academic and research programs in agricultural engineering, the Institute of Agricultural Engineering (IAE).

The Institute of Agricultural Engineering (IAE) of CEAT has a very strong program of agricultural engineering where master's and doctoral courses are also offered. In fact, CEAT has been recommended by the TPAE board as the national college of agricultural engineering education under the NAES, which means that it has to take the national leadership in agricultural engineering education including post-graduate programs and also conduct basic and applied research work.

The expansion of the curricular offerings of the college started in the early decade of 1980s. While this expansion occurred at the time of the decline of enrollment of agricultural engineering or BSAE, it can be more attributed to the proliferation of schools offering the same course in many regions of the country. This historical fact can be seen in Figure 2. Subsequent opening of other engineering courses did not affect the demand for the BSAE course as seen in its gradual increase starting in School Year 1987-88 to the present.

Consistent with its mandate of providing quality engineering education to its region of location, a high percentage of its agricultural engineering students comes from the Region 4 (Fig. 3). It is to be noted also that a large number of students come from two other nearby regions, the highly urbanized and industrialized National Capital Region (NCR) or the Metro-Manila area, and Region 5 or the Bicol Region towards the southeast of the main island of Luzon.

Curricular changes

The BSAE curriculum at UPLB started in the 1950s as a general program covering all the sub-systems enumerated above, i. e. agricultural machinery and electrification, agricultural processing, soil and water management, and, agricultural structures. Revisions in the program were made in the 1988 to make the course flexible and relevant. The revisions allowed students to choose a desired field of specialization while maintaining the basic requirements of the course as determined and stipulated by the government through CHED. Thus, the kind of academic training that students of BSAE undergo can now be described in the form of a 'T' pattern : the vertical line denotes deep-rooted grounding in the basic sciences and in one of the sub -disciplines in the above list, and, the horizontal line represents the balanced and adequate knowledge of all of the enumerated sub

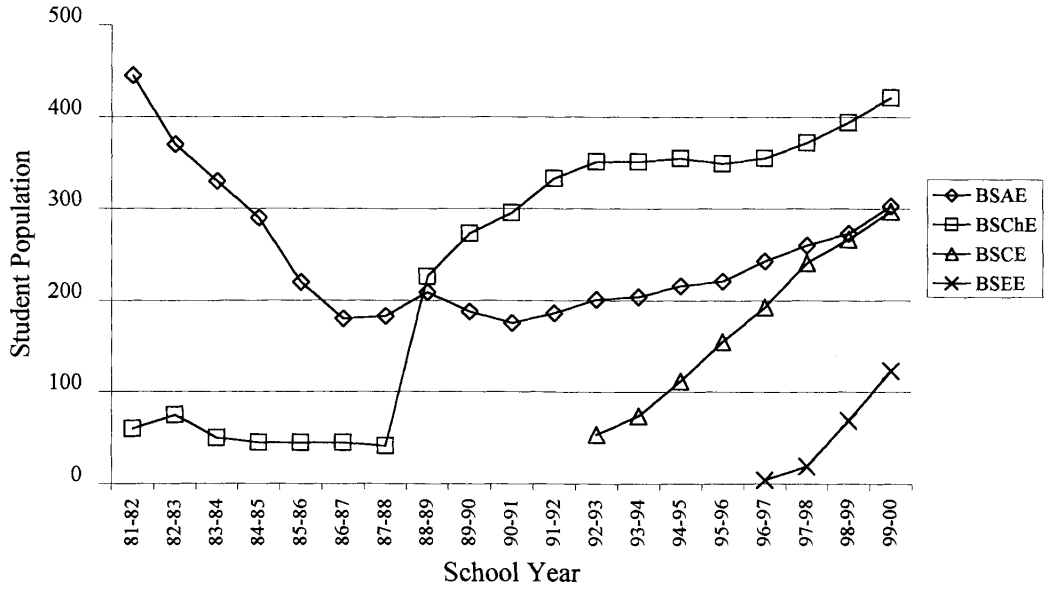

Figure 2. Enrollment trend, CEAT, UPLB, 1981-1999.

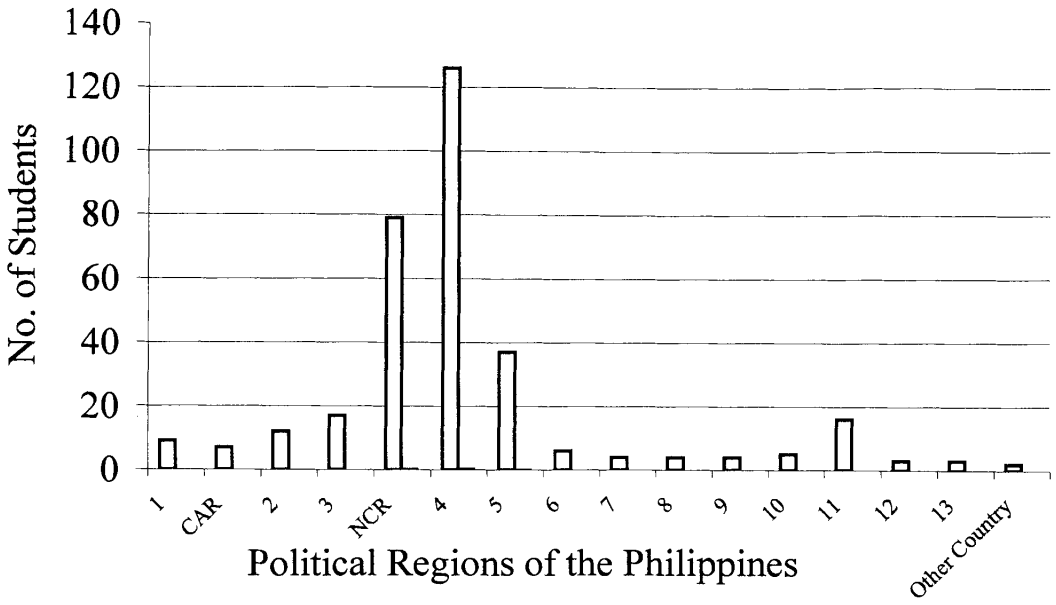

Figure 3. Regional Origin of BSAE students, CEAT, UPLB, 1999.

-disciplines (Franco, 1993).

1. Education on environmental protection and alternative energy sources

The awareness for the need to protect the environment and conserve energy grew from the events which occurred in decade of 1960 and onward. Rachel Carson's "Silent Spring" in the 1960s and Dennis Meadows' "Limits to Growth" in the 1970s helped in advancing the cause for environmental protection. The nuclear power plant disasters in the Three Mile Island and, later, in Chernobyl , the oil crisis, the threat of global warming, ozone layer depletion and many others brought to light the vulnerability of life on earth and the need for a proactive approach to sustain it. The integration of environmental concern was therefore considered not only in certain specific degree courses but in the contents of general education itself.

Moreover, the concepts of environment protection and energy conservation were included in various agricultural engineering courses of CEAT to equip its graduates with the capability for analysis and design of machines and systems for agricultural and biological applications. Among these changes include the revision of the traditional course on farm power and energy to include topics on renewable and alternative sources, and, the institution of courses on waste and water quality management.

2. Computers, information technology and other educational facilities of CEAT

The BSAE course was also updated in terms of the developments in computer and information technology. While only the graduate students were trained with computer use in the decade of the 1970s, the availability of personal computers in the 1980s also afforded undergraduate students the chance to learn and make use of them in their academic training. Numerical techniques which need the application of selected computer softwares also became a required course. In the early 1990s, another addition was the computer drafting and design course. Limited application of Geographical Information System (GIS) has also been initiated in the college.

While a university main library is available, CEAT also established a wide collection of information materials with emphasis on engineering. Further, access to library information was facilitated with the development of a data based computer program which is being adopted by the UPLB campus itself. There is also an on-going move to link all records of existing library collections situated in the various locations of the campus with the ultimate goal of making them available in

the internet.

The changing academic environment of agricultural engineering education at CEAT

The following are a few of some important changes and developments which have relevance to agricultural engineering education at UPLB.

1. The college setting

The college continues to expand its program offering. In addition to the chemical engineering (BSChE) which was started in early 1980 and civil engineering (BSCE) in 1992, the college started its electrical engineering (BSEE) program in 1996 and industrial engineering (BSIE) early in 1999. This expansion, however, is not expected to affect the absolute number of enrollees in the agricultural engineering (BSAE) course. Moreover, the exposure of agricultural engineering students to the students of the other fields of engineering is expected to provide an enriching engineering education in general.

In terms of facilities, CEAT has recently acquired a GIS hardware facility which will be used to support its instruction and research activities in agricultural engineering and other related fields.

2. The campus setting

The traditional strength of the UPLB campus was in agricultural and forestry education. The worldwide awakening to the perils of high input agriculture led to the redirection of thrust towards 'sustainability'. This paradigm shift effected the adoption of sustainable agriculture in course offerings of the College of Agriculture. The College of Forestry (now the College of Forestry and Natural Resources or CFNR) aligned its structure and program towards the concern for sustainable forest management, bio-diversity conservation, bio-resources utilization and greater local participation in forest management. The School of Environmental Science and Management (SESAM) was also established in the campus to serve as the lead unit in the integration of efforts devoted to environment-related activities of the different units of the units in the campus.

In information technology, the university also provides an internet service which enables all constituents, students included, to be a part of the information highway. The main library contains not only printed matters but also an expanding collection of CD -ROMs. There is also an on-going project to create a common data base of all the information materials which are situated in the various libraries and reading rooms of the campus.

3. The university system

The university system is continuously seeking ways to democratize UP education. Agricultural engineering as a course is seen to support countryside development and it is generally expected to admit students from the less urbanized rural areas. Data show however (See Fig. 3) that in addition to the relatively rural regions, Region 4 and Region 5, a high percentage of BSAE students come from the highly urbanized and industrialized Metro -Manila area in comparison to the very low number of enrollees from the other regions. As UP studies its entrance tests to minimize this bias against the poor, rural-based students and cultural minority groups, it has already instituted ways and means to provide forms of financial and learning assistance packages to students especially freshmen that they may overcome the economic, academic and adjustment difficulties.

The university system affirms its nationalist bias in its educational mission with the main objective of helping unify the citizens into a strong cohesive nation with its own identity in an information and technology -oriented civilization. The intellectualization and modernization of the national language, Filipino, is considered as one approach to it. At CEAT, several courses in agricultural engineering have been handled in the Filipino language instead of the traditional English and have proven to be more effective in the process despite inadequacy of textbooks in the vernacular. The university has continuously

supported a program to encourage the faculty to write textbooks in the national language.

Preparing for the new millenium

The university is inspired by a three -pronged vision : 1) to be the apex and main support of the Philippine education system ; 2) to be a significant participant in the international community of universities ; and 3) to be a strong union of the autonomous universities bearing its name. As the national university, it takes the role of serving as a model for undergraduate instruction, a principal center for research and graduate education and leader to other tertiary-level academic institutions.

Agricultural engineering education is the main responsibility of the Institute of Agricultural Engineering of CEAT at UPLB. As the national leader in this particular field of engineering, it seeks to improve and update its program to the need of the times. It is therefore, continuously vigilant for the emergence new challenges within its domain of expertise. As early as 1998, it has prepared to open new areas of specialization such as aquaculture engineering, food engineering, bio-systems engineering and renewable energy sources as it moves to change the name of the course ' Agricultural Engineering' to 'Agricultural and Bio-systems Engineering'.

Conclusion

Agricultural engineering in the Philippines has already established a firm recognition as a legitimate engineering field. Although not as popular as the traditional fields of engineering, it occupies an important role in the development efforts of the government for countryside agro-industrial development.

Anticipating that the beginning of the new millenium will be characterized by information and technology-driven growth, by open markets and global competitiveness, the College of Engineering and Agro-Industrial Technology of the University of the Philippines Los Banos takes a proactive stance to continuously provide a relevant agricultural engineering education.

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Cuello, Joel L., "Toward a New Engineering Order", **Agricultural Engineering**, Vol . 73, No. 6 (November, 1992), pp. 17-19.

Commission on Higher Education (CHED), "A Review of the Macro Plan for Agriculture Education", October, 1998.

UP President, 1999, "The UP Centennial Plan 2008", **The UP President's End-of -Term Report**, Vol. 9.

List of acronyms

AFMA - Agriculture and Fisheries Modernization Act

BSAE - Bachelor of Science in Agricultural Engineering

BSChE - Bachelor of Science in Chemical Engineering

BSCE - Bachelor of Science in Civil Engineering

BSEE - Bachelor of Science in Electrical Engineering

CAR - Cordillera Autonomous Region

CEAT - College of Engineering and Agro -Industrial Technology

CHED - Commission on Higher Education

IAE - Institute of Agricultural Engineering

NCR - National Capital Region

TPAE - Technical Panel for Agriculture Education

UPCA - University of the Philippines College of Agriculture

UPLB - University of the Philippines Los Banos

Philippines : Discussion

Q : Is Agricultural Education more expensive than other courses in the Philippines? Is this one reason for poor academic rates? I am also interested

about the ratio of gender studying agricultural engineering, could you please tell.

A: Schools of higher learning in the Philippines can be grouped into two, the private schools and the government funded public schools which we refer to as "state colleges and universities". Most private schools are in the urbanized areas. They offer courses like accountancy, computers, etc. In private schools, the students pay the cost of education in full.

The state colleges and universities are scattered in the country and mostly located in rural areas. As the government subsidizes the cost of education, the fees are always less than those in private schools are. While they offer courses similar to those offered by the private schools, they are the institutions that also offer agriculture education. Courses in agriculture are not very attractive such that private schools, which are generally run as business enterprises, do not offer them. In effect courses in agriculture cost less as they are offered by the public schools? Out of the more than four (400) hundred schools offering agriculture education, only less than ten percent (10%) are private.

Although I do not have any ready data on gender ratio, I am aware that there is not much difference in the population of male and female in agricultural engineering courses. I our college, for example, only a little more than 50% in agricultural engineering are male. The reverse however is true in chemical engineering. Civil and electrical engineering students are also dominated by males, but I expect that our newly opened industrial engineering course will attract students in both sexes.

Q: How about the job market for agricultural engineering graduates. Are there specific demands of their qualification or should they compete with graduates from mechanical, electrical engineering, etc.?

A: There are jobs specific for agricultural engineers. They are generally employed in the government agencies particularly those involved with irrigation activities, design and development of agricultural machine, processing of crops and rural planning. In the private agencies, however, it is correct that they have to compete with graduates in the other engineering field because employers almost always do not know about the qualifications and capabilities of agricultural engineers. In effect, they are considered "less engineers" than other engineers though there are jobs where they can do better than other engineers. Let me explain that further, with an example. One on my students applied for a job which was advertised for either an electrical, mechanical and chemical engineer. The work will be about investigations on alternative energy source in the rural areas, like biomass, solar, water, etc. He found the job description suits him well. During the interview, he realized that the interviewer does not know about agricultural engineering.

Q: Shed some light on the status of research especially in farm tools and equipment and the linkage to adoption of hard technology from outside.

A: Our college has a body called the Agricultural Mechanization Development Program (AMDP) which is partially funded by the Regional Network for Agricultural Machinery or (RNAM) of the United Nations Development Program (UNDP). AMDP is doing research and development efforts on farms tools and other agricultural engineering disciplines like agricultural processing and land and water resources engineering. Most of the staff of the college particularly those in the field of agricultural engineering are conducting research under the umbrella of AMDP.

Through the AMDP, the college collaborates with other member nations under RNAM on the exchange of information and prototypes. One example of the result of this collaborative work was the manual transplanter whose design originated in China. A prototype was made by the International Rice Research Institute (IRRI) modified in Sri Lanka and came to AMDP who made a design for local manufacture in the country by agricultural machinery manufacturers.

I would like to add also that there are bodies that conduct research and development activities in agricultural machinery. These include the International Rice Research Institute (IRRI), the Philippine Rice Research Institute (PhilRice) and Bureau of Post-harvest Research and Extension (BPRE). PhilRice and BPRE are under the Department of Agriculture.

Comment from Australian delegate:

"I enjoyed the presentation-well done".

7. Application of global and regional information for the innovation of agricultural and environmental education in Thailand

Sanao KATKASAME

Introduction

Agricultural still occupies a dominating position in the economy of Thailand. It's take about 45 percent to the total gross domestic and providing employment to more than 50 percent of the population. It is also a major source of foreign exchange earnings and has influenced the establishment of agricultural information systems. The information systems intend to provide timely, reliable and accurate information on agriculture to support planning and decision making at various levels for increasing agricultural production and maximizing the benefits.

The agricultural information services are provided by the agricultural statistic agencies and agricultural extension units. Both the agencies are under the ministry of agriculture. The agricultural statistical agencies were primarily concerned with the production of agricultural statistics. There are obtained from surveys, census and administration records. The agricultural extension units are focussed on providing information about farming practices faced by such system and the appropriate remedial measures for future improvement that assess the current station of agricultural information systems in the context of agricultural development and institutional involvement in Thailand.

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Ministry of Education, Bangkok, Thailand

Performance of Thailand agricultural information

Agricultural information services in Thailand are presently taking place to the emerging agricultural development issues and thrusts. With the availability of additional resources, Thailand have managed to develop more extensity the agricultural information services by using computerization of data processing.

To assemble important and timely agricultural statistics for facilitating data uses in studying and conduction a research related to agricultural economics situation of the country. Its had many problems e.g., limited resources, lack of making and infrastructure facilities, lack of technical capacity, inadequate computer and communication facilities, lack of coordination among data collecting agencies, inaccurate integrating, untimely release of information, lack of an integrating framework, limited access to popular media agencies, and inadequate government intervention.

Government Policies for agricultural information and program

Changes in the agricultural policies and strategies and many of programs are being undertaken to provide timely, reliable and adequate agricultural information to support planning and program implementation as well as to assist the formers in maximizing income from there agriculture product. The agricultural marketing information system is well establish, where marketing data are mow

processed using personal computers and which are connected to video for dissemination of data.

The importance of agricultural information is now widely recognized and as a result, there is a greater allocation of resources towards its improvement. How, Thailand now moving towards full of partial computerization has been extended up to the local level to ensure that adequate and accurate information reaches the farmers as well as the local planners and decision-makers in time.

To enhance technical capacities training programmer on information system, computer applications and software have been provided to data producers. Training programmer for extension workers and farmers have also developed and improved.

Role of information network system in agricultural Development

The development of information system in agriculture was accelerated with the advancements in computer technology. The conventional biology-oriented, chemistry -oriented and mechanics-oriented technologies play important roles for increasing production at the former stage. Increasing form income is the main concerns where information technology serves a critical function and agriculture becomes more commercialized and market-oriented. The farmer's managerial ability is significantly enhanced by obtaining accurate and reliable information data which rapidly changing.

The information of society is bared principally on the rapid progress of related technologies and is presumed to proceed in the following direction ;

1. from industrial sector-oriented to social, cultural or living sectors ;
2. from large sized enterprise-oriented to total business circle including small and medium sized enterprise ;
3. from within enterprise-oriental to between different types of venture ;
4. from a disconnected of system with respect to production and marketing to a coordinated system ;
5. from centralization to localization ;
6. from a closed to an open systems ;
7. from national to global system

To make the role of agricultural information more efficient, the users ability also needs to imprové significantly. There may be various categories of users, viz.

1. administrative organizations,
2. research institutions,
3. extension agencies,
4. farmers' organizations,
5. agribusiness industries,
6. farmers,

Users and sources of information are both certain situation. Because of the rapid advancements in innovation technology, the infrastructure of agricultural information systems is expected to improve significantly, and increase accessibility to information. Hence, major efforts are required for the promotion of information literacy.

Developing agricultural information systems in Thailand

Agricultural information systems have evolved over time with the advancements in computer and communication technology. In earlier phase, primary emphasis was placed on electronic data processing. To make the data more usable for decision-makers, management information systems were developed. But these systems were still limited in their capacity to support decision-makers because of their design structure. To address their limitations, decision support systems have been involved, which provided better support to managers in decision-making process.

The first step in building a decision support system is a careful identification of the problem faced by the decision-maker. One of the approaches the problems confronted by decision-makers is to ask them to identify the critical factors for performance evaluation and making sound decisions. Another approach used is the six stages of methodology of implementing information, data administration and maturity. Depending upon the stage of development, the users will have different expectations of the information.

To consider investment in information systems, one must ensure that the effective value of the information generated by the information system would be more than the cost of the information system. Three essential conditions must exist in order to implement a system that helps decision-makers, namely: 1. The system must gain the approval and esteem of those who work with it; 2.it must be cable to meet the changing conditions and requirements; and 3.the various components of the information systems must operate in harmony to provide mutual support to the system users.

The user interface is an important component of the system as sit links the decision -maker with the other components of the decision support system. Since it is the most critical and difficult components, design should not be takes lightly. It must have three essential features, namely; (1) a presentation language appropriate to the problem which is easily interpreted; (2) an action language for the user to instruct and query the system; (3) knowledge of the user.

One of the major concerns while designing information systems is to evolve a procedure to extract knowledge for decision making from available data. Once an information system has been developed, its maintenance in a cost- effective manner becomes a major concern. Careful design and the use of good software development tools will help in minimizing the amount of resources needed for the maintenance function. It should be noted that as information systems grow and evolve, the resources for maintenance was increase in size.

Application of information Systems in Agriculture

The information systems in agriculture have been applied and developed especially the development of computer technology in agriculture. Most of the projects proved to be useful and effective as some of these are still in use. Some have also been replaced by more effective methods developed with the advances is computer and communication technology. As the system developed, there was an increasing involvement of the decision-maker in the use of the system and thus the system's usefulness and effectiveness also increased. These was possible by moving data processing from mainframes located at central sites, to microcomputers located on the actual business site. As the decision-makers increased the direct use and control of the system, they became more aware of the system's potential for extracting needed information for the specific problem being addressed. As the computer technology progressed, some systems became absolute. It became increasingly apparent that the earlier systems had some limitations; particularly they lacked integration capability. The various application components of a system employed unique data structure. Thus, even if the goal was to increase the level of integration, it might not be possible because the data could not be accessed without extensive costs in terms of interface development.

To meet the information needs of the future, the information systems should be more sophisticated and powerful in their capabilities. There will be an increasing use of decision support system to meet these demands.

Various decision support systems have been developed which different categories depending on their approach, problem area and functional area. These are (1) specific problem systems (e.g., problems in evaluation alternative cropping systems, soybean marketing at the farm level); (2) function related systems (e.g., financing, marketing, livestock feeding programs and nutrient management); (3) systems for evaluating system performance (e.g., dairy forage simulation model and plant growth model).

Information network for regional agriculture in Thailand

How Thailand has made its agriculture an attractive enterprise for new farmer entering the work force by reestablishing the production infrastructure as well as providing a better living environment. It is necessary to change the existing values towards agriculture

and have a nation consensus in that direction. Increasing productivity, saving labor and effectively using the information at each stage from production to sales were the objectives of providing information system. The mains concept which will characterize the changes and restructuring of Thailand agriculture were the transition from mechanized agriculture to information agriculture. Thus, the prime force for restructuring of agriculture will be the information technology and globalization of the world markets. The need for agricultural information and effective usage depends on the type and scale of farming. Compared with other industries, agriculture is lagging behind in information users are limited. Farmers and managers must do all the jobs themselves. They make information based decisions and judgements about various jobs ranging from overall management to managerial planning, information processing, food maintenance and operation, quality control, etc. Accordingly, skill information networking and information processing have become basic requisites for effective farm management.

Regional information Networks in Thailand

It is general acceptability that the importance of information for the farmers and other people related with agricultural development, working in the government or private sector. But the collection, processing, and dissemination of information is difficult task and faces many problems. The importance of information not only the national governments, but also the international and United Nation agencies, both of the global and regional levels, have made it one of their major functions to serve as sources and repositories of information.

At the global level, the FAO is the most important source of agricultural information for its member governments. On the other hand, ESCAP, a regional arm of the United Nations, has developed databases and information system in many specific fields such as fertilizers, agro-pesticides, participation rural development, non-farm employment, etc. The development of appropriate information systems requires an effective organization and operational management appropriate skill, expertise and professional competence and basic to such development. An effective and cost efficient way to develop information system in any field of human is coordinate individual efforts of small and large centers. This involves coming together into formal networks. In recent times, networking arrangement have been increasingly resorted to at the national, regional and global levels by government, non-governmental organizations (NGOs) and the business sector to enhance economic development and social progress. There are a number of criteria to be considered to ensure the success of networking arrangements. There are : (1) the network should meet identified and felt needs of members and potential members, leading to improved service for end-users ; (2) the objective should be clearly and concisely defined ; (3) there must be realistic plans for carrying out objectives, including obtaining/re-deploying the necessary resources ; (4) the minimum necessary administrative procedures to facilitate substantive tasks ; and (5) the network must have flexibility to meet new needs, incorporate new technologies, cooperate with new and changing organizational structures and phase out tasks/services which are no longer needs by the members and other ends -users. In the field of agriculture, AGRIS (International Information System for Agriculture Sciences and Technology) ; CARIS (Current Agricultural Research Information System) ; and GIEWS (FAO's Global Information and Early Warning System) are the major information networks at global level. At the regional level in Asia and the Pacific, the FAO has either sponsored or supported nearly two dozen networking arrangements aimed at assisting member counties to improve their relevant national systems of collection, analysis and dissemination of information related to specific elements of food, agriculture, fisheries and forestry sectors through close contact with statistics organizations, field missions, country or regional

studies and training courses.

Rural and Agricultural Information System

Rural and agricultural information system are set for assisting local organization and central agriculture-related organs in their planning and decision-making activities, providing these information at the right time, and constructing a system for them to utilize there data in advanced and convenient manner. The users of RAIS are local and public organizations and many other agricultural organizations. Various services, such as data retrieval, processing and analysis of the retrieved data, processing and analysis of user' s data, editing of output and use of the agricultural information processing system, are being rendered.

The RAIS network center, which is established as the core, constructs the database covering statistical information and document information in the host computer. Member uses have access to the center through their PC terminals via communication circuits for RAIS to retrieve and obtain the needed information.

Conclusion

These paper focussed on approaches, way, and means to improve and strengthen the present systems for providing the relevant, accurate and timely information to farmers and agriculture-related institutions. In this regard, a more detailed study of the Thailand experience was under taken both in terms of the presentation and discussion of the paper. We hoped that the agricultural information systems working at various levels were the most advance, efficient, effective and useful for sustainable agricultural development in the future in Thailand.

Thailand : Discussion

Q : How is the status of computer utilization by farmers in Thailand? Do they use computer to access information regarding the agricultural information developed in your country?

A : There are only few big time farmers who are utilizing computer for their own use. Most of them get agricultural information in an indirect way. For example, the developed information can be transferred/relayed from the database (e.g. Statistical agencies, Central Library of University) to the extension officer by the Internet and then the extension officer will transfer the information to the farmers directly or either by giving the documents, etc. Small time farmers could not access the information directly.

8. Education of Agricultural Information in Japan —— Facing Reformation of the Curriculum ——

Tomohiro TAKIGAWA

Introduction

Japanese agriculture has been facing many difficulties including a decrease in farming population, aging of farmers and global competition. Effective utilization of agricultural information in daily farm management is expected to play an important role in the creation of a future farming system that can survive in the severe competitive environment. Of course, information related technologies will be one of the keys for future society. Hence Japanese Ministry of Education is planning to reform information education, including agriculture. This paper reports on the current status of agricultural information education and the outlook for future information education in agriculture.

Features of information utilization in agricultural areas.

Decision making in agricultural management depends in large part on the amount and quality of information. Information can be gathered from various communication channels, such as television, newspapers, extension services, information networks, and personal communication in rural communities. Along with these channels, farmers can also get instrumental information, and heuristic or perceptive knowledge, by analyzing data collected during their own daily management activities.

Such kinds of information for decision making in agricultural management can be classified into two categories: internal and external. Internal information is that information accessible without communicating with outside sources., such as the states of field, soil, crops, labor, etc. External information is obtained from outside information sources, and includes weather information, weather forecasts and market price information. However no clear boundary between the internal and external information exists. For example, soil fertility data provided by a soil inspection organization is external information, but once it has been given, it will be utilized as internal information.

Advanced information technologies allow us to employ new methods of decision making in almost all aspects of agricultural management. For daily internal information records and analysis, programs for agricultural bookkeeping, farming logs, etc., enable us to store long-term records of our agricultural activities. Advancements in sensing and control technologies also enable an accurate and continuous recording of various factors involved in agricultural production. The best example might be the new farming system called " Precision Farming", in which various farm management data are collected and recorded with the location of recording by machinery equipped with positioning sensors, such as a Global Positioning System sensor. This means that we can record quantities of sown seed, applied fertilizer and yield for each location monitored in one field, within a positioning accuracy of 10m, together with environmental data such as the soil and climate conditions of the field.

National and prefectural governments

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and their affiliated organizations as well as the private sector have started providing external agricultural information. With the spread of the Internet, farmers can access large amounts of information easily. However it is still difficult to utilize accumulated information properly. This difficulty comes from having a great array of agricultural knowledge, but no general method for processing it cohesively.

Information infrastructure in Japan

This section makes reference to statistical data be reported on the status of public information infrastructure in Japan[1]. Recent trends in households that utilize communication devices are shown in **Fig. 1**. Though ownership rates of word processors, video camera and fax machines are still higher, it can be seen that the increasing rates of personal computers and fax machines are comparatively large recently. The Internet is now becoming the most effective and influential medium. Numbers of computers connected to the Internet are listed in order of total number in **Table 1**. Though the worldwide growth rate of computers is decreasing, computers are increasing drastically in Asian countries. Ratios of number of computers in 1998 to that in 1995 were 54.3 in Indonesia, 28.7 in China, 20.0 in India, 12.1 in Japan. As a result, the number of Internet users also increased, attained, for example 11.5 million in 1997 in Japan, with more than 40 million users expected by 2005.

Agricultural information utilization in Japan

The results of the questionnaire on information needed for agricultural management are listed in **Fig. 2**[2]. Now we can access these kinds of data through various communication media. Several communication media, including fax machines, cable television, personal computers and the Internet, are of service. The

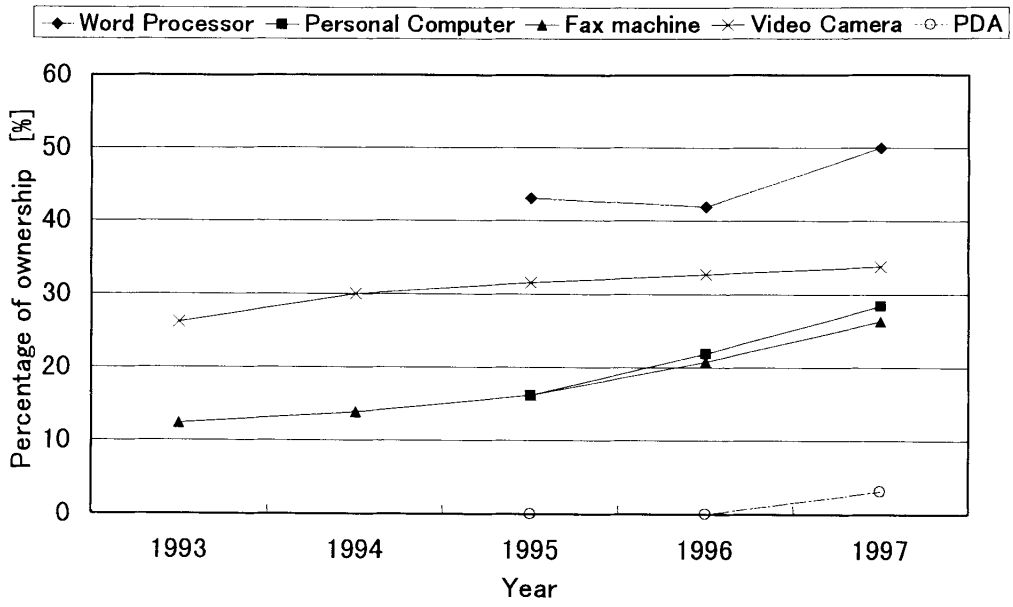

Fig. 1 Trends in ownership rate of major communication devices

Table 1 Number of computers connected with the Internet

(Unit : one million)

Nation	USA	Japan	German	UK	Canada
Number of host computers	20.62	1.17	1.0	0.99	0.84

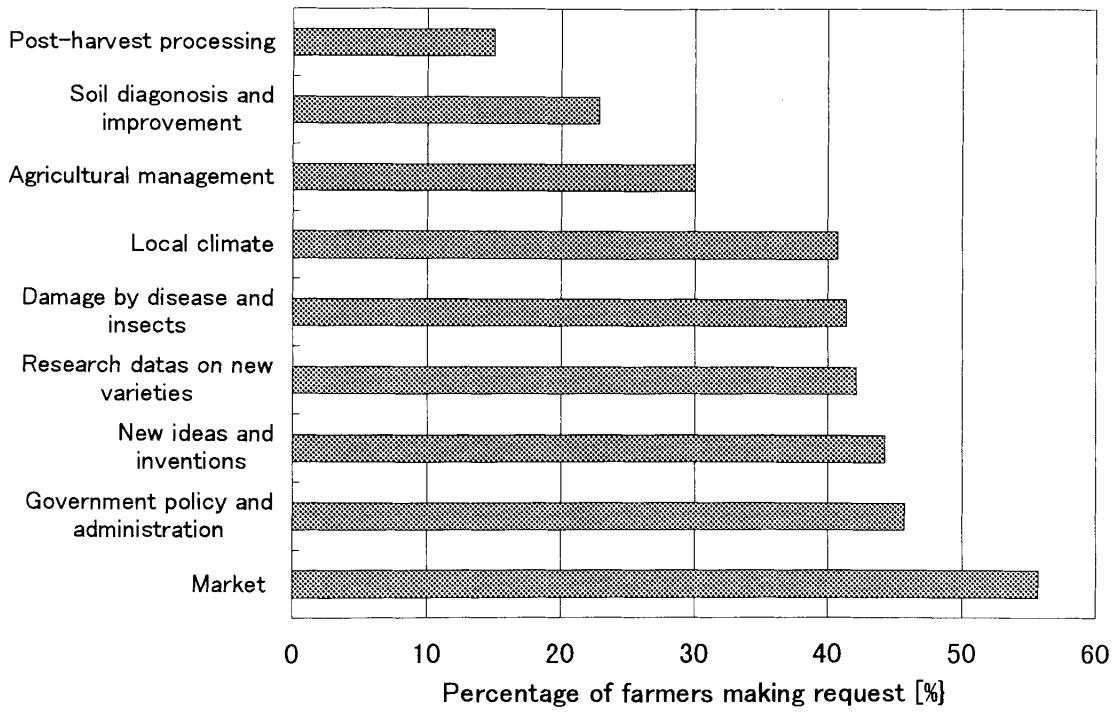

Fig. 2 Specific information requested by farmers[2)]

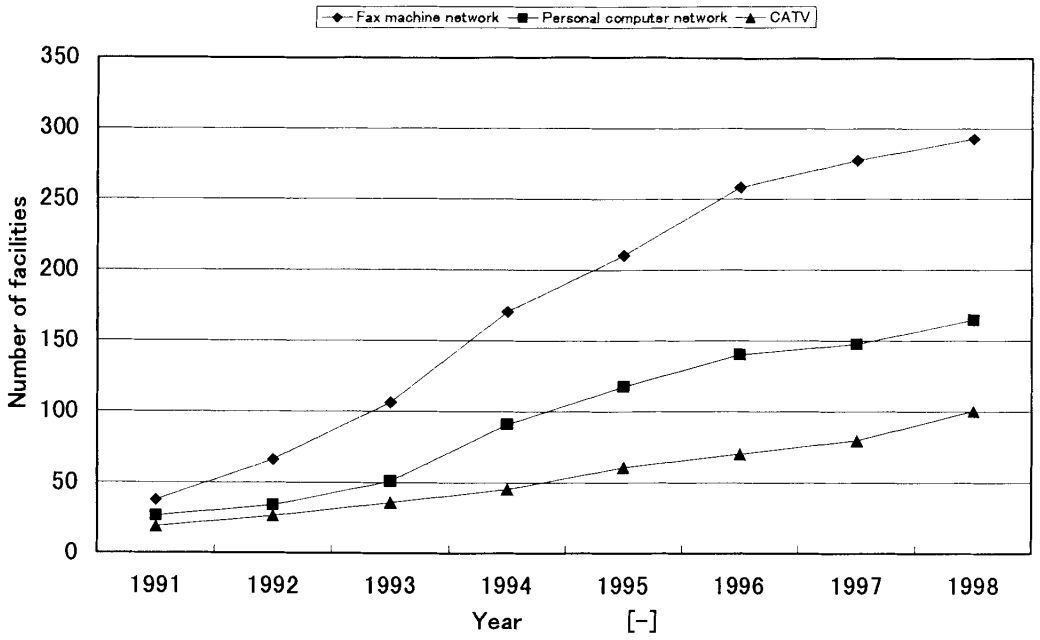

Fig. 3 Increase in communication facilities for agriculture[3)]

Ministry of Agriculture, Forestry and Fisheries has assisted the construction of knowledge-based communication networks in farming areas. As a result, the number of communication networks in agricultural areas has increased, as shown in **Fig. 3**[3)] This kind of facility is designed to function as an information hub in a village. However such facilities cover only 700 villages out of 3200 (total number). In addition, agricultural organizations and private companies provide wide variety of agricultural information.

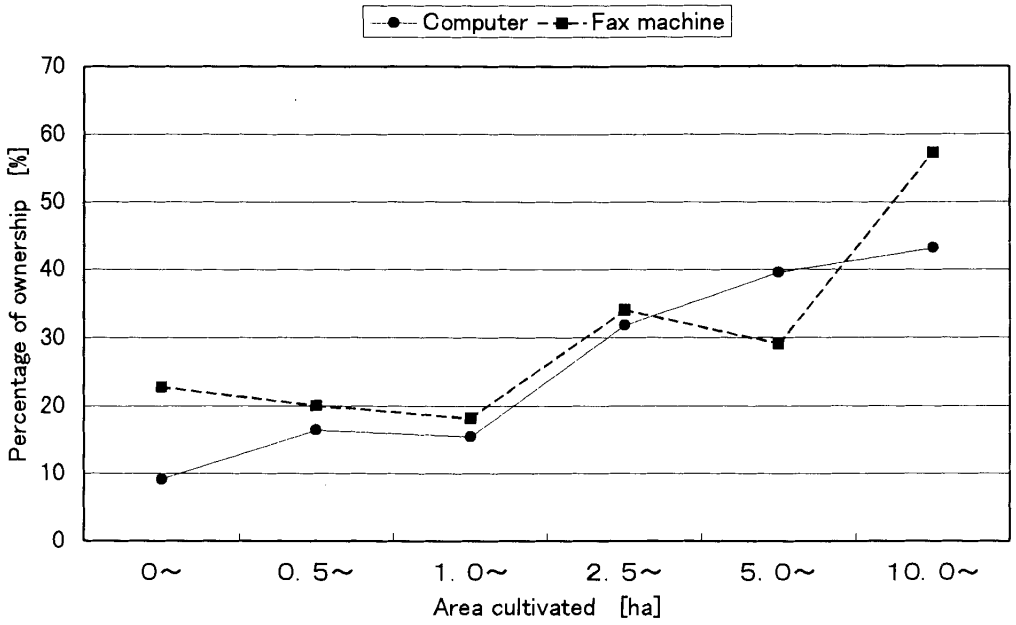

Fig. 4 Relation between possession of communication devices and land area cultivated[3)]

When compared with the industrial sector, the current level of information utilization is still low. For example, the percentage of personal computer possession is 15.1% among farming households, while that is 25. 2% among total households. However, motivated farmers, cultivating larger areas, are using information devices intensively as shown in **Fig. 4**[3)]. To enhance the information utilization in farming areas, we need to improve information infrastructure, provide opportunity to learn on information technology and construction of comprehensive and real-time databases that offer a wide range of agricultural information.

Information education in Japan

Facilities for information education

The Ministry of Education, Science, Sports and Culture (hereafter Ministry of Education) has installed and improved educational aids (e.g., computers), information communication networks, information equipment and software for education[4)]. The average number of personal computers was 22 per elementary school, 42 per lower secondary school and 44 per upper secondary school in 1998. The percentage of schools equipped with computers has increased as shown in **Fig. 5**, although the rate of Internet connection is still low level ; 1998, it was 7.3% in elementary schools, 22.7% in lower secondary schools and 37.4% in upper secondary schools.

Improving information education requires human resources.

According to the statistics, the percentage of teachers who have the necessary information education teaching skill is low, as shown in **Table 2**

To promote information education, the Ministry of Education released a report titled "National Curriculum Standards Reform for Kindergarten, Elementary School, Lower and Upper Secondary School and Schools for the Visually Disabled, the Hearing Impaired and the Otherwise Disabled" in 1998[5)]. The report stressed that consistent and systematic information education through all stages of school education will require sufficient improvement of related materials and active use of computers in virtually every subject. For this purpose, elementary schools will employ computers for children's learning activities during the "Period for Integrated Study" and other classes.

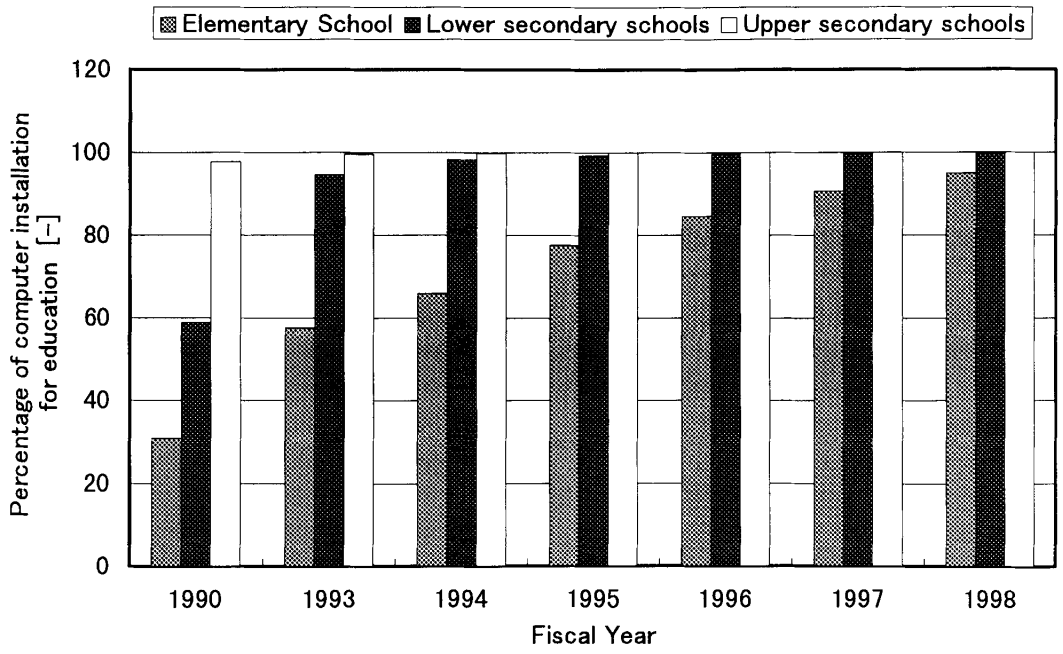

Fig. 5 Increases in computer installation[4]

Table 2 Shortage in human resources for education[4]

	Percentage of teachers who can operate computers	Percentage of teachers who can teach by using computers
Elementary schools	50.9	22.7
Lower secondary schools	51.8	23.8
Upper secondary schools	62.2	24.4

Information learning in lower secondary schools

In lower secondary schools basic study on information has been taught as part of "Industrial and homemaking class". In the new standard, it is reported that lower secondary will require students to learn the information basics including basic computer skills in industrial arts and homemaking class. Thus greater part of the class will go for information study and following subjects will emerge:

(1) The role of information in everyday life and industries
(2) Composition, functions and operation of computers
(3) Utilization of computers
(4) Information network
(5) Utilization of multimedia created by computers
(6) Instrumentation and control by computers

Information education in upper secondary schools

Upper secondary school will establish a new subject area called "Information Study", as a required (i.e. compulsory) area. Its purpose will be to help students acquire communication skills and manner. This subject will consist of three sub subjects:

(1) Information A: Use of a computer and information networks
(2) Information B: Scientific understanding of the function and mechanisms of a computer
(3) Information C: The role and influence of information communication networks

in society.

Each school or individual student can choose one class from among them.

Information education in agricultural upper secondary schools

In agricultural upper secondary schools "Agricultural information processing" was introduced about ten years ago to teach new technologies related to agricultural information. It was a required subject and covered not only subjects related agriculture but also a basic knowledge of information science. Major items included in the subject are as follows:

(1) Computers in industrial society
Human society and information processing
Areas of computer application
Information in society, industry and for profession

(2) Utilization of computer
Utilization of word processors for Japanese
Utilization of simple software

(3) Hardware
Basic functions of computers
Components of computers

(4) Software
Software system
Programming

(5) Computer and communication
Data communication
Computer and control

(6) Computer application in agriculture
Database
Instrumentation and control systems
Utilization of CAD
Expert system

As mentioned previously, with the introduction of "information study", "agricultural information processing" will become an optional subject that will focus on agricultural themes. A new subject, "agricultural information processing", aims to give students an understanding of the importance and role of information in our society, and help them to acquire skills and techniques for information utilization in agricultural areas. Contents of the subjects are as follows

(1) Industrial society and information
Information and its utilization
Roles of information in agricultural fields
Information ethics and security management

(2) Utilization of communication media in agriculture
Hardware and software
Information systems
Multimedia and data

(3) Utilization information for agricultural purposes
Information network
Systematization of agricultural production, processing and distribution
Utilization of agricultural information

Each school will be allowed to select some items from this list. Though much effort is being made to compile new textbooks and guide books for this subject, it is still not completed.

As mentioned previously, the qualitative improvement of information education depends on teaching ability. With the reformation of national curriculum standards, there will be shortage of trained teachers for information education. For this reason, a new lecture called "Operation of information devices" will be introduced as part of teacher training programs in universities, and service training of information education starting in 2000.

Conclusion

As this report shows, information education in Japan is at a turning point and must be thoroughly examined and evaluated. Concerning agricultural information education, it can be pointed out that following issues will remain after the coming reform.

1. Though agricultural information education is essential for future farming, it will become an optional subject. So we have to make the subject appealing to students.
2. Basic knowledge on agriculture and a scientific background are essential for the utilization of agricultural information. We must, therefore, emphasize the relation

between information study and other agricultural subjects.

3. Methods for sensing, control and storing method of measured data must be learnt
4. How to combine internal data with external data is one of the key points for utilizing agricultural information. Thus the advanced methods should be continuously introduced.

Acknowledgement

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