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Evaluation and Improvement of Natural Grassland (Patana) in the Hill Country Dry Zone of Sri Lanka for Economic Livestock Production

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(Based on research studies conducted at the MAB Project 3 Research Station — Bandarawela)

The dry patanas or the natural grasslands occurring in the hill country dry zone of Sri Lanka are situated on the Eastern slope of the Central massif and consist of about 67,000 hectares. About 25% or 16,000 hectares of patana are situated on gently sloping areas which is suitable for economic livestock production provided that this grassland is improved to carry additional stock than it is carrying now. Most of the land is found in the Upper Uva basin at an elevation of 800 — 1500 metres.[2,3]

The temperature is moderate by tropical standards and ranges from 18°C to 25°C with a diurnal variation of 5°C to 10°C. The mean annual rainfall is around 1500 mm of which about 1000 mm is received in the period October to January and the balance 500 mm in April and May.

The dry patana soil was characterised as "Red Yellow podzolic soil" [4] and described as being deep to very deep, well drained, with a variable A horizon depending on the erosion. The texture is moderately coarse to moderately fine, and the structure weak to moderate crumb. Soil reaction is acidic to strongly acidic with increase in rainfall. Organic matter and nitrogen are low to moderate; Phosphorus, Potassium, Magnesium and Calcium content is low. This shows that the soils are basically suitable for cultivation provided that the low fertility level could be corrected by proper fertilizer treatment and subsequent management.

About 75% to 90% of the plant population consists of grasses, and generally presents the appearance of a close cropped meadow land but composed of tussocky coarse grasses which have, both morphologically and physiologically progressed towards a xeromorphic habit and thus becomes less palatable except for tender shoots.[2,5]

The principal species of the grass complex are **Themeda tremula, Arundinella villosa, Eulalia phaeothrix, Cymbopogon polyneuros, Heteropogon contortus, Ischaemum ciliare.** The tall mana grass **Cymbopogon confertiflorous** is dominant at lower elevation and often in association with **Themada** in ravines and depressions. A small percentage of herbaceous species such as **Hedyotis** sp. **Elephantopus scaber, Desmodium triflorum, Pteridium aquilinum** are also observed. Low shrubs like **Knoxia platycarpa, Atylosia trinervia** and **Osbeckia octandra** are also common.

At present, the ruminant population in this area depend mainly on the natural grassland, consisting of grasses referred to earlier. The carrying capacity of this native sward was found to be extremely low. In a recent study, it has been observed that without application of any fertilizer the dry matter yield in the first year varied from 1000 — 2000 kg/ha, depending on the frequency of defoliation clipping. However, in the second year there were substantial reduction in the yields and the highest being when the sward was cut more frequently. Although application of nitrogen fertilizer increases the dry matter yield, the response was found to be very low, only about 7 kg of dry matter per kg of nitrogen applied compared to 25 kg of dry matter per kg of nitrogen reported for improved pasture under local conditions. Application of fertilizers to obtain higher dry matter yield from the native grass sward, therefore, could be a wasteful practice.

Based on the above, the carrying capacity of the native grassland would be in the region of one animal for every 3 hectares. But, even at such a low stocking rate there was a general reduction in the yield in the second year reducing the carrying capacity to about 5 hectares per animal.

There is very little scope of improved grassland production and management techniques based on native grasses of the dry patana for economic animal production. Therefore, it is imperative that these poor quality grasses with low rates of productivity be replaced with high yielding improved quality grasses and legumes to make animal production to be an economically viable proposition. However, replacing the native grasses with improved pasture would not be possible unless sufficient organic matter is incorporated into the soil in order to improve both the physical and chemical nature of the eroded infertile soil. Further, procuring sufficient organic manure in the region is not practicable because of high demand of farm yard manure for vegetable cultivation. Therefore, the only alternative would be to produce the organic matter on the

land itself in situ which can be achieved by the cultivation of short duration crops, preferably legumes to improve the fertility status of the land before introducing the desired pasture species.
It has been demonstrated in various parts of the world that the fertility status of soils can be improved by a process of pioneer cropping by growing fertility rebuilding crops, especially legumes.
This phenomenon was tested earlier and it was established that soil fertility rebuilding pioneer cropping phase over a period of one year before establishing improved species resulted in a five fold increase in the dry matter yield of the pasture during the establishment year. However, the question of economic returns from the pioneer crops during the first year was investigated only recently and it was established that growing maize in the Maha season followed by a crop of horse gram in the Yala gives the highest economic returns with the prevailing price structure for these products.

The yields obtained from maize (grain) and horse gram (seed) are 1167 and 1148 kg/hectare respectively. Because of the variable nature of price for these products, changes in the cost of production, and above all the benefit accrued to the pasture established subsequently, it would be difficult to predict the actual cost-benefit ratio of this operation. But, it would be reasonable to assume that the expenses incurred can be recovered without much difficulty. Another combination, but less attractive under prevailing prices, is maize in Maha and Kurakkan in Yala. The grain yield of Kurukkan was estimated to be in the region of 800 kg/hectare.

The **Paspalum dilatatum** (Poir) pasture established after pioneer cropping exceeded the control treatment without pioneer cropping by 100 to 200% depending on the type of pioneer cropping combination during the first year and to 200 to 300% in the second year.
The most interesting observation was that the treatment without pioneer cropping or the control gave the same dry matter yield both in the year of establishment and in the second year. The yield was around 1200 kg/hectare/year which is comparable to the native sward which it has replaced. However, unlike the native sward the digestible organic matter (DOM) is around 55% and was neither affected by different pioneer cropping treatments nor there is any difference observed between the 1st and the 2nd year.
Another desirable feature observed was the number of weeds in the treatment without pioneer cropping, where four or five weedings were required both in the establishment and the second year while the number of weeding required in the pioneer cropping treatments was two and one respectively. This is due to the vigorous growth of the pasture which kept the weeds under control. This is a real advantage and minimises cost of establishment and subsequent management due to infrequent weeding.

Management studies on improved pasture established after one year of pioneer cropping were also undertaken to evaluate the production potential of one of the popular pasture grass that was identified for dry patana area namely **Paspalum dilatatum** (Poir). This is a pasture grass exhibiting a low and spreading habit, ideal for grazing, forms a dense sward and prevents erosion on steeper slopes and also has a very rapid recovery growth.

The two aspects that were studied are its response to (1) Different nitrogen levels (2) Cutting frequencies. The nitrogen levels were 0,75,150,225,300 kg of nitrogen/ha/year. The cutting frequencies were 30 days and 60 days. The parameters measured were, dry matter and digestible organic matter (DOM) by in vitro techniques.

From this experiment it may be concluded that:

1. There is an increase in both the dry matter and digestible organic matter yield with increase in the level of N and this was most significant when the pasture was cut at 2 months interval.

2. Significantly higher dry matter yield for some nitrogen treatment was observed when cut at two months interval but at lower nitrogen levels because of reduced digestibility, the total digestible organic matter was not significant.

Another experiment was conducted to evaluate the animal production potential of **Paspalum dilatatum** pasture. Two levels of nitrogen at 50 kg/ha and 100 kg/ha was applied in two split doses at the commencement of the experiment and three months later. South Down lambs (7-8 months old) at two stocking intensities of 20 and 12.5 animals per hectare were allowed to graze continuously. The experiment commenced in January and continued for a period of 6 1/2 months. The experiment was discontinued when field grazing was limited due to the onset of the dry season in June/July and animals started losing weight. No supplementary feeding except mineral mixture was provided.

It may be concluded that at 50 kg nitrogen level and at a stocking rate of 20 animals per hectare the daily individual gain is depressed because of insufficient herbage available for grazing. On the other hand individual gains, as expected, reached maximum with high nitrogen level and low stocking rate; and the other two treatment fall within these two values.
The ideal nitrogen level and stocking rate out of these combinations depends on the cost of nitrogen fertilizer and price of the finished product.

Summary: The natural grassland or patanas in the Hill country dry zone of Sri Lanka hitherto received very little attention because of its limited potential for

livestock activities. The dry matter production of the native grassland is between 1000—2000 kgs/hectare in the first year and less than 1000 kgs/hectare in the second year under a cutting management without any fertilizers. The response to inorganic nitrogen was only 7 kgs of dry matter per kg of nitrogen applied. The Digestible Organic Matter (DOM) of the chief native grass species was lower than 30%. **Paspalum dilatatum** grass established after pioneer cropping the land for a period of one year produced a 200% increase in dry matter yield in the year of establishment and over 300% in the second year compared to that without pioneer cropping. It has been found that with 200 kg of nitrogen per hectare per year the dry matter yield exceeded 6000 kg and the potential of such a pasture produced a liveweight gain of one kg per hectare per day with growing South Down lambs.

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