Ceylon Cocon. Q. (1972) 23, 103-107
Printed in Ceylon.

CATTLE UNDER COCONUTS

J. G. OHLER
Agricultural and Research Department,
Royal Tropical Institute,
Amesterdam.

INTRODUCTION

Intercropping and grazing under coconuts have been practised for a long time in many countries. The wide spacing between the coconut trees and the great height of their canopies have led logically to the idea to use the land of coconut plantations for a second purpose. It is expected, at present, that because of the pressing need in tropical countries to raise the output from land suitable for agriculture, the practice of mixed cropping and mixed farming with coconuts will increase. The technical and economical merits of such a practice have been doubted as much as they have been praised, probably due to differences in ecological conditions under which this farming system was practised, and also due to different levels of farm management where this system was carried out (5, 39, 44, 45).

Obviously, the undertaking of a second activity on the same land could lead to a net-income increase of this land expressed in terms of cash, or of better food supply, to the availability of animal traction facilities from cattle, and to the manufacturing of stable manure, and consequently to an increase of the soil fertility. An eventual decline of the coconut yield, as a result of using the land for a dual purpose, might occur, but could be outweighed favourably by the return of the second crop (7).

COMPETITION

The undergrowth of course, cannot compete with the much taller coconut for light and air, but competition for soil moisture and nutrients can certainly be substantial (40). The favourable response of coconuts to clean weeding is a generally known fact (4, 39). However, the difficulties of maintaining a clean soil surface, and the inconveniences suffered, such as erosion and expenses involved, are often prohibitive factors in maintaining such a system (12, 36, 49). In Jamaica it was shown that young palms grew more quickly and came in to bearing earlier when the weeds were chemically controlled in circles around them. A detailed consideration of the results from one of the experiments indicated that the weeds were competing for soil nutrients; though this was not proven conclusively (48). In other experiments it was demonstrated that the natural pastures under widely spaced tall coconuts compete with the palms and limit coconut yields (49). According to Santhirasegaram (40) the reduction in yield of coconuts caused by the pasture is negligible on soils with low or high availability of moisture and nutrients; however, if the presence or lack of these elements is not outspoken, any appreciable utilization of soil moisture and nutrients may result in a considerable reduction in yield of coconuts.

COMPETITION FOR NUTRIENTS

When establishing a pasture under coconuts, the existing weeds are replaced by grasses and legumes that are able to produce forage of good quality and quantity. The replacement of weeds by the desired pasture plants may result initially in a reduced root competition in an increase of coconuts yields. However, coconut yields may decline sharply after some years of grazing as a result of removing two crops a year from the same soil instead of one. For a long time it was assumed that one of the greatest advantages of grazing cattle under coconuts was the enrichment of the soil by the droppings of the cattle which would result in an increase of coconut yields. Paltridge emphasised the importance of excrements as a means to increase the fertility of the soil and the growth of good quality stock feed under coconuts (25).

Reproduced from *Tropical Abstracts* Vol. 24, No. 10, October, 1969.

Although the droppings of cattle enrich the soil, the manure produced by the cattle is less valuable than the food eaten because vital elements of the forage for the cattle are retained in their bodies. Furthermore part of the remaining elements in the excretions of the cattle may get lost by volatilization (Nitrogen) in dry, hot weather by or run-off during heavy rains. Therefore, the droppings return only part of the elements that were taken away, albeit in a concentrated form (43).

Different grasses have different growing habits and requirements and they have therefore different effects on the yields of coconuts (42). In the wet zone of Ceylon, the effects of various grasses, which were regularly fertilized, on yields of coconuts were studied. Compared to control (natural vegetation) *Panicum maximum* caused a reduction of 500 nuts/ha/year, whereas palms underplanted with *Brachiaria brizantha* and *B. miliiformis* gave a yield increase of 235 and 545 nuts/ha/year, respectively. The herbage yields of *Panicum* were twice as high as those of the Brachiaria spp. (28) and resulted apparently in a heavier competition for nutrients. In another trial conducted in the wet zone of Ceylon, coconuts in *B. miliiformis* pasture yielded 580 nuts/ha/year more than those growing in B. brizantha pasture (31).

The effect of mineral fertilizers on coconuts and grasses was also shown in Lunuwila in Ceylon (33). *Pennisetum purpureum*, grown under coconuts, caused a 39% reduction of the copra yield. Application of NPK fertilizer gave a 59% increase of the copra yield, and an eightfold increase of the fodder production, whereas the same fertilizer application in no-fodder plots resulted in a yield increase of 38%. A heavy application of N alone in the no-fodder plots reduced the copra yield by 10%, whereas in the fodder plots the copra yields increased with 44%; this meant that the excess of N was probably taken up by the growing fodder, and thus prevented a negative effect on the crops production. Symptoms of a negative effect of N on nut yield with increasing levels of N application were also noticed in latter experiments, carried out in Ceylon (14). Special attention should be given to the different nutrient requirements of palm trees, grasses and cattle in order to adjust the fertilizer scheme according to need (24, 29, 39).

COMPETITION FOR MOISTURE

Kasarogod (India), where the yield of coconut is considerably affected by the dry season, which may prevail for 5 months, the elimination of weeds under coconuts by regular cultivation resulted in yield increases from 10-47 nuts/palm/year. Manuring in addition to cultivation caused an increase of 64 nuts/palm/year. Manuring without cultivation was less effective than cultivation without manuring (21). Measurements have shown that the moisture content of soils under an inadequate system of cultivation, and consequently with ineffective weed control was only slightly higher than of unweeded soils; a thorough system of cultivation, resulted in a considerably higher soil moisture content during dry season (22). In Ceylon a sharper decline of the moisture content during the dry season was measured in soils under three different cover crops (weeds and 2 grass species) than in soils which had no cover crops and were kept free of weeds. For coconuts, growing under W. African conditions, the maintenance of a clean weeding system is advised for the first three years after planting to avoid suffering of the young trees from root competition with the ground cover. After this period, the establishment of a ground cover (*Centrasema pubescens*) is recommended, but the growth of this cover, should be checked by grazing (51). Experiments in the Ivory Coast with coconuts, growing in a sandy soil with a low water-retention capacity (5%), showed also a notable competition for water between young palms and a ground cover of *C. pubescens* (1). But it was assumed that under adult palms with a well developed root system, a ground cover, which does not grow too vigorously may be an advantage, because it acts as a mulch for soil improvement and prevents the growth of noxious grasses. The disappearance of the negative effect of *C. pubescens* after the palms have grown up was stated by Fremond and Brunin, who mention also that an extra income could be provided by grazing it as a pasture (12).

The effects of grazed and ungrazed pastures which received regular fertilizer applications, were reported from Ceylon (15, 31, 38). The grazed pastures had a less depressive effect on yield than the ungrazed pastures under conditions of a climate with a dry season. Experimental evidence that competition for soil moisture was responsible was obtained in Ceylon (46). When ground covers of *Indigofera endecaphylla* and *C. pubescens* were maintained for periods of less than two years, the loss of soil moisture, down to a depth of 45 cm. was greater of soils under the ground covers than of clean-weeded

land. The reverse was true when the covers were maintained for much longer periods. It was assumed that when soils with an unfavourable structure (low capacity of rainwater intake) were used, the effects of the increased permeability and porosity of the soil effected by growing of mixed covers, favourably outweighted the effects of desiccation caused by transpiration of the ground cover. From regions with an abundant rainfall in Ceylon it was reported that depressive effects of pastures on nut yields could be eliminated by fertilizer applications (38, 39, 41).

GRAZING HABITS

Studies of grazing habits of Zebu cattle in coconut plantations showed that pastures were grazed mainly during day time (16, 20). This means that the cattle can be taken in to the corral at night without affecting their food intake, particularly when some extra rations are given in the corral. This allows for improved production of farm-yard manure, and avoids also unnecessary trampling of the pastures. In case the feeding of the cattle is seriously disturbed because of heavy rains, some extra grazing at night or some extra rations should be provided for. Cattle from temperate climates, such as Hereford and Friesian, do not graze at the hottest time of the day (6). In order to provide on optimum of plant food for cattle, quantitatively as well as qualitatively, and to avoid the deterioration of the pasture as well, a rotational grazing scheme is essential; this allows the pasture to be grazed at its optimal nutritive value (6). Tethering of the cattle to the palm trees, with cattle feeding on the pasture around the trees, is also practised particularly on small-holdings (15, 26, 34, 47). Free ranging leads to selective grazing and to local overgrazing, resulting in the deterioration of the pasture quality and production capacity (15, 17, 18, 32, 44). The effect of grazing on the distribution of grasses and legumes was demonstrated in the Solomon Islands under conditions of high and well distributed rainfall, regular grazing of the pastures under coconuts caused dominance of *Paspalum conjugatum*. After exclusion of the cattle *Mimosa invisa* became predominant (13). In a grazing trial in Ceylon, *Brachiaria brizantha* was overgrown by *B. miliiformis* after some time of grazing in one of the plots (31). Some mowing or weeding will always be necessary as selective grazing will occur always, and this, even in smaller lots, will lead to uninhibited growth of unpalatable weeds that are resistant to trampling by cattle.

MANURE PRODUCTION

With a system of manufacturing pen-manure, 10 tons of manure can be produced/head/annum, which would be sufficient for about 200 trees. One should be aware of the fact however that manure pits are excellent breeding places for *Oryctes* beetles. But on the other hand when adequately managed, the eggs and larvae will be destroyed and the pit may thus function as an insect trap (11, 35, 44, 47).

Tethering as a manuring system will not enrich the soil in any way unless extra rations are fed to the cattle and organic matter be brought in from outside to be mixed with the excretions. The number of palm trees that can be manured in this way is rather low, about 18 trees per head of cattle per annum under Ceylon conditions (35).

DAMAGE BY CATTLE

Cattle in young coconut plantations may damage the young trees by eating and trampling. Leaf-eating can be prevanted by: (*a*) the application of slurry of cattle, dung or chemical repellents on the leaves; (*b*) the building of husk walls around the trees; and (*c*) individual fencing or fencing off the whole plantation. Repellents have the disadvantage that have to be applied again after each rain. On heavy soils trampling may cause serious deterioration of the soil structure. Cattle may also seriously damage the drainage system (7, 11, 20, 23, 26, 50, 52).

CARRYING CAPACITY

The carrying capacity of the pastures under coconuts may vary according to differences in climate, soil fertility planting density of the coconut trees, type of cattle additional rations fed to the cattle, and the efficiency of management. Carrying capacity of .5-2 head of Sinhala cattle per ha. are mentioned from Ceylon where in all cases the animals received daily additional rations of 1.4 kg. of coconut press cake per head (3, 8, 9, 28). In the Ivory Coast, about 0.75 head per ha could be maintained under coconuts

on sandy soils covered with *C. pubescens* (10). Under favourable conditions in the New Hebrides, the Solomon Islands and Samoa it is possible to keep 3 head/ha (6, 11, 14). In climates with a dry and a wet period one has to cope with problems of adjustment of the right cattle population on the land throughout the year. This problem can be solved by providing extra rations of concentrate to the cattle during the dry seasons, and possibly by mowing part of the pasture in the wet season for making hay or silage to be used during the dry season. However, such measures can be carried out usually only on larger plantations, as they require capital, knowledge and organization.

CONCLUSION

Grazing of cattle under coconuts without affecting the yield of palm trees is possible provided sufficient soil moisture and plant nutrients are available for both crops throughout the year. Heavy soils are less suitable because of soil structure deterioration by trampling. Soil fertility deficiencies can be corrected with fertilizer applications, but soil moisture may be a limiting factor in climates with a pronounced dry season. The earning capacity of this mixed farming system depends on the effectiveness of the management the prices of the products, and the marketing conditions. A mixed farming system will be more flexible and less vulnerable to changes in prices, and it may provide also a better distribution of labour requirements throughout the year enabling the former to make a better use of available labour capacity on the farm.

REFERENCES

1. Boyer, J., Nature de la couverture du sol et influence sur le bilan hydrique 'dune cocoteraxie. Oleagineux 20, 7 p. 437-40 (1965). See Trop. Abstr. p.102.
2. *Brachiaria Brizantha*—the perfect pasture. Ceylon Coconut Planters Rev. 3, 1, p.22-5 (1962). See Trop. Abstr. k2375.
3. Burgos, C. H., You can raise livestock in coconut groves. Agr. Indust. Monthly 5, 11 p. 12-3, 36, 38, 44 (1938).
4. Childs, A. H. B., and Groom, C. G. Balanced farming with cattle and coconuts, E. Afr. Agr. Forestry J. 29, 3, p. 206-7 (1964).
5. Coconut as part of a mixed farming system. Commod. Rept., F.A.O., Nw. Ser. 1, p. 1-29 (1966). See Trop. Abstr. p. 1676.
6. Eden, D. R. A. The management of coconut plantations in Western Samoa. Techn. Paper S. Pac. Comm. 48, p. 1-32 (1953). See Trop. Abstr. b3057.
7. Eden, D. R. A. Pacific copra production near possible serious decline. S. Pac. Comm. Quart. Bull, 8, 1, p. 25-8 (1958). See Trop. Abstr. f1539.
8. Ellewela, D. C. Report of the animal husbandry officer. Ann. Rep. Coconut Res. Board Coconut Res. Inst. 1954, p. 43-4 (1956).
9. Ellewela, D. C. Report of the animal husbandry officer. Ann. Rep. Coconut Res. Board Coconut Res. Inst. 1955, p. 46-8 (1957).
10. Ferdinandez, D. E. F. Effect of pasture on the yield of coconut. Ann. Rep. Coconut Res. Inst. Ceylon 1967. Ceylon Coconut Quart. 19, 1-2, p. 54-6 (1968).
11. Fremond, Y., et al, Le cocotier, Paris, Maisonneuve & Larose, 1966, p. 148-9.
12. Fremond, Y., and Brunin, ch. Cocotier et. couverture du sol. Oleagineux 21, G, P. 361-4 (1966). See Trop. Abstr. p. 2318.
13. Green, A. H. and Foale, M. A. The improvement of the coconut palm production of the high islands of the tropical Pacific. Symposium on tropical crops improvement. Tenth Pac. Sci. Congress. S. Pac. Comm., Noumea, p. 65-9 (1961). B. See Top. Abstr. j2548.
14. Groeneveld, S. Landwirtschaftliche Entwicklung im Kustengebiet Ostafrikas und Geispiel der Kokospalmen —Rindviehprojekte in der Tanga-Region in Tanzania. Munchen, Welftforum Verlag, 1967. 124 p.
15. Goonasekera, G. C. M. Rotational grazing under coconut. Ceylon Coconut Quart. 2, 4, p. 181-3 (1951).
16. Goonasekera, G. C. M. Report of the Animal husbandry officer. Ann. Rep. Coconut Res. Board, Coconut Res. Inst. 1953, p. 37-8 (1955).
17. Goonasekera, G. C. M. Pastures under coconuts. The incidence of weeds. Ceylon Coconut Quart. 4, 1, 9-12 (1953).
18. Goonasekera, G. C. M. Pastures under coconuts. Ceylon Coconut Quart. 4, 3-4, p. 135-6 (1953).
19. Goonasekera, G. C. M. Cattle under coconuts. Feeding trials with indigenous cattle. Ceylon Coconut Quart. 5, 4, p. 227-31 (1954).
20. Goonasekera, G. C. M. Grazing habits of indigenous cattle under coconuts. Ceylon Coconut Quart. 4, 2, p. 73-5 (1953). See also Trop. Agriculturist, Ceylon 110, 1, p. 25:9 (1954).
21. Krishna Marar, M. M. Intercultivation in coconut gardens—its importance. Indian Coconut J. 4, 4, p. 131-7 (1953). See Trop. Abstr. b 1489.
22. Krishna Marar, M. M. et. al. Trial of intercultivation practices in coconut gardens. Indian Coconut J. 14, 3, p. 87-99 (1961). See Trop. Abstr. i3039.
23. Martyn, E. B. Coconut diseases in Jamaica. Part I. Trop. Agr. Trinidad 22, 3, p. 51-9 (1945).
24. Narayana, G. V. Manuring of the coconut crop. Indian Coconut J. 5, 2, p. 105-13 (1952).

25. Paltridge, T. B. Some notes on the management of coconut estate in Ceylon. Ceylon Coconut Quart. 7, 3-4 p. 11-20 (1956).
26. Piggut, C. J. Coconut growing. London, Oxford University Press, 1964. 109 p.
27. Quintana, E. U. et al. Farm Business management of coconut farms. Philippine Agriculturist 42, 8-9, p. 374-89 (1959). See Trop. Abstr. g2082.
28. Rajaratnam, D. T. and Santhirasegaram, K. Comparison of grasses. Ceylon Coconut Quart. 14, 1-2, p. 35-6 (1963).
29. Rajaratnam, D. T. & Santhirasegaram, K. Experiment on methods of application of manures. Ann. Rep. Coconut Res. Inst. Ceylon 1962; Ceylon Coconut Quart. 14, 12, p. 36-7 (1963).
30. Rajaratnam, D. T. and Santhirasegaram, K. Cultivation x pasture experiment, Ratmalagara Estate, Ceylon Coconut Quart. 14, 1-2, p. 37-8 (1963).
31. Rajaratnam, D. T. and Santhirasegaram, K. Intensity of grazing trial. Ceylon Coconut Quart. 14, 1-2, p. 38-9 (1963).
32. Rajaratnam, D. T. and Santhirasegaram, K. Rotational grazing vs. Continuous grazing, Ceylon Coconut Quart. 14, 1-2, p. 39-40 (1963).
33. Rodrigo, E. Fodder grass experiment (Lunuwila). Ann. Rep. Coconut Res. Scheme 1943 p. 11 (1945).
34. Salgado, M. L. M. Some problems of coconut manuring. Papers Coconut Conf. Colombo p. 9-16 (1947).
35. Salgado, M. L. M. Preliminary studies on the chemistry of cattle manuring on coconut estates. Trop. Agriculturist, Ceylon 107, 4, p. 218-24 (1951).
36. Salgado, M. L. M. Land use and soil water relations with reference to coconut cultivation, Ceylon Coconut Quart. 9, 1-2, p. 12-9 (1958).
37. Santhirasegaram, K. Observation of soil moisture under pastures. Ann. Rep. Coconut Res. Inst. 1958, p. 62 (1960).
38. Santhirasegaram, K. The effect of monospecific grass swards on the yield of coconuts in the north western province of Ceylon. Ceylon Coconut Quart. 17, 2, p. 73-9 (1966).
39. Santhirasegaram, K. Utilisation of the spacing among coconuts for intercropping. Ceylon Coconut Planters Rev. 4, 2, p. 43-6 (1966).
40. Santhirasegaram, K. The effects of pastures on the yield of coconuts. J. Agr. Soc. Trinidad. Tobago 66, 2, p. 183, 195-93 (1966). See Trop. Abstr. q284.
41. Santhirasegaram, K. Intercropping of coconuts with reference to food production, Ceylon Coconut Planters Rev. 5, 1, p. 12-24 (1967). See Trop. Abstr. r1840.
42. Santhirasegaram, K. and Ferdinandez, D. E. F. Yield and competitive relationship between two species of Brachiaria in association Trop. Agr. Trinidad 44, 3, p. 229-34 (1967). See Trop. Abstr. q2080.
43. Schrader, R. H. S. Ceylon livestock industry. Trop. Agriculturist, Ceylon 89, p. 193-205 (1937).
44. Schrader, R. H. S. Combining the husbandry of livestock with the cultivation of coconuts. Papers Coconut Con. Colombo, p. 17-29 (1967).
45. Schrader, R. H. S. Livestock and coconut cultivation, Ceylon Coconut Quart. 2, 2, p. 77-82 (1951).
46. Silva, M. A. T. de Cover Crops under coconut. Ceylon Coconut Planters Rev. 11, 1-2, p. 17-22 (1961). See Trop. Abstr. j2546.
47. Silva, M. A. T. de Cattle for manure. Ceylon Coconut Quart. 2, 1, p. 15-7 (1951).
48. Smith, R. W. The effect of chemical weed control on early growth and onset of bearing in the coconut palm: In: Technical meeting on herbicides for tree crops with emphasis on coconuts. Coconut Industry Board, Jamaica, 1968 p. 41-52.
49. Smith, R. W. The role of herbicides in the management of bearing coconut palms. In: Technical meeting on herbicides for tree crops with emphasis on coconuts. Coconut Industry Board, Jamaica 1968 p. 53-60.
50. Stanley de Silva. Cattle damage to coconuts. Ceylon Coconut Quart. 4, 3-4, p. 137-140 (1953).
51. Villemain, G. Entertien des Cocoteraies. Oleagineux 19, 1, p. 27-31 (1963). See Trop. Abstr. m1097.
52. Weltje, H. C. Kokosplantages op de Solomon elilanden, Banket Chocolade, Suikerwerken, 34, 1, p. 31-8 (1966).