

## Issues on the Establishment of Pasture in Korean Woodlands – an Outsider’s View

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### Introduction

Thank you for this opportunity to speak to this audience of people, who are all concerned with the protection and improvement of natural resources.

I, in my capacity as an agronomist with a strong tendency towards livestock and the development of fodder sources, but also as an extension worker concerned with motivating farmers to utilize natural resources available to them in the most economic and technically sound manner would like to draw your attention to some of the facts and difficulties, if not uncertainties in the field of pasture establishment on woodlands and pasture management in Korea, as I see them as a foreigner.

Let me begin to develop my opinion on the subject with some explanation of a more general nature. What do we agronomists understand by the technical term pasture? It is a man-made and man-managed production base for roughage. As such, it is part – and a very vital part indeed –, of a production system which involves herbivorous animals. The economically most important animal of this group is the cattle. The quality of pasture in terms of ecology and usefulness for its utilizer is depending upon the specific locations where pasture is to be or has been established (that is, the kind of soil, soil profile, topography, ground water level, climate), and on management decisions executed by man, which are utilization systems,

level of fertilization, level of technical skill which is needed to maintain productivity over many years under different production systems. Under the influence of those factors, there happen to be very strong competition among the various species of which a pasture is composed which will lead to various, different plant societies. Particularly this can be observed on permanent pastures, on which in the course of some years a certain equilibrium of all species in occurrence (presence) and proportion (dominance) will be established.

Usually, no more than 5 to 7 species will remain in a sward, whereas under ideal conditions the native vegetation consists of many more species.

Those facts which I have described briefly reflect the need to carefully consider the establishment of pasture wherever environmental consequences must be expected. It also stresses the need of possessing a good understanding of environmental processes and also, that a high degree of management ability must be developed to be able to integrate economic necessities and facts attached to pasture and ecological demands.

### Economic Considerations

Historically, cattle in this country have been used mainly for draft. It was once the single most important farming tool. Feeding those animals was done by members of the farm household and most of the forages were supplied from waste land around the homestead, from so called forests,

which very often were nothing else than woodlands, and from road-river and canal banks.

This is, of course, no longer the case. The amazing economic upsurge this country has experienced during the past 15 years or so has led to a situation in which cattle have been replaced by all kinds of tractors.

Cattle, therefore, could be reared again to produce beef in a commercial manner. Moreover, the economic performance has also triggered off an enormous increment of living standard, thus creating an ever growing demand on livestock products; milk and milk products were of particular interest in this case. From almost nil the consumption jumped to 15 kg per capita. Consequently, dairy cattle were introduced, requiring additional farm produced high quality forage.

From the beginning of the commercialization of cattle production and the departure from mere keeping of cattle and influenced by confrontation with shortages in manpower, it became apparent that this transformation of management also necessitated the production of forages. At the same time the dependence on imported feed material reached an intolerable level. Figures published by the MAF and the Korea Feeds Association demonstrate that during the last 10 years Korea's self sufficiency in feed has shrunk drastically from 83.4% to 39.5%, whereas only 60% of the total beef demand can be produced in this country. The remainder has to be imported.

To produce beef and milk, those large quantities of imported feed are, as a matter of fact, not essential simply because cattle can, due to its unique system of digestion, utilize all kinds of herbage. If such herbage is of good quality, it can not only meet the maintenance requirement of the animals, but also contribute considerably to milk and meat production. To illustrate, a cow producing about 12kg of milk a day can be fed entirely on roughage, provided this is of the appropriate quality.

A different picture, of course, has to be drawn for piggery and poultry operations.

Considerations regarding farm produced roughages have taken place rather early and resulted in several promotional activities by the government, such as the Grassland act which was enacted in January 1969 and governmental financial support in subsidies and loans. Since 1982, those financial back-topping has been financed from the National Livestock Improvement Fund.

Side by side, strong emphasis was also given to relevant research into the subject as well as to training and extension. Quite clearly, a tremendous amount of knowledge was required because cultivated pastures presented a new subject to farmers and extension workers, rather unlike the situation you find in sectors such as food grain production and cash crop farming, to name but a few production systems. There, very high levels of productivity have been reached already.

As certain knowledge and experience were not available during the first time of pasture establishment activities and certain skills and technologies not developed, the method of oversowing suitable areas with grass seeds and fertilizers after removing parts of the original vegetation was only revitalized in 1980 and approved as a standard method. It is less intensive in capital investment than other technologies and should – at least in hilly areas – become the standard method of pasture establishment.

The technology is rather simple and has been demonstrated several times over and will continuously be demonstrated in the future. Nevertheless, as demonstration continues, more research must be done to develop even less expensive and less pretentious technologies.

As a result of the promotion of the full cultivation method being eligible only for financial support in the past, many scepticism have been developed regarding possible effects of pasture development on erosion in general.

For 1984, the government intends to establish additional 10,000 ha pasture, for which an amount of ₩12,070 mil. has been set aside. In other words, the establishment of 1 ha pasture following the oversowing method would require ₩946,000./ha; thus, a farmer who establishes 5 ha according to this technology will be eligible for a subsidy of 40%, in monetary terms ₩1,892,000,—, the same amount he will receive as a soft loan, and 20%, that is ₩946,000.— he has to finance by himself, usually by contribution of labour and such materials which are available locally. In case of full cultivation, the same pattern of assistance apply. However, the investment may climb to ₩1,200,000.— ha. In case, somebody establishes a pasture which is larger than 10 ha, he may receive 80% of his investment as a soft loan and must finance the remainder by himself.

Those facts and the figures for the years 1982 and 1983 which are very similar in scale may assist you understanding why this field of agricultural activity has gained so much prominence in the past and why it is debated everywhere.

### Land Uses

Now, the next question must obviously be what kind of land resources are to be used for the purpose of pasture establishment and whether there exists a competitive situation, in which various production processes are considered to be in need of the same land.

Korea ranks third in the world as population density per land unit is concerned, and it is reported that two-thirds of her territory are occupied with hills and mountains. Flat areas are predominantly used for the production of food grain, though some of the same area is also utilized to a certain extent for roughage production in crop rotation systems.

However, cattle production in the plains will be economic only if the farm based forage production is encumbered with very low opportunity

costs only and is thus cheaper than feeding cattle with concentrated feed on the basis of cereals, by-products and paddy- and barley straw. Those facts draw a tight line to the enlargement of forage production on those areas, which thus will be of real economic benefit on non-arable land only. Non-arable land does not encumber the calculation with high opportunity costs as it would be in the case of the highly profitable fruit and vegetable plots are used, and this consideration refers us back to the development potential.

Those hills and mountains represent a base, from which suitable areas can be selected for pasture development. You all know, that there are about 6.7 mil ha of forest or so called forest areas, which are often used to refer to uncultivated, hilly and mountainous areas.

Looking somewhat closer at those areas, it is a striking feature that 75% of them belong to the private sector, and 25% to the government or to the communal and municipal sectors.

The forest sectors most important role at present seems to be supplying timber and other forest products. A stepping up of domestic timber production may be of considerable importance as traditional timber-exporting countries may impose restrictions on the exploitation and exportation of their forest resources by foreign contractors for environmental and economic reasons.

Also of increasingly considerable importance is the conservation of forest and water resources and the development of recreational facilities for the rapidly increasing urban population. In this connection, stability and protection of such areas as the feet of hills and the terminal points of valleys reach high significance. They represent the most vulnerable locations for erosion, in particular in the occurrence of coarse soils, mostly derived from granite rocks and in the absence of vegetative covers.

Most of the erosion problems in this country are caused by rainfall. Though the climate of Korea is often called to be temperate, one knows erosive

rains mostly from tropical regions. According to Hudson (1973, Soil Conservation), the approximate latitudes 40°N and 40°S limits of destructive rains are. Korea is situated just at the boundary of this belt, so there should not be too much suffering from erosion. But, conditions as mentioned before have already led to some irreversible levels of erosions in this country. Is it then permissible that the country can dispense with some portions of its forest or forest land?

In an attempt to answer this question, I believe that we have to be clear on two issues:

There should be no direct damage resulting of such a dispensation of land. I mean that there must be a large resource of governmental and private areas available for an merchantable timber and fuel wood production as well as for other forest products. Whether or not governmental forest lands are to be converted to other production processes and how much area is needed for that purpose must than be decided upon by means of a priority checklists which have to be elaborated by the concerned authorities. The same applies for other purposes including landscaping. As for private forests, there are principally economic considerations to be cleared. Private forest areas are typically very small in size and the owner depends on them, because they must provide funds. As for forest, the growth per ha may be 5 to 6 m<sup>3</sup> per year, providing an income of ₩150,000,- to 180,000,-. There are of course systems, which provide for better economic returns. However, investment in forest usually pays back only after 70 years or more, whereas the pasture pays back right 2 years after establishment-which is highly profitable.

The second issue I would like to raise in this context is indirect damage which could occur from a result of transforming forest land to pastures. I am thinking of ecological repercussions which are erosions, atmospheric pollution,

watterretention, air temperature and other issues you are well aware of.

If both of the questions can be answered positively, that area *can* be spared and no more damages are to be expected than I suggest arises the question how much such area can safely be converted and also, what the particular requirements are for pasture land regarding slope, physical soil properties, exposure, water run-off and volume, topography, accessibility and remoteness.

In order to get a clear picture on the actual potential of forest land suitable for grassland establishment, one has to undertake a detailed survey. Some of those were made, the results vary considerably. In 1970, K.C.Pearse in his "Report to the Government of the Republic of Korea on Possibilities for Development of Range, Pasture and Fodder Resources" speaks of at least of "one million hectares", whereas Kim, K.S. in his article on "Prospects and solutions for supply and demand of roughages in 1978 (Korean J. Animal Sci. 20, 1-13) cites figures of about 321,000 ha reported by the Office of Forestry. Weinberger, Pak and Kwon in their recent publication of "Korean Woodland (Im - Ya) as Resources for Grassland Development" - this publication has helped me a lot in preparing this paper conclude that there are 152,000 ha available with good feasibility and additional 388,000 ha with a moderate feasibility.

The MAF operates with figures of about 980,000 ha (Korea Times, Sep. 13, 1979; Mar. 17, 1981). Of course, the higher figures are obtained by including steeper categories of land than others see fit for transformation. According to the Weinberger study, the figures would be matched with the MAF's figures, if all im-ya lands ecologically suitable and fully or partially reforested with less than 20m<sup>3</sup>/ha timber would be included. That, I believe, would be a very promising possibility for expanding the grassland potential, however, I suggest this is not to be acceptable because such an approach would imply a very low regard for the investments already made

for forestation so far. In determining exact figures everyone seems to interpret them for the good of his own purposes. That is of course, no surprise at all, - not only agronomists, but also foresters are interested to claim the better land. Weinberger claims - to illustrate again -, that 82.7% of inter-planted timberlands were found to be on locations classified as possessing moderate to good grassland potential, and in the case of fully afforested areas, those figures are close to 100%. Those findings also suggest that areas classified with no or only poor feasibility for grassland are excluded from forestation activities.

I agree that areas suitable for grassland establishment are also lucrative for forest activities. Thus areas unsuitable for grassland are not unsuitable for forest development.

I would like to suggest that a joint high level commission is appointed to look into those matters and to develop priority checklists, according to which decisions can be made on future land use. Further, I suggest, that available surveys and data are examined closely by the concerned institutions in order to obtain a clear picture on the potentials available in this country and to concentrate then, once the data base has been established very firmly, on questions which are concerned with technologies, rentability, reduction of investment costs, utilization and management improvement as well as long term planning.

### **Grassland Suitability**

What, now, should one consider to contribute to the attributes suitable for grassland?

Before I elaborate, I would say that principally one should keep apart strictly areas for grazing, fuel and timber production in case of dairy and beef farming. Any dual type of land use systems may be useful only for farmers raising but a very few head of livestock.

### **1. Topography**

The general relief and altitudes belts in Korea have been described elsewhere. It seems that the undulating hill regions between the eastern Taebaek-Range and the western basins hold an important potential for the development of improved pastures.

### **2. Slope**

In assessing potentials for pasture development, it is very much a decisive criteria what amount of slope is acceptable. Various aspects should be considered here. Among these aspects are those referring to erosion potential, prospects of mechanization, and livestock itself. I have already mentioned earlier some opinions regarding the erosion problem but let me make on point very clear. A properly established and managed pasture will in no way add to erosion if, among other things, the slope on which it is established is not too steep. This fixation of a border line would however be a subject of intensive research, which we are still lacking to some extent.

In the introduction remarks I have already pointed out that agriculture will be faced with serious labour problems. Whereas we know that pasture and meadow management can be safely carried out on very steep slopes by using manual labour, mechanized farming and pasturing systems draw rather narrow limits. Normal tractors can not operate on gradients steeper than 35% and special tractors can for day to day work not operate on slopes steeper than 40%.

As for livestock itself, there are as well limits to which it can adopt. In case of heavy dairy cattle I would believe to see the limit between 30-40% (16-22°), whereas young stock can be grazed also on steeper slopes. Beef cattle can do the same, and the limit for those two groups would be around 50-60%. Sheep of course can graze slopes of 45° easily, but I believe, that areas of that steepness should not be grazed at all - intensive grazing will lead there to bare soil and consequent additional

erosions. Keeping those considerations in mind, I would say, that pasture can be established without repercussions on slopes till 45% or 24°. All areas steeper than that should to my mind not be converted. However, alterations and improvements in grazing management, including the introduction of cattle suited to slope grazing, will widen this limit to a certain extent.

### 3. Physical soil properties

The texture of soil is important for the infiltration and the rate of water movement, water holding capacity, aeration and root penetration. It is therefore important for agriculture, though less for grassland than for cultivated crops. The texture data available from the Korean Soil Survey Programme (ORD, 1971 and 1975) indicate that Im-Ya soils may contain considerable amounts of cobble, gravel and stones. Stoniness is generally more acceptable for grassland than it is the case for cropping. But also stoniness presents us with a borderline. Shin Y.H. in *A Training Manual for Soil Fertility Research and Fertilizer Use for Upland Crops* (ORD, Suweon 1972) states that upland with a stone cover of 15-35% is to be rated as moderately suited, and of 35-50% as poorly suited. As an agronomist, I would regard those figures rather high and should like to keep similar margins for grassland suitability.

### 4. Soil depth

The climatic extremes throughout the year appear to provide favourable conditions for quick soil development. In many cases however, it appears that on those areas we talk about soils are not given much chance to build up under current conditions, they are washed down due to lack of vegetative cover. Water storage is of particular importance when grassland is being considered. Relatively dry periods from May to June coincide with the period in which coolseason grasses are supposed to reach their peak productivity. On shallow soils therefore it is difficult or even impossible to realize the pro-

duction potential of pasture because of the much reduced water storage capacity.

Here too, one has to draw a limit - and locations showing an effective soil depths of less than 15cm should never be considered for pasture development. Shallow soils of 15-30cm depths would still be doubtful but could be considered if slope and other factors are favourable.

### 5. Soil fertility

I would state that generally, unfavourable chemical soil properties do not mean any hindrance for establishment and management of pasture. Strong acidity and poor state of nutrient availability can be overcome by corrective measures.

But this has to be seen strictly in context to the afore mentioned physical soil conditions - because those can not be corrected even with plenty of capital investment.

### 6. Soil protection

The key factor in reducing water erosion is the development of sufficient vegetation coverage. Anything, which leads to a better ground cover will therefore lead to a reduction in depletion of woodlands. Establishment of pasture offers an very economic way in achieving this goal. Grasses belong to the most important means of restoring soils that have been worked out by detrimental utilization. They form a dense vegetation cover. They bind the soil with their roots, they add organic matter, they increase thus the water holding capacity and improve physical soil conditions generally. They owe this property mainly to the fineness of their leaves, stems and roots. Simple (1968) in his publication on *Grassland Improvement* stresses this point particularly. Of course, one has to add that this function needs some prerequisites:

- 1) Grassland on slopes needs very skillful management, overgrazing may lead to increased erosion;
- 2) Areas steeper than 45% should not be grazed but if at all those areas are used for grassland, the

- cut and carry systems should be employed;
- 3) Controlled grazing must be executed at all times to disallow concentration of stock;
  - 4) Sward composition must include sod - forming bottom grasses to maintain a dense sward. (*Agrostis gigantea*, *Festuca rubra*, subsp. *rubra*, *Poa pratensis*, *Lolium perenne*);
  - 5) Once pasture land has been established, it should not be allowed to be converted again to any other use. The concept of zero-tilling is essential for the im-ya land to be successful. If arable crops of any kind are cultivated, the improved status of soil could easily deteriorate again rather fast.

#### Structural Restrictions

Among these criteria putting a limit to pasture development are graves and tombs. There is a tremendous number of graves that are scattered all over the country, and in particular in areas which would otherwise be considered suitable for grassland. The figures available to me suggest that areas between 25.935 ha (MAF, 1977 Agricultural Yearbook) and 85.000 ha (Korea Times, 19. 7. '80) are used for that purpose. Of course, where very many graves are concentrated, no pasture can be established, even if all other factors were favourable. With less numbers, the proposition to make pastures may be more feasible. Anyway, one has to move here very cautiously.

Another problem in the area of structural restrictions is the amount of over all available land for pasture development. Korea is a very dissected country and the mountains and foothills show marked changes in slope over short distances. Whereas soci-economic factors can be overcome by forming cooperative pastures of large units, I consider that there are limitations due to the very high occurrence of dissection. In actual terms, suitable areas may be not too many in one particular location to form an economic viable farm unit where several has of pastures can be formed

in one concentrated area without lowering the utilization I have mentioned earlier, particularly slope.

Likewise, factors of remoteness and accessibility have to be taken into account, however, this should not pose too much of a problem.

And lastly, one has to conclude that if there are certain amounts of solid timber and wood stock on areas suitable for grassland, one has to make a decision where those borderlines are to be drawn. If there are already 20-30m<sup>3</sup> timber, it should probably not be cut in order to allow pasture development and areas which are partially or fully planted with trees of any kind should also not be considered.

I have tried to point out some of the issues involved. However, I am sure this debate can and should be continued for some time. I am told that the Office of Forestry does engage itself in a survey to establish land use pattern and prospects. I am convinced that this is an important work and that all efforts should be undertaken, also such as integrating other relevant organizations.

I also like to make clear that pasture management and utilization activities, as well as research must be enlarged and improved, a process which is already well under way of implementation.

But I would consider it most necessary that pasturists and foresters sit together to develop a framework of action in order to establish priorities, designate areas for land use develop implementation manuals for utilization activities and not to look at the problems from their own professional backgrounds only.

As a resume of the aforementioned thoughts, I suggest:

1. Domestic forage production for cattle must be enlarged in order to be able to increase the number of ruminant livestock and to reduce the dependency on imported feedstuff for that kind of livestock.
2. The most economic system of raising ruminant livestock is that of maximum utilization of plant

material, particularly grasses and forages.

3. Establishment and proper management of pastures are essential components of such a system. Nevertheless, catch cropping on paddy-fields wherever feasible and forage-cropping on upland can and must supplement such a system. However, climatic as well as economic factors impose limits. More research is required before statements on any order of magnitude of extending areas for both production systems can be made.
4. There are areas among Korean hills and mountains which are suitable for the establishment of

grassland, the extent of which depends very much on suitability-criteria one establishes. The important ones I have already stated.

5. Clearly, there will be conflicts over land-use particularly between foresters and pasture-agronomists. Keeping in mind that any any form of land-use should avoid indirect damages of any kind, finally economy will decide which land-use pattern is the most appropriate one.
6. Again, I consider it most appropriate that a formal institution is created in which representatives of all disciplines concerned elaborate jointly recommendations on these issues.

#### Comment by S.G. Hong

It is difficult job to adjust two extreme ends, especially in case of grass and wood which are very competitive in nature too. As a plant ecophysiologicalist, however, I would like to add my ecological view to your opinion related to the transformation of the woodland to the grassland in Korea.

The forest ecosystem in Korea can be divided into two parts in a large scale. These are the alpine forest ecosystem and the low altitude forest ecosystem. The alpine ecosystem is located in the range of Taebaek mountains and the southern Soebaek mountains which have the abundant forest and water resources in Korea. The alpine ecosystem is surrounded and protected by the low altitude ecosystem. It is ecologically more stable than the low altitude ecosystem because of its remoteness and less accessibility to the human interruption. The low altitude ecosystem has been repeatedly destroyed by maldevelopment and mismanagement in the past especially, during World War II and Korean War. It has been reforested into fairly good shape during last two decades. However, recently the forest ecosystem is threatened by various development projects, fuel supply and pollutions near the heavily cultivated farmland with chemical fertilizer and pesticides as well as the urban area and the industrial park. The ecological stability of the alpine forest ecosystem should be maintained to keep the maximum multipurpose benefits from wood, water, hydraulic power, all kinds of environmental and genetic resources.

Last year I visited Daekwan Ryung pasture established 12 years ago on the top of northeastern Taebaek mountains. It has been known as one of the most successful cases in Korea. However, the Daekwan Ryung pasture has many problems as I see it. The serious soil erosion is occurring by strong wind during dry spring period and also by heavy rain during wet summer season. The cattle excretion and the heavy pesticides are polluting the upper stream of Han River. Many kinds of poisonous and noxious plants are invading into the pasture. These problems were more serious in the grazing sites.

My suggestion is that the establishment of pasture should be confined to the low altitude forest ecosystem and among the low altitude ecosystem to a selected site manageable intensively in a small scale as you suggested before. To do so, studies on the development of proper new species of forage crops are urgent at the present time, I think. I would like to have another comment on the soil erosion. As you pointed out already, many



factors; rainfall, wind, slope, soil properties, temperature, vegetation and etc. are involved in the soil erosion. Among these factors the intensity of rainfall is one of the most critical and unique factors in Korea. We are having two third of total rainfall in June, July and August. Your generalization of Hudson's data might be dangerous to mislead the importance of soil erosion in the practice of pasture management in Korea.

Reply to the Comment by **Jens von Barga**

1. Alpine forest ecosystems should remain intact to preserve forest and water resources before that system is considered, all other resources must be developed and exploited.
2. The low altitude ecosystem offers many possibilities for pasture development and it should have priority over other systems in utilizing it for that purpose. However, criteria according to which transformation can take place, must be developed jointly.
3. I agree that pastures should be developed within the mentioned low altitude forest ecosystems and low altitude ecosystems pastures should be of manageable sizes only. Also here the same: Only land which is most suitable for pasture should be selected. That automatically implies: areas of 3-10 ha only should be transformed. Larger areas would inevitably mean that concessions have to be made regarding suitability traits, as I have pointed out them before.
4. There is - no doubt - an urgent need to do research work on the development of available and new species of forage crops. Almost all grass seeds are imported from abroad, and some species need to be adopted to the unique Korean conditions.
5. I did not intend to mislead you on the critical and unique factors of rainfall in Korea. I simply wanted to draw on the fact that you usually find destructive rainfall between the altitudes mentioned by Hudson and that Korea is an exception in that respect.