PART II

ABSTRACTS - BIBLIOGRAPHIES OF RELATED PAPERS ON CROP-LIVERSTOCK INTEGRATION IN SLOPELANDS
PART II

This section presents the abstracts and bibliographic citations of related papers presented during international seminar-workshops sponsored by FFTC. All of these papers focus on crop-animal integration in slopeland areas.


The three agroecological zones share common characteristics of Yogyakarta upland areas. Most are rolling to hilly with steep slopes formed from volcanic ash or limestone. The monsoonal climate has 3 to 5 dry months. The main land is utilized for upland annual crop farming but poor management made the lands prone to erosion, ultimately rendering it unproductive. The Component 8 of Yogyakarta Upland Area Development Project (YUADP Component 8) pursues conservation farming, focusing on vegetative methods of terrace stabilization and the incorporation of fruit trees and ruminant animals. Forage grasses, grown as contour strips or on the edge of the terrace, effectively reduce erosion while supporting two to three cattle per hectare during the rainy season, and less during the dry season. By conserving the run-off water in small reservoirs during the rainy season farmers are able to grow high value vegetables during the dry season. Moreover, trickle irrigation, combined with mulching and shading, allows young trees to survive in the dry season. Adoption of the technology by farmers in the surroundings is expected. However, current adoption rates seem to be slower than expected, probably due to low soil fertility, poor condition of the farmers and, among others, lack of capital.


Japanese Shorthorns are being raised in the Northern Tohoku district of Japan. Here, these cows and suckling calves are grazed on cooperative pastures in the uplands during the growing season. To reduce the management cost of the cooperative pastures, a new system was introduced whereby a small, improved pasture was integrated into the surrounding vast woodland pastures. In this open-woodland pasture system, trees of lesser value are cut down and the area is planted to forage crops using a new type of seed-pellets spread on the forest floor. It is anticipated that this system will play a key role in producing beef cattle at a low cost while producing valuable lumber as well.


During the 1960s and early 1980s, incentives for reclaiming forests and expanding pastures were included in Korea's agricultural policies. Around the late 1980s, however, pasture for grazing decreased as prices of land and wages increased, and people stopped doing dangerous, difficult, and dirty work. This weakened the competitiveness of Korea's livestock industry. Increasing cooperative farming corporations and boosting the goat industry are expected to solve the problems, so far. The 'tonic-oriented-trend' of Korean people is a
major fostering factor of the goat industry. However, relevant institutions including marketing and processing should be strengthened to further develop it.


Current development of the ruminant industry in Malaysia is directed towards optimal use of agricultural resources and by-products. With 4 million hectares of rubber and oil palm, coupled with the growing demand for beef and the need to increase the self-sufficiency level of local beef producers, the development of large scale ruminant production under plantation crops offers considerable scope for the expansion of the livestock industry in the country. Present knowledge of livestock integration and soil management practices indicates that sheep can be effectively integrated under rubber, and a wider range of species of livestock can be integrated under oil palm. Some of the benefits of livestock integration include savings in weeding cost, reduction of chemical fertilizers and income from the sale of livestock. Future integration of livestock in sloping/steep lands will depend on the current progress of the ruminant industry within the plantation sector.


Through the Royal Project, sloping agricultural land technology, especially the crop-based technology, was developed. It proved to be successful in northern Thailand where large number of hilltribe people live and farm. There is renewed interest in animal production for the people in the Royal Project areas. The Thai government in affiliation with the Royal Foundation is now trying to develop animal production in high altitude area. Research into integrated farming system in highland is suggested.


To determine the benefits of raising livestock in poor small farms and the technology adoption for farmers, two models of animal-crop integration in sloping lands were developed in the eastern region of Vietnam. One farm, 1.5 ha. was divided into two parts: one for growing leguminous hedgerows following the contour lines and the other for cash crops. Two cows were raised under this system whose animal net farm income was more than US$500. Another farm, 0.25 ha, was planted to leguminous crops and Napier grass. Five dairy goats were raised, with an annual net income of more than US$600.


Taiwan is a mountainous island in Asia. Soil and environment conservation is a major concern in developing and utilizing land resources by the government, especially in sloping agricultural land. Raising animals especially goats in sloping lands, has been forbidden due to the problem of soil erosion. The confinement system combined with limited grazing
system has been extended to the farmers since 1985. It has not only increased production, but also solved the problem of soil erosion. Recently, some farmers developed an integrated management model which not only combine agriculture, forestry, aquaculture and livestock, but also balanced ecology, production and recreation. This model seems to have potential in the future.


Meat type goats fed full ration of Rensonii from weaning to 6 months showed no sign of ill health and weighed 20-30 kg at 6 months. On the other hand, Barbados Blackbelly sheep (15 lactating females) fed for two years with 75% Rensonii and Gliricidia and 25% grass with no grain supplement performed as well as a control herd of 15 lactating females fed various mixed forages and a supplement of 250 grams rice by-products per day. The forage fed to the MBLRC goat dairy herd for the past 6 years has been 100% legumes (no grass) and no ill-effects have been observed. These legumes consist of 50% Desmodium rensonii, 25% Gliricidia sepium and 25% Flemingia macrophylla. A simple milk ration has also been fed with an average milk production of 2/5 liters per day over 250 days of lactation.


Since 1992, the University of Agriculture and Forestry in Thu Duc District, Ho Chi Minh City, has implemented a program to help poor farmers in two villages in Long Thanh district, Don Nai province and in Chuchi district, Ho Chi Minh City. A credit program and sustainable technologies in raising livestock and cultivating crops were extended to improve the farmer's situation.

The results observed from these two upland village projects in Southeast Vietnam revealed that:

- Farmers increased their profit when they raised livestock using local feeds;
- Work became available to farmers during the dry season;
- Credit program is necessary for the success of a project; and
- Raising native chickens could be expanded to poor farmers because it needs low input, has a stable price and is suitable for rural areas in Vietnam.


A combined system of farming, livestock husbandry and forestry has been established in the hilly land of Kyushu region, where 80% of the land is forest. Sustaining the system, however, becomes difficult because of low utility and marketability of forestry products and the requirement in time and labor in forestry operations.

Some farmers in Oita prefecture have recently introduced Kunugi (Quercus acutissima Carruth.) trees into their forest. The logs harvested were used for the production of mushrooms, which brought in a good income. Furthermore they used the forest as woodland
pasture for beef cattle grazing, thereby, saving time and labor for weeding the forest. Because of this, they were able to concentrate on the production of mushrooms and vegetables using the surplus of time and labor. These benefits derived from interactions between livestock husbandry and forestry are considered to be a key factor in the improvement of the combined system in the hilly land.


The crop-livestock mixed farming system was implemented at a small-scale subsistence level of traditional agriculture using the farming systems research and development approach. These efforts increased products as well as farm income and mobilized idle labor while improving land utilization. However, rapid industrialization has commercialized farming and reduced rural labor. Such circumstances made crop-livestock relationship estranged from each other. New research approaches should be toward productive and profitable farming of capital and technology-intensive types. These should be environmentally in harmony with a sustainable agricultural system, with strengthened multidisciplinary teamwork.


Crop-animal farming systems research and development in the Philippines, both in the lowland and upland agro-ecosystems, has been an on-going activity for the past 10 years or so. Smallhold upland farmers with scarce capital resources populate the upland environments, which are usually marginal for farming. Thus, the animal component of the farming systems is possibly more important in the uplands despite its being only secondary to the crop component. Despite its potential, the contribution of crop-animal integration in improving farm productivity is little explored. Research institutions as well as state colleges and universities have exerted research efforts to study and improve the potential and make technologies available to farmers. Sustainability, multidisciplinary collaboration in research and development, and transfer of appropriate technology through proper delivery systems are some of the issues that need to be addressed in the development of the upland agro-ecosystem through crop-animal integration.


Taiwan is one of the most densely populated countries in the world. Its flatland area is only representative of one-third of the total 36,000 sq. km. Therefore, agricultural production in the uplands is of prime importance. The slopeland soils are shallow and low in fertility. Animal manure is a good source of organic fertilizer that can enrich soil fertility and promote crop production. The combination of animal and plant production naturally forms an ideal integrated crop-livestock farming system in the uplands of Taiwan. However, due to the unfavorable geological condition of mountains and uplands, improper land utilization will cause serious soil erosion.
To utilize the uplands, the control of soil and water erosion must be carefully considered. Organization of various levels that plan to initiate crop-livestock projects should completely follow the concerned laws and regulations.


Upland farms in Hokkaido have achieved an enlarged scale and a specialization of product. They are facing problems of cost reduction, quality improvement of upland products and the introduction of new intensive products. In Shirataki village located in the marginal upland area, the agricultural system is solving these problems.

The agricultural system consists of regional resource utilization and the introduction of beef cattle in upland farming. The beef cattle raising center which is managed by agricultural cooperatives raises newborn bull calves from dairy farms. Beef cattle are fed ammonia-treated wheat straw, which is a by-product of upland farming. Bark from sawmills is also used as bedding. In return, compost and barnyard manure are supplied to the upland farms.

In this integrated system, ammonia treatment is the key technology. This system enables the raising of beef cattle using regional resources, and the return of compost and barnyard manure to the uplands. Raising beef cattle is intensive and profitable. The supply of compost brings a yield increase and improvement in quality of upland products. In this way, this system solves the above problems and increases productivity and income levels in regional agriculture and upland farming.


Success or failure in dairy farming depends on the efficient use of quality roughage feeds. In countries with high population densities like Korea, cultivating forage crops competes with food crops. Therefore, dairy farms in Korea are dependent on concentrates rather than on roughage feeds. These farms improved their productivity in terms of milk, fat content and breeding rate.

Thus to improve the productivity of livestock, it is recommended to cultivate and use good forage species. In the case of farms where their own land are not sufficient for roughage feeds, renting of non-crop lands during the winter season and the cooperative use of costly implements in seeding, harvesting and silage making are recommended. Furthermore, application of manure to forage crops reduces fertilizer use, improves soil fertility and also reduces environmental pollution to some extent.

Brief reviews of the sugarcane and coconut industries in the Philippines are presented. Due to the heavy dependence of both crops upon the world market, the use of sugarcane juice or the traditionally processed muscovado sugar for pigs was critically analyzed compared to other ways of utilizing sugarcane. In the case of coconut, grazing of cattle on Signal grass pasture was compared to coconut production alone.


The increase in the consumption of dairy products in Taiwan is associated with the economic development in the country. The climatic condition is favorable for growing tropical and subtropical forage grasses and for developing grassland farming. Dairy farmers can overcome technical problems in feeding dairy cows when temperature and relative humidity is high in summer. Thus, the number of dairy cows and milk production performance per cow are increasing every year. The major production performance cost of milk is feed (52.73%), including concentrate (23.11%) and forage (29.62%), followed by cow depreciation (15.77%) and labor cost (14.34%). Attempts are being made to reduce milk production costs. There is still a great potential to develop the dairy industry in Taiwan in the future.


Several farming systems researches (FSR) have been conducted in the open upland regions in Indonesia. The upland FSR resulting in transmigration high rainfall and low rainfall regions indicating a considerable potential to increase the crop-livestock production, the cooperative farmers’ income, and soil fertility simply by improving the existing farming systems and introducing adaptive new technologies. However, the heterogeneity of soils and cropping patterns make it difficult to produce crop yields as reliable as in lowland areas. The role of livestock in the upland region is to compensate for the reduced crop production. In general, the promotion of farmers’ income, derived from the livestock component, varied from 15 to 50% depending on the type of agroecosystems. The involvement of extension agencies, farmers, local government and other supporting institutions are important in disseminating the upland FSR innovations.


Solving the food shortage problems remains a big task for some provinces in the remote mountainous and hilly upland areas in China. Data show that the total arable land has not changed, but the population has increased. As a result, arable land per capita has decreased, creating high creating high pressure on agriculture although production has been progressively increased. This was through the introduction of new technologies and the increase in the agro-inputs. Since 1985, the Chinese government has initiated a number of upland development projects. This was aimed at developing upland economy and improving the regional farming systems through investment for infrastructure and introduction of the suitable technologies. Meanwhile, the central and provincial governments have allocated
poverty alleviation funds and loans to some impoverished upland areas. Apart from the financial support to the upland areas, research and development on relevant technologies have also made a very important contribution to upland development.


The paper highlights major researches on tree crop-livestock integration, focusing on feed resources, management and production of livestock under tree crops. namely: oil palm, rubber and fruit trees. Exemplified was the Oil Palm-Cattle Integration Project in RISDA Estates (ESPEK), describing the grazing techniques, health programs, animal performance, problems encountered, revenues and expenditures, and other benefits of cattle integration with oil palm.

From this Project, the following were highlighted:
- Tree crops are suitable for integration with ruminant animals.
- Cattle and sheep can be introduced into oil palm plantation at when the palm trees are more than 18-24 months old. The recommended stocking rate is 2-2.8 cattle per ha or 6-10 sheep per ha for immature palms and 1-2 cattle per ha for old palms.
- Sheep are suitable in rubber plantations. They can be introduced when the trees are more than two years old. The stocking rates are 6-8 sheep/ha for immature trees and 3-5 sheep/ha for mature trees.
- Sheep have been shown to integrate well with some fruit trees. However, the long-term effects on the trees are not known.
- Benefits from livestock integration with tree crops include reduction in weeding cost, recycling of organic wastes and supplementary income from the sale of animals.
- There are no adverse/negative effects of livestock integration on the tree crops if animals are managed correctly.


Although there is a technical potential for increasing overall productivity of integrated crop-livestock systems, the attainment of all the desirable economic and resource goals in Thailand depends on careful farm level management which, in turn, depends on a number of social and institutional factors.

The scarcity of land is the fundamental constraint to increasing the number of livestock. The demand for adequate and improved quality feed has to be met by using marginal areas of slopeland which are vulnerable to erosion.

Similarly, for efficient husbandry, regular labor is required. The farm household members who take care of animals should be the target people for delivery of extension services and technical advice.

The integration of livestock in crop production system requires high initial investment capital, which is beyond the financial capacity of farmers. Although, at present, institutional lending is available, one constraint is the lack of land rights document to guarantee the loan. Another limiting factor is the farmers' attitude toward capital
investment for livestock enterprise. Most farmers admit that livestock raising is highly profitable, but it takes too long a time and there is some degree of risk in realizing a profit. Therefore to them, livestock is household-saving not a productive investment. Overcoming this attitudinal and behavioral constraint seems to be an ambitious goal in the present crop-livestock farming system.


Northern Thailand over the past few decades, has faced a major problem of deforestation due to a rapidly growing population and the consequential demand on land area for agricultural purposes and human settlement. One of the major causes of deforestation appears to be shifting cultivation practiced by the hilltribe farmers in the highlands. In the uplands, cattle and buffalo are providing draft power in the farm. In the highlands, however, this use of livestock for draft is less important than their socio-cultural and the investment roles.

The nutrient role of livestock in providing manure as organic fertilizer is uncommon. The role of non-ruminants such as pig and poultry as converters of crop carbohydrates to meat and eggs in such areas is more prominent. In terms of nutrient recycling, livestock consume crop residues or by-products, and provide the manure as organic fertilizer for crops. The intensive cropping systems in the highlands in the Royal Project extension areas serve as a few examples of livestock manure being utilized to effectively increase crop production. Nevertheless, the livestock manure has to be purchased, and transported up from the lowlands. To intensify the nutrient-recycling role, the integration of livestock and cropping systems must be improved.


The integration of crop and livestock in the highland of Northern Thailand is in transition. Promotion of cattle is being handled with care, as returns to capital are extremely low. It is expected to decline as grazing grounds diminish. Cattle production is too labor-intensive and expensive unlike pig production. Small-scale pig keeping may continue as it is an important source of subsistence food and since pigs serve sacramental purposes. It is important to raise the weaning rate by means of pest and disease prevention measures. The improved pig breeds and feeding practices can contribute to that goal.

Farmers do not adopt composting, and are not making use of the manure from their livestock in the fields. This is because labor needed for collecting plant residues and properly storing them in pits is expensive. Moreover, in the traditional livestock system, animals are rarely confined in pens, hindering further the collection of manure which do not accumulate at one place. Traditional norms also prohibit the handling of manure.

About 23 million hectares of slopeland in Indonesia can be developed for food crops and horticulture. Slopeland productivity is generally low due to infertile and erosion-prone soils, unevenly distributed rainfall, lack of infrastructure, disease, and inadequate extension. Livestock is an important component of the land farming system because it produces organic matter for maintaining soil fertility while providing draft to substitute manpower. Lack of infrastructure is an obstacle in putting soil conservation technology into practice. This paper discusses Indonesia's soil conservation program, problems associated with implementation, and suggests problem solving strategies.


This paper discusses some of the agricultural activities in slopeland areas in Malaysia. It highlights the strategies required to make them sustainable and some other future concerns and issues. The agricultural activities include production of perennial crops (rubber, oil palm, orchards, tea and pepper) and high-value vegetables, floriculture, shifting cultivation and livestock production (dairy cattle and buffalo). Major livestock activities are located in the rainfed lowland and upland areas.

The trend in slopeland use pattern indicates low priority in developing livestock under plantation crops; nevertheless, the technologies on production systems and by-products utilization are readily available for immediate use. The most common by-products are oil palm fronds and palm kernel cake. Among the measures taken by the government to make slopeland agriculture viable are land development (undertaken by Federal and State land agencies), provision of grants and subsidies to farmers, and extension of credit through the various financial institutions. Future concerns and issues are related to environmental lobby, shortage of labor in the plantation sector and problem of mechanization in the slopeland.


The Korean Peninsular is mountainous consisting of 66% forest and 23% cultivated land. Thus, Korea is in absolute shortage of land for producing roughage and crops. Hence it is necessary to develop the forest area to increase farmers' incomes.

When the processing management of cultivating crops was disregarded, the forests were exploited, damaging forestlands and causing soil erosion. Forest development therefore was considered related with natural environmental preservation and land utilization. The slopeland of Korea was utilized for vegetable cultivation, orchard and pasture establishment, and as grazing area for livestock. Radishes, Chinese cabbage, and potatoes are cultivated in the alpine area, and chestnuts and persimmon are mainly cultivated in slopeland.
Some Korean native cattle, goat, and dairy cattle are raised in the slopeland or alpine areas. Of all the domestic animals in slopeland areas, the Korean native goat is one of the most favorable animals. Cooperation between slopeland management and crop-livestock integration would be expected as an alternative for the increase of slopeland utilization in the Republic of Korea.


Most of the land in Nagano Prefecture is sloping and forested, with Sasa spp. a typical vegetation. Sasa is an important natural forage plant for cattle in Japan, but it inhibits the regeneration of trees, especially oak, Fagus crenata.

The first study was aimed at promoting the regeneration of the oak by cattle grazing. Cattle grazing reduces the time and labor required for the removal of Sasa. However, the oak regenerated only in small areas since the cattle density was low. In Nagano, foresters planted larch trees (Larix leptolepis) about 30-40 years ago, but their forestry management (periodic thinning etc.) has now become difficult because of the introduction of cheaper timber. A solution to this problem is the conduct of intensive thinning and leasing of the forest to livestock farmers. In addition, the farmers should introduce herbage species into the forest so that the productivity of livestock can also be improved.

The second study was the selection of the herbage most suitable under larch forest. Results show that orchardgrass and reed canary had high yield and persistency.


Taiwan is a mountainous island with limited flatland area, but is one of the most densely populated countries in the world. The appropriate utilization of slopeland and the control of soil and water erosion are very important in integrating crop and livestock in slopeland areas in Taiwan.

Pangola grass is a superior pasture for the lower sea-level slopeland. However, due to the high cost of land, grazing was found uneconomical in the slopeland of Taiwan. The combination of crop-livestock production, recreation and ecology conservation has formed an ideal integrated crop-livestock management system in the slopeland of Taiwan.


Vietnam is a tropical country in the Indochina peninsula. The country's total area is about 330,541 sq. km. with a population of more than 75 million. Seventy per cent of the population lives on agriculture, and two-thirds of the arable land is classified as upland where the issues of natural resource conservation and sustainable agriculture are acute. There is misuse of land resources in the uplands that often causes soil erosion, land degradation, loss of biodiversity, low productivity and farmers poverty.
In the past five years, the National Institute of Animal Husbandry, the Bac Thai University, the University of Hue, and the College of Agriculture and Forestry for the Vietnam National University - Ho Chi Minh City have carried out many programs on crop-livestock integration in the uplands with the aim of transferring appropriate sustainable integrated farming systems technologies to the farmers.

The emphasis was on achieving a full circle system: crops (sugarcane, cassava, corn, leguminous trees) and animal production for producing food and energy for people and returning manure to the plants. A successful element in this recycling process, which was well accepted by farmers, was a simple biogas digester made of plastic.

From North to South Vietnam, crop-livestock integration in the sloping land areas has given encouraging results. Livestock were considered as integrated part of sustainable development. Livestock were not seen as a specialty, but attempts have been made to see livestock adapted to the available feed resources rather than changing the environment or feed resources to match the animals.

It may take time before the national goals in providing food security, improving income and reducing poverty and managing natural resource on long-term sustainable basis are met. There are many new opportunities for integrating livestock in farming systems on slopelands. The challenges are for the technologist to develop more efficient systems and a holistic approach to derive benefit from solar energy. Likewise it is important for the economist to determine, in monetary terms, the presently intangible cost of pollution and the income to society of activities that enhance, rather than destroy, the environment.