Sustainable Roughage Production in Korea*
- Review -

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ABSTRACT : Beef and dairy cattle are the primary ruminant livestock in Korea, but there is a serious shortage of both fresh and dry forages. Small areas of forage crops or pastures, unfavorable soil and climatic conditions, high costs for pasture production, low establishment and management technologies, etc. are the main factors limiting roughage production in Korea. To meet the roughage demand of cattle several suggestions are presented. About 845,000 ha of hilly area could be developed for pastureland. Almost the same area of paddy field, and more than 200,000 ha of reclaimed land could be used for pasture production. If all the potential area is developed for pastureland, the area could be extended to 10 times more than is presently used for pasture crops and pastureland. Productivity would be increased by developing new technologies of establishment and management. Silvo-pastoral systems should be introduced to Korea. (*Asian-Aus. J. Anim. Sci. 1999. Vol. 12, No. 3 : 445-448*)

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INTRODUCTION

Agricultural production in Korea was one of the most important industries until the early 1960s. However the production ratio of agriculture to the gross domestic production has drastically decreased from 15.5% in 1980 to 6.6% in 1995. The share of livestock farm income out of a total agricultural income has increased from 7.5 % in 1975 to 24.9 % in 1995. The numbers of beef and dairy cattle have been increased from 1.4 million and 207 thousand in 1980 to 2.6 million and 552 thousand head, respectively, in 1998 (table 1).

Table 1. Numbers of cattle and cattle farms

Year	Beef cattle			Dairy cattle		
	Head (thousand)	Farm	Head/ Farm	Head (thousand)	Farm	Head/ Farm
1970	1,286	1,102	1.2	24	3	7.6
1980	1,424	997	1.4	207	22	9.4
1990	1,622	620	2.6	503	33	15.3
1998	2,633	450	5.9	552	16	34.2

To feed the cattle about 7.9 million t of roughage is necessary. But in fact only 4.1 million t is produced which is 52% of total roughage demands. To make matters worse, the amount of roughage of good quality is about 1.9 million t, which is approximately 24% of total demands, and rice straw has been used as the other main roughage source (table 3). Due to the absolute shortage of roughage, it has become inevitable to rely on feed concentrates. The feeding ratio between roughage and feed concentrates is 33:67, which is the reverse of other developed countries. This paper will discuss the reasons for low production of roughage in Korea, and suggest some solutions for sustainable roughage production in Korea.

Table 2. Land use and cultivated area per farm in Korea

Total area	Cultivated area	Paddy field	Upland	Cultivated/ Total	Area/ Farm
	(thousand ha)			(%)	(ha)
9,931	1,945	1,176	769	19.6	1.32

(Statistical Yearbook of Agriculture & Forestry, 1996, MAF)

LIMITED ROUGHAGE PRODUCTION IN KOREA

Limited area for forage or pasture production

Cultivated land in Korea is 19.6% of total land area (table 2), and the area for roughage production is 195,000 ha (table 3), which is only 2% of the total area.

The land area per head of beef cattle is 0.003 ha, while that for dairy cattle is 0.078 ha. Mean land area per beef cattle farm is about 0.06 ha, whereas that of dairy cattle farms is 1.75 ha. Accordingly Korean beef and dairy farmers have only a small area for roughage production, and are heavily reliant on imported feed grains.

Low productivity of pasture

Soil and climate conditions are very different from the countries where pasture and forage originated. Average forage and pasture production per ha are 12,400 and 7,000 DM kg/ha, respectively (table 3). One of the reasons for low productivity is low soil fertility. The layer of top soil of pasture is very shallow and shows a low soil pH level of 5.1. The organic matter content of potential pasture land is less than 1.0%. The levels of

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Table 3. Area and production of pasture or forage in Korea

Area (thousand Ha)				Production (thousand M/T)				
Pasture	Forage		Total	Pasture	Forage		Rice straw & Wild grasses	Total
	Upland	Paddy field			Upland	Paddy field		
63	98	34	195	441	1,176	238	2,252	4,107

Table 4. Chemical characteristics of newly reclaimed land and cultivated upland soils

Arable land	Organic matter (%)	Available P_2O_5 (ppm)	pH (H_2O)	Exchangeable cations, me/100g			CEC me/100g
				Ca	Mg	K	
Cultivated upland	2.9	101.0	5.7	4.20	1.20	0.34	9.6
Reclaimed land	0.9	11.3	5.1	0.75	0.73	0.22	6.5

available phosphorus and CEC are also very low (table 4).

The climate of Korea is unfavorable to the growth of pasture. Low technology used in pasture establishment and management is another reason for low productivity. The selection of pasture species, varieties, or seed mixture is sometimes inadequate. Pasture species or varieties need to be vary with region and location. Top dressing with fertilizers is much less than is recommended by Government. The cutting height and frequency, or timing of the harvest is sometimes inappropriate. Cattle producers have paid little attention to the maintaining and utilization of pastures. Consequently pasture quickly deteriorates four or five years after its establishment.

High cost of pasture or forage production

Recently land prices and labour costs have sharply increased in Korea. As the average farm size is small, basic expenses are high. It is not economic for each farmer to buy heavy farm machinery for himself. Pasture establishment costs 1,229,430 won/ha, and 2,494,300 ~ 3,542,900 won/ha for forage production. It costs 273 ~ 340 won to produce one kg DM from pasture or forage crops (table 5).

Dislike of hard work

Livestock farmers usually don't like hard work. The establishment, management and utilization of pastures require hard and tiresome work. So, many cattle producers would prefer to rely on feed concentrates rather than growing pasture or forage crops.

Administrative support

Since 1970s several joint projects with New Zealand, Australia, and Germany have been established to introduce and establish grassland farming in Korea. Through these joint projects, we have been able to obtain practical experience of grassland farming systems upon which technical information extended to farmers has been based. But still there are many practical problems to solve. Dissemination of technical information is also weak, further limiting the development of grassland farming.

The relative importance of pastoral agriculture is increasing, but there is no administrative organ exclusively taking charge of roughage needs. The research section in the National Institute of Livestock Technology dealing with roughage was reduced.

In spite of Government support with subsidies and loans for pasture establishment, farmers have not managed and utilized their pastures efficiently.

SUGGESTIONS FOR SUSTAINABLE ROUGHAGE PRODUCTION

To solve the above problems and produce enough roughage on a sustainable basis, here are four suggested solutions :

Extension of pasture and forage lands

Two-thirds of the total land area in Korea is hilly or mountainous. This apparently offers a promising potential for pasture development. A significant area of forest lands is suitable for pasture development. According to the results of soil surveys by ORD, about 845,000 ha of hilly area can be developed for pasture taking into consideration the soil status and degree of slope (see Agroforestry system below).

Rice farming is the main type of primary agriculture

Table 5. Production costs or purchase prices of concentrates and roughage

Feed	Constituent		Production cost or purchase price		
	DM (%)	TDN	As fed (won/kg)	DM (won/kg)	TDN (won/kg)
Concentrates	87	68	248	285	365
Silage corn	15	9.8	41	273	418
Green rye	17	10	57	335	570
Pasture	10	6.2	34	340	548
Rice straw, imported	85	40.8	170	200	424
Tall fescue, imported	89	40.1	243	273	607
Alfalfa bale	89	48.1	350	393	728

Table 6. Recommended land area and classification in accordance with slope

Slope, %	Upland		Orchard Mulberry		Grassland		Woodland	
	%	Class*	%	Class	%	Class	%	Class
2>	8.7	I	15.0	I	3.2	I	0.2	I
2~7	29.6	II	24.0	II	22.8	I	0.7	I
7~15	38.7	III	5.5	II	38.5	I	3.2	I
15~30	20.0	IV	21.7	III	20.2	II	8.9	I
30~60	2.6	V	3.2	IV	13.8	III, IV	32.8	II,III
60<	0.3	V	0.6	V	1.5	V	54.2	IV
Recommended area (ha)	878,501		119,011		102,846		6,425,489	

* Class I is high production and needs little soil management.
Class II is moderate production and requires more soil management.
Class III is low production and needs special soil management.
Class IV is uneconomic.
Class V should not be used; or cultivate alternative crops.

in Korea taking up 60.5% of the cultivated land (table 2). Most of the paddy fields are for rice only, and a small area is used for forage or horticultural crops during the off-season. About 34,000 ha of paddy fields are used at present for forage production. However 823,200 ha could be used for that purpose during the season when rice is not being cultivated. Forage production in paddy fields has many advantages in southern Korea.

Utilizing reclaimed land is another choice for roughage production. The vast seaside reclamation project, for example, the Semangeum Reclamation Project, is under construction on the southwest coast of Korea. When all the available reclamation work is finished, more than 200,000 ha could be used for pasture production.

Many farm youths have moved to cities, depleting rural populations and inflating city numbers. On the other hand many urban people have bought farm land for the purpose of land speculation. As the farm labor force has decreased, the area of idle land has increased. About 80,000 ha is not utilised because of absentee landlords. Therefore, these areas could be converted to pasture or forage land.

System renovation

1) A Department of Pasture and Forage Crops must be established within the Ministry of Agriculture and Forestry. Also, a Research Institute of Pasture and Forage must be established. Research funds on roughage need a sharp increase.
2) Scientists and pasture growers must make the policy planners of Government understand that grasslands conserve soil and water, protect and beautify the environment, and improve the quality of rural life. Government needs to actively encourage farmers to establish grasslands with subsidies and loans.
3) The RDA should promote extension work to transfer practical technologies to farmers on how to establish, manage, and utilize pasture or forage. Technical magazines or brochures on roughage will be beneficial to farmers.
4) The Government needs to let farmers lease national or public land for grassland, and make it easy and simple to get permission to establish pasture land.
5) The Government needs to organize several farms into a farming complex and help them with money and expertise to purchase machinery cooperatively for their joint use. Setting up companies to lease farm machinery and equipment is also recommended.
6) Models of diverse roughage production could be presented to farmers according to their farm size, location, and livestock farming systems.

New technologies for better production and use of pasture

1) Collect a variety of germplasms of pasture and forage, and select those suitable for each situation.
2) Develop surface sowing methods on hilly areas. The surface sowing method is recommended in hilly areas to protect soil erosion. Technologies for effectively defoliating unwanted plants and the coating of seeds are important for hill pasture establishment.
3) Introduce forage crops before rice harvests on paddy fields as this is necessary to extend the growing period for forage.
4) Collect salt tolerant germplasms and select those suitable for reclaimed areas.
5) Develop cultivation methods for sustainable roughage production on reclaimed land, and develop model livestock farms on this reclaimed area.
6) Develop new conservation methods for roughage, and new feeding systems.

Agroforestry system

The recommended grassland area is 102,846 ha, and 6,425,489 ha is classified as woodland (table 6). The proportion classified as class I among the recommended grassland is about 64.5%, and this area may be used to

cultivated grassland. Class Ⅱ ~ Ⅴ need special establishment and management technology to increase pasture production and soil conservation. What is specially noteworthy is that woodland classified as class I, 835,314 ha, is recommended for agroforestry use.

The presence of a stand of trees has several effects on the microclimatic and soil components of the environment within which it is located. Reduction of wind, a decrease in solar radiation, and the resultant decrease in evapotranspiration result in a more humid understory microclimate. Agroforestry contributes to soil humidity and improved soil structure. It also contributes to organic matter buildup. These results lead to better pasture production which is beneficial to the livestock. The presence of animals may in turn contribute to pasture and tree growth through reduction in competing understory vegetation and through recycling of organic matter.

Likewise silvo-pastoral systems sustain roughage production by conserving the soil, enhancing biodiversity, conserving carbon in terrestrial ecosystems, and enhancing nutrient capture and retention.

Good pasture development, in harmony with good forest development, can contribute not only to a sound cattle production base but also to the provision of a good environment for people to live in, which is very important in a highly populated country like Korea.

To make the above suggestions possible, Government, scientists and livestock farmers must cooperate together and all available resources need to be mobilized.

CONCLUSIONS

Pastoral agriculture is a relatively new industry in Korea, beginning with dairy farming development in the early 1960s. Thereafter pastoral farming has continuously developed. There are several joint projects with more advanced countries. Nevertheless there are still many problems to be solved in Korea such as the limited area for roughage production, low productivity, high cost for establishment of grasslands, etc.

These problems could be solved by the mutual efforts of Government, scientists, and livestock farmers. More than 1.9 million ha which is 10 times of present area of roughage production can be used if all the available hilly areas, paddy fields, reclaimed land and idle land are developed for pasture or forage production. Productivity will be increased by developing new technologies. Roughage can be complemented by other sources such as improved utilization of rice straw and wild grasses. The silvo-pastoral system gives diverse benefits which produce trees and pasture, protect the environment, and improve the living standards of people. All of these suggestions should make it possible to sustain increased roughage production in Korea.

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