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Utilization of Coconut Lands for Pasture Development

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The area under coconut in Ceylon is estimated to be around 1.2 million acres. Recent estimates based on aerial surveys give a figure of 600,000 acres as existing in monoculture. An appreciable portion of this area lies within the wet zone where the annual rainfall is over 75 inches and well distributed throughout the year. As a result of this favourable rainfall conditions, this area is ideally suited for the cultivation of tropical pasture species. In the intermediate zone where the rainfall lies between 55 and 75 inches per year pasture production would follow closely the bimodial rainfall distribution pattern. This means that there would be periods of excess pasture alternating with periods of low production.

Under a mature stand of coconut considerable space and growth factors are available for the growth of a ground cover of weeds. In most instances this weed cover is so thick that it becomes a costly operation to keep it under control. In pasture production under coconut what one does is to replace this weed cover with highly productive pasture species.

Plants growing together compete with each other for essential growth factors such as light, soil moisture, plant nutrients etc. Competition is a purely physical process and begins when any one or more of these factors are in supply below the requirement of the association. Thus when pasture is planted under coconut and if any one or more of the essential growth factors are in short supply competition for these factors will be operative.

The Effect of Pasture on the Yield of Coconut

When the cultivated pasture utilizes the available growth factors more than the extent to which the natural weed population did, then there would be a corresponding decline in the yield of coconut.

In a mature stand where the crowns are held at a considerable height from the ground there would not be any competition for light detrimental to the yield of coconut. Below ground level there would be competition for soil moisture and plant nutrients.

From experiments carried out at Madampe and at Lunuwila it has been shown that soil moisture would not be a serious limitation to the satisfactory cultivation of a pasture under coconut. It has also been shown that competition for plant nutrients could be eliminated by adequate manuring of both crops. Madampe is at the Northern end of the Wet Zone. Thus it is seen that in the wet zone of Ceylon the establishment of a pasture under coconut is not detrimental to the yield of coconut provided both the pasture and the palms are adequately manured.

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Suitable species for Cultivation

The naturally occurring pasture species under coconut in the region are unproductive to be economically exploited. Further these species do not show sufficient response to added fertilizers. The yields of the naturally occurring pasture species at Lunuwila due to levels of added nitrogen are given in Table I.

TABLE I

The yield of naturally occurring pasture species at different levels of added nitrogen

Level of Fertilizer	*Yield lbs./acre*
N_1	983
N_2	989
N_4	1003

It has been estimated that these naturally occurring pastures at their best have a carrying capacity of 1 animal to 5 acres. The species present in any region are determined not only by evolution leading to adoptation to local conditions, but also by geohistory. Geohistorical effects such as isolation may limit the lines of evolutionary advance that large floristic differences develop between regions which are otherwise ecologically similar. Plant introductions aim to remove the genetical limits to production by providing plants and specific characters either for direct use or for use in breeding programmes. Thus the only logical way to improve production in the region is to introduce new species with high yield and production potential. It is appropriate to mention here that introductions of new pasture plant species have played a significant role in the development of the cattle industry in Australia and in other parts of the World. In Australia for example the carrying capacity based on natural pasture was 1 animal to 50 acres in certain regions. With improved pasture based on introduced species it has been possible to increase the carrying capacity to 1 animal to 2 acres.

The suitability of introduced species for any locality is measured in terms of production during the growing season, palatability, tolerance and quick recovery from extremes of soil moisture conditions, nutritive value of the edible parts and the efficiency of recovery of added nitrogen. As a preliminary measure the Coconut Research Institute evaluated and compared the pasture species *B. brizantha* and *B. miliiformis*, that had been introduced to the country earlier, for suitability to be grown under coconut. This study has shown that—

1. *B. miliiformis* is less competitive than *B. brizantha* with coconut.
2. *B. miliiformis* responds more to added nitrogen under the shade prevailing under coconut than *B. brizantha*.
3. *B. miliiformis* withstands grazing and drought as well as *B. brizantha*.
4. Animal preference of *B. miliiformis* is more than that of *B. brizantha*.

Cattle grazing on pasture under coconut.

On the basis of these findings B. miliiformis has been recommended as a suitable pasture species for cultivation under coconut.

Subsequently a large number of species and varieties have been introduced for evaluation in this special environment. The yields obtained with a fairly heavy dose of nitrogen application (200 lb./N/acre) and the percentage of nitrogen recovery are given below (Table 2).

TABLE 2

The yield and percentage of nitrogen recovery of pasture species grown under coconut

Species	*D. M. Yield (lb./acre/year)*	% N *recovery*
B. miliiformis	15,426	30.82
B. mutica	10,666	21 92
Paspalum commersonii ..	10,812	22.83
Paspalum notatum	13,193	36.73
Paspalum plicatulum	12,824	33.29
Digitaria decumbens (Pangola) ..	15,047	37.62
Panicum coloratum	8,919	27.53
Setaria sphacelata	14,268	32.14
Eurocloa spp.	11,598	33.47

The more promising of these species are being subjected to detailed studies at Lunuwila and Madampe.

Use of Nitrogen for pasture production under coconut

When other factors were not limiting, increased grass growth from the use of fertilizer nitrogen has been demonstrated in many areas of the tropics. In the Virgin Island, where fertilization of Pangola grass with ammonium sulphate in amounts equivalent to 0,75,150, and 300 lb. of N per acre was done yields of 3.1, 4.6, 5.4 and 7.3 tons of dry matter respectively have been reported.

It is well known that the growth potential of tropical grasslands in areas with adequate rainfall is quite remarkable. The highest dry matter yields ranging from 11 to 34 tons per acre/year have been reported from Puerto Rico.

Under coconut, apart from soil moisture, light appears to be the major limiting factor for obtaining high yields by the use of fertilizer N. However there appear to be large varietal differences in the response to added fertilizer N under the shade prevailing under coconut. In this respect both *B. miliiformis* and *Digitaria decumbens* have been found to be superior to most of the other species tested. The data from some experiments on the use of high levels of fertilizer nitrogen applied on *B. miliiformis* and *Digitaria decumbens* at Lunuwila are summarised in Table 3.

TABLE 3

Levels of Nitrogen applied, herbage yield and crude protein content of *B. miliiformis* and *D. decumbens*. Levels of fertilizer N applied and herbage yield d.m.-lb/acre/year

	B. Milliformis		*Digitaria decumbens*	
	Yield	*% C.P.*	*Yield*	*% C.P.*
20 N	8,111	6.4	8,590	8.9
40 N	11,210	6.9	12,435	9.6
80 N	12,360	7.2	12,826	9.9
160 N	13,060	9.6	13,291	10.6

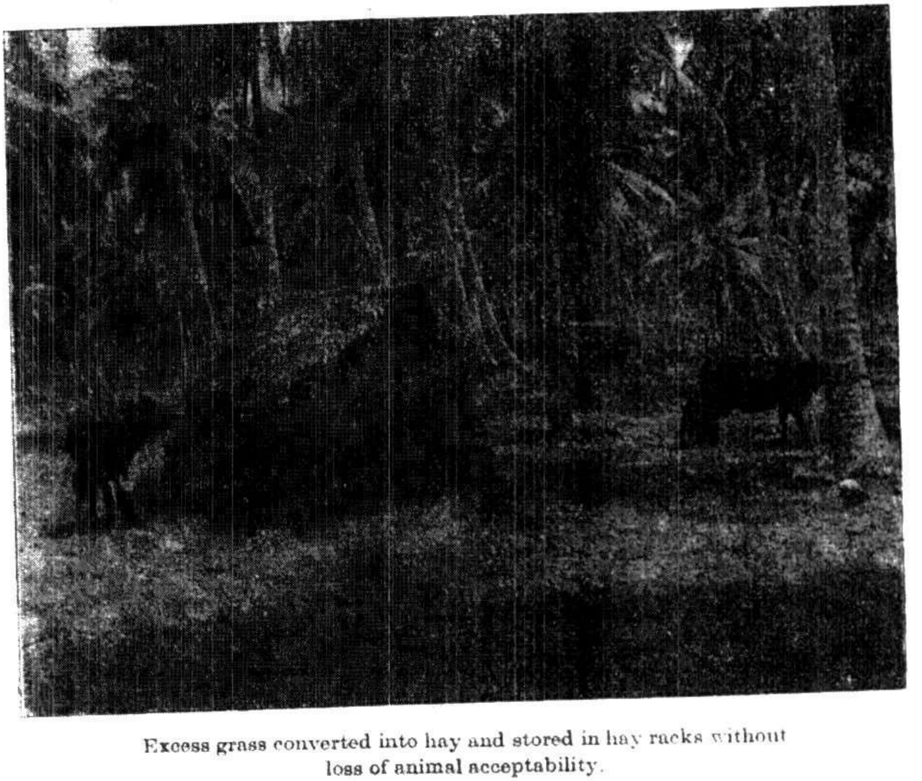
The data show that substantial yield increases both in dry matter and crude protein have been obtained at moderately high levels of applied N. At Lunuwila when both these trials were conducted, it has been possible to obtain over 800 cow grazing days per year from a pasture of B. miliiformis fertilized with 60 lbs. N per acre per year using (Sindhi x Sinhala) cross bred cows weighing approximately 600 lbs. each.

Mixed Pastures

The role of a legume in a pasture is two fold. The first is to increase the nutritive value of the herbage by increasing its protein content and the second is the transference of nitrogen fixed by the legume to the grass. Therefore a suitable legume in a pasture should possess an efficient *Rhizobium* symbiosis associated with a high yield of dry matter and crude protein and ability to persist under grazing conditions. It is often argued that tropical legumes are unable to build up enough nitrogen in the soil to maintain pasture productivity at a high level.

This is due particularly to the adverse environmental conditions such as high soil temperature and the rapidly alternating dry and wet soil conditions. However Graham (1951) has shown that *Centrosema pubescens* was able to support a productive perennial pasture in the wet tropical coast of Queensland.

The mixing characters and the persistency under grazing conditions of *Centrosema pubescens*, *Pueraria javanica* and *Calopogonium mucunoides* growing in association with *B. miliiformis* under coconut were studied. The dry matter production of all three legumes was comparatively low. Only *Centrosema* could withstand grazing to any extent. This is due to the fact that *Centrosema* has a number of dormant buds at the base of the stem and even when grazed to ground level could regenerate by the development of these dormant buds. It has not been possible to estimate the amount of nitrogen added to the pasture by these legumes. Although the cheapest source of nitrogen for a pasture is that derived from associated legumes, until such time as we develop suitable species that are able to associate with vigorously growing tropical pasture species under grazing conditions we have to depend on fertilizer nitrogen for increased grass production. Further, suitable strains of *Rhizobia* capable of fixing sufficient quantities of nitrogen and surviving under the adverse environmental conditions have to be isolated before we can depend on legumes to provide at least a portion of the nitrogen required for our pastures to maintain them in a productive condition.



Excess grass converted into hay and stored in hay racks without loss of animal acceptability.

Conservation

Grass has always been the cheapest source of food for ruminants. Profitability of a cattle husbandry project depends on the availability of cheap food round the year and its efficient conversion into a markatable product. Except in the wet zone, production of pasture will be seasonal so that there will be periods of excess grass followed by periods of want. To tide over such difficulties one has to resort to feed conservation. During the Maha rainy season, hay making is less likely to succeed due to the heavy showers experienced. Since ensiling is independent of the weather conditions it appears to be the most feasible alternative method of conservation. However, excess grass remaining at the end of the rainy season can be made into hay in the field and stored for use during the drought. At Lunuwila, it has been possible to conserve, one cut taken in January, as hay and stored in open sheds for over 4 months without any loss of quality or animal acceptability.

A suitable animal for the area

From the foregoing it is seen that suitable species of pasture plants could be grown under coconut in the wet zone without any detrimental effects on the palms. The success of an animal husbandry project in this zone therefore depends on the efficiency of conversion of this grass into milk and/or meat. It is known that the bulk of the cattle population in the low country is found in the coconut growing areas. However, the indigenous cattle found in the zone are the descendants of a primitive type that has been indiscriminately crossed with various Indian breeds and this population is called the "Sinhala cattle". The average weight of an adult Sinhala cow is 450 lbs. yielding 5 pints/day over 250 days per lactation, under excellent management conditions. Under village conditions the yield is as low as 1.5 pints/day. For all intents and purposes such an animal is an inefficient converter of grass into milk and meat. Various cross-breeding policies have been promoted and carried out in the past to improve cattle production in the region. Attempts have been made to improve the indigenous cattle by cross-breeding with Indian breeds such as the Sindhi. However the improvement obtained has not been substantial for economic exploitation. Considerable attempts have been made to cross Sinhala cattle with temperate breeds. The popular temperate breeds used in this country have been the Jersey, Friesian and the Ayrshire. In all these crosses, considerable improvements in yield have been recorded in the F_1. It is well known that this increase in yield is due to hybrid vigour. However in all instances there has been a progressive decrease in yield in the subsequent generations. This drop in yield has been attributed to lack of adaptability. Attempts have also been made to back-cross the F_1 to the two parent breeds. In both cases there had generally been a decrease in yield of the progeny. Reviewing the data from all these exercises Prof. Mahadevan states that "the conclusion is inevitable that in areas of medium agricultural potential in Ceylon a three breed rotational cross-breeding programme for milk involving Zebu, Jersey and Friesian cattle has the greatest chances of success at the present time". It must be mentioned here that although the cross-breeding programmes carried out earlier have not yielded the desired results, still as a result of these we have been left with a better foundation herd to implement the three-breed rotational cross-breeding programme suggested by Prof. Mahadevan. There are good chances of this three-breed rotational programme yielding the desired type of animal.