

# INTEGRATED CROP-LIVESTOCK PRODUCTION ON SLOPELANDS IN KOREA

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## ABSTRACT

*Crop-livestock mixed farming was well integrated in the past, when farming in Korea was small-scale and mainly for subsistence. A farming systems research and development approach was followed, to increase the range of products and farm incomes by more intensive utilization of available labor and land. However, Korea's rapid industrialization transformed farming into a commercial, specialized type of production, and created a rural labor shortage. Under such circumstances, the production of crops became separated from the production of livestock. A new research approach should be toward productive and profitable farming which is highly intensive in terms of both capital and technical skill, while being environmentally friendly and part of a sustainable agricultural system. Work by multidisciplinary teams will be needed to achieve this end.*

## INTRODUCTION

The agriculture of Korea reflects its high population density (44 million people on 99 thousand km<sup>2</sup> land), the hilly or mountainous topography (only 20.7% is arable land), and its cool temperate climate with a limited growing season (its land utilization intensity is around 110-150%). The traditional farming system, based on rice and barley production (63% of the arable land is paddy fields), was characterized until the 1960s by semi-subsistence small-scale crop-livestock farming. The average farm in 1965 had only 0.9 ha of arable land. More than half the total farm households raised beef cattle (the Korean native breed) and/or pigs and chickens. Of the households raising livestock and chickens, the average number raised were 1.1 cattle, 1.3 pigs, and 9 chickens per household. At this stage, the role of livestock was to supply draft power and manure, and earn some cash income. They also utilized otherwise idle resources of labor, and of feedstuffs such as crop by-products and wild grasses. However the rapid industrialization and economic growth of the last three decades has transformed both crop and live-

stock production. There is a farm labor shortage caused by the migration of rural people to industrial cities. The purpose of farming has changed, from subsistence to selling in the market place, and there has been progressive specialization which has gradually loosened the crop-livestock links of the past.

## ORGANIZATION OF AGRICULTURAL RESEARCH IN KOREA

Agricultural research and extension are the responsibility of the Rural Development Administration (RDA). This is under the administrative control of the Ministry of Agriculture, Forestry and Fisheries (MAFF) but has autonomous planning and implementation of rural development programs. The RDA headquarters in Suweon has 6 bureaux, while there are 15 subordinate research institutes on a national level, provincial RDAs, and city or country guidance offices at a local level.

Under this centralized system, extension and development achieved some degree of uniformity. However, the Korean government is now beginning to transfer government to local authori-

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ties. Local assemblies were formed a few years ago, and provincial governors and heads of cities or countries are to be elected next year (1996). Following this political change, agricultural extension and development can be expected to follow a more pronounced regional pattern.

### **Livestock Research**

The major concern of livestock research during the 1960s and 1970s in Korea was to replace feed concentrates for cattle and pigs with other resources such as agricultural by-products, other roughage sources, and sweet potato, either the roots alone or roots and leaves made into silage. Research into grassland improvement and forage production on uplands included the selection and improvement of pasture and forage species, particularly for dairy cattle. A series of experiments on grassland establishment on hilly land by means of oversowing were conducted during the 1970s, accompanied by studies of the effects of burning, herbicides and heavy grazing to control the natural vegetation. There were also some studies on the utilization of native grasses and woodland pastures, but the results were not widely applied because the labor shortage in rural areas meant that such land was tending to revert to dense woodland.

Research into the utilization of roughage by cattle was mainly to reduce the need for concentrates and thus feeding costs, but since the end of the 1980s the situation has changed. Because of the high cost of labor, purchased roughage is often more expensive than feed concentrates. With compound concentrates for dairy cattle at 25 cents/kg, imported alfalfa cubes at 33 cents/kg and rice straw at 20 cents/kg, roughage is definitely more expensive than concentrates in terms of energy value (TDN). Of course, home produced quality forage and locally produced rice straw are still relatively cheap. Research into roughage utilization nowadays should be concerned with fulfilling the nutritional and fiber requirements of cattle, and the results must be evaluated in terms of the cost and feed value of the products compared to other sources. Researchers into crop/livestock production also have to be very sensitive to labor productivity and labor costs, in the context of overall farm management. This is a completely different concept from that of the past, when an increase in yields and incomes by the better mobilization of labor and more intensive cropping were considered the most important values.

### **HIGHLIGHTS OF RESEARCH INTO CROP-LIVESTOCK PRODUCTION**

Various farming systems which combine crops and livestock have been developed in Korea over the past twelve years. Most of these include the raising of two to five head of beef cattle. One model included 0.6 ha of paddy field (one third of which was used for a forage crop of rye during the off-season), 0.6 ha of upland (food crops 0.1 ha and cash crops 0.6 ha, giving a land use intensity of 140%), and the raising of three cows and two fattening steers. This project involved 5,740 villages and 98 thousand farms, and emphasized regionally specialized crop production as well as the integration of crop and livestock. Although it generally gave an increased farm income, there were some problems of over-production of certain items and price fluctuations. Nevertheless the project made a significant improvement in farmers' ability to manage a commercialized farming system.

Twenty-four years of soil survey and land classification, beginning in 1965, has provided a detailed soil map of the country and much useful information. It showed that only 9% of Korea's arable upland is flat, and the rest is slopeland. The productivity of 42% of upland soils is reasonably high, while the remaining 58% is rather infertile. In recent years, with the growing interest in sustainable agriculture, soil research is concerned with efficient soil management and proper use of fertilizers, and fertility management which is adapted to local environmental conditions.

The development of the dairy industry in Korea is a striking example of upland development for livestock production, even though it involved many problems as well as success stories. The number of dairy cattle increased from less than one thousand in 1960 to 553 thousand head in 1993. A 10-year dairy development program began in 1962, and numerous dairy heifers were imported, eventually reaching a total of 113 thousand head. These animals were distributed to farmers who had established grassland or forage land on a regulated acreage, while grassland establishment was encouraged with subsidies and loans. Research on an improved roughage supply for dairy and beef cattle continued steadily, and included intensive production of two or three crops of forage annually on arable uplands, grassland establishment on hilly land after the clearing of trees and shrubs, and forage production in paddy fields during the off season.

Improved utilization of crop by-products included the treating of straw by ammonia (NH<sub>3</sub>) or sodium hydroxide (NaOH). Major forage crops are corn used for silage and a hybrid of sorghum-Sudan grass, also cut green over the summer, while rye, oats, rape and Italian ryegrass are cut in autumn and spring. Establishment of grassland by oversowing without removing the existing vegetation was widely practiced during the 1970s and 1980s, until the shortage of labor made it necessary to mechanize grassland operations. This practice reduced the cost of establishing grassland by 40%, improved soil conservation, and gave better grass productivity during the early stages. This grassland development program was not accompanied by proper management and utilization, and about 55 thousand ha were later abandoned (about 42% of the total).

### **EXTENSION PROGRAMS FOR INTEGRATED CROP-LIVESTOCK SYSTEMS IN UPLANDS**

The main ways of disseminating new technology to farmers in Korea are on-farm demonstrations (farms or villages as a center of diffusion), and training courses. The main season for training is during January and February, when it is mid-winter and the idle season for farmers.

During the 1970s, 1,500 demonstration villages were involved in a program to promote the raising of ungulates. Every village grew newly developed silage corn varieties or other forage crops in a demonstration plot, and selected villages had cattle raising programs for beef or dairy. Rabbit raising was encouraged for several years during the mid 1970s, but did not last long because of marketing problems. Forage production in paddy fields before or after the main rice crop has been promoted since the early 1970s, using Italian ryegrass in southern Korea and rye further north. This was successful for some time, but was then widely abandoned as farmers adopted new rice varieties which had to be transplanted earlier, leaving less time for the forage crop. This trend was reversed again in the southern part of Korea by the introduction of a new technique of overseeding Italian ryegrass in the standing rice crop ten days before harvest, at a time when the soil has a suitable moisture content and texture. This was followed by another decline, mainly because of the shortage of rural labor and lack of proper machinery for harvesting.

Extension related to grassland establishment was very successful during the 1980s. When a farmer applies to his county office for help in establishing grassland, an extension officer visits his farm

and evaluates the site, taking soil samples which are analyzed in a laboratory. The results are used for a recommendation to the farmer of the seed mixture, fertilizer requirements and seeding time. Farmers are also given group courses in skills such as the use of electric fences, and extension officers visit each farmer to see him at work and advise on whether he is following proper procedures.

Recently in the 1990s Korean farmers have come under pressure from free trade. Extension programs have concentrated on the improvement of agricultural competitiveness by such means as specialized farm management, and cooperative farming whereby several small farms are managed as a single medium sized unit, giving economies of scale.

### **CONSTRAINTS IN CROP-LIVESTOCK SYSTEMS IN THE UPLANDS**

#### **Use of Livestock Manure in Crop Production**

With increasing farm specialization, the traditional complementary crop-livestock relationship between crops and livestock has tended to disappear, and the two have become rather estranged. An exception is the breeding of beef cattle, which is still mainly done on mixed crop-livestock farms. Specialized breeding of beef cows is not possible without an appropriate area of land supplying roughage, but this is less profitable than other land use alternatives. However, with the current concern over environmental issues, the livestock industry is having to reconsider how to make proper use of livestock manure. The aim must be to develop productive, profitable and sustainable livestock production, either on an individual farm basis or collective regional basis, with one type of farming complementing another. The necessity of good rural community planning is an important issue, but it is not easy to overcome the conflict of interests between individual farmers.

#### **Geographical Separation of Crop and Livestock Production**

The geographical separation between fields of crops and grassland or other cattle raising areas, and the fact that each type of production occurs on numerous scattered pieces of land, reduces the efficiency of crop-livestock integration. This is particularly the case with grassland established on hilly land after the clearing of trees and shrubs, which tends to be in isolated locations. In the days when the labor

shortage was less pressing, forage and grasses were utilized every day by a cut-and-carry system, but this is no longer feasible, given the lack of labor or suitable machinery. Although silage or hay production is possible in isolated fields after a single harvest, the growing of short-season green crops and utilizing these by grazing is not practicable. The consolidation of upland fields has definite benefits in terms of promoting efficient farm mechanization and farm management. However, it is technically more difficult, and also more costly, than consolidating paddy fields. Before machinery can be used on upland pastures, all tree stumps have to be removed and the surface smoothed over.

### **High Land Prices**

Korea's high population density and rapid industrialization raised the price of land faster than that of any other commodity. This was accentuated by land speculation. During the 1970s and 1980s, this situation had a harmful effect on agricultural production, because the increase in land prices brought more profit than a good crop yield, or livestock production. When this situation is combined with high labor costs, farmers are not very eager to put their best efforts into increasing their production.

### **Utility Life of Research**

Because economic circumstances are changing rapidly, the utility life of research results is often restricted. Representative examples are grassland establishment by oversowing, and recommended fertilizer levels on crop land and grassland. Oversowing pasture establishment was a very useful technique during the 1970s up until the mid-1980s, since it had the merits of lower labor costs and conservation of topsoil. Such pastures were well utilized, either harvested by hand or grazed. When the shortage of farm labor became the major limiting factor after the late 1980s, the use of these grasslands was restricted to grazing alone, and then only when they were located in a place near where livestock were being kept. Recommended fertilizer levels were as high as 280 kg/ha of N, and 200 kg/ha P<sup>2</sup>O<sup>5</sup> each year on mown grassland, and 200 kg/ha N and 150 kg/ha P<sup>2</sup>O<sup>5</sup> on fields of silage corn. However in

recent years, these high fertilizer levels have been thought to cause chemical pollution in soil and groundwater. Experiments are now being conducted to find optimum levels in terms of environmental safety as well as productivity, and recommended rates are moving downwards.

### **Information Needs of Extension Staff**

As livestock farmers have become more specialized and operate on a larger scale, their technical knowledge has improved. There is a painful information gap between specialized farmers and extension workers. In the past, when farmers practiced small-scale mixed farming, it was easy for livestock or farm management extension officers to instruct them. Nowadays, many leading livestock farmers are far ahead of average extension officers in terms of their specialized technical knowledge and practical experience, especially since ordinary livestock extension officers are expected to look after all aspects of livestock and forage production, including animal health.

### **CONCLUSION**

In a country like Korea with a high population density and a limited area of arable land, the value of land is much greater than its value as an agricultural resource. Agricultural land is, of course, owned by individual farmers, who have to use it to earn income for their families. At the same time, it is a national resource, and part of everyone's environment. Therefore, land should have several functions, including being a source of farmers' incomes, the food production base to meet national demand, and a source of natural beauty and environmental health. As this last function becomes more and more important, the livestock industry must find its role in meeting all three functions, whether as a specialized farming or mixed farming system. The first and second functions are concerned mainly with farmers' efforts, while the third is largely the responsibility of government policy and management. Both capital and technology must be invested in a type of livestock production which is productive and profitable, while being part of a sustainable agricultural system. Multi-disciplinary teams working in research and development will be an important part of this effort.

## DISCUSSION

Participants were interested in the ammonia treatment of rice straw in Korea. Dr. Lee explained that experiments on ammonia treatment had begun in Korea ten years previously, and that many dairy farmers had adopted the practice. Treatment with sodium hydroxide had been found to give similar results, but ammonia treatment is easier for farmers to use. To treat straw with ammonia, farmers need a pit lined with plastic so it is airtight. The ammonia gas is injected into the straw, which is then left for four weeks. In the sodium hydroxide treatment, it is difficult to get the sodium hydroxide evenly distributed through the straw. A special machine is needed to do this, and most farmers cannot afford it.