

A MODEL FOR INTEGRATION OF PASTURE, TREE FODDER AND CATTLE IN COCONUT SMALL-HOLDINGS

Of the one million acres under coconut cultivation in Sri Lanka, about 75% are small-holdings. In a large majority of coconut holdings, chemical farming is the accepted practice. This involves the use of inorganic fertilizers and herbicides. The small-holder who often encounters problems such as crop losses due to adverse weather and fluctuating prices has only limited resources. These problems often discourage the farmer to provide the necessary inputs. The cost of inorganic fertilizer and its application constitute about 40% of the total expenditure on the maintenance of coconut holdings. Any technology developed to reduce expenditure on these two items would be of considerable benefit to the small-holder. Integration of cattle farming with coconut production provides a feasible way to achieve this goal.

Based on the experiments conducted at the Coconut Research Institute during the past two decades, an integrated farming model comprising pasture, tree fodder and cattle was designed for the coconut small-holder. This model is discussed in this article.

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Description of the system

The total land area of the system is 0.8 ha (2 acres). This area is fenced to form five paddocks, each paddock containing 24 coconut palms, about 40 years old and spaced at 8 m X 8 m (64 palms/ac). In each paddock a mixture of ipil ipil, gliricidia, *Pueraria* and *Brachiaria miliiformis* is planted. A schematic diagram of a paddock is given in Fig. 1.

Ipil ipil is planted in two rows along the coconut avenue with a spacing of 2 m X 1 m giving a density of 16 trees per coconut square (Approximately 1025 trees/ac). Grass (*Brachiaria miliiformis*) and the legume (*Pueraria phaseoloides*) are planted in alternative rows 60 cm apart, in the balance area among coconut palms leaving the manure circle free. Along the boundary



fences of the five paddocks, gliricidia and ipil ipil are planted 1.0 m apart alternately. In this system, coconut is fertilized with 750 g muriate of potash and 180 g saphos phosphate per palm annually to supplement the organic manures provided by cattle, tree fodder etc. A basal fertilizer mixture of urea, saphos phosphate and muriate of potash in equal proportions (25 kg/ha each component) was applied to the grass legume mixture.

Cattle can be introduced to the system one year after the establishment of various crop components. In our model, we introduced four heifers of 6 months of age. At the beginning of the grazing cycle, the animals were tethered to four palms in the row A of the first paddock (Fig. 1), and allowed to graze the grass/legume mixture available around the palms. During the night, animals were tethered to the palms in order to get all the dung and urine to the coconut manure circles. On the following day animals were moved to the next four palms in the row B. This rotational grazing system was continued upto the row F. At the end of the grazing period in the paddock, animals were transferred to the second paddock where they grazed for six days, similar to the procedure adopted in the first paddock. This rotational grazing cycle was completed after 30 days with the completion of grazing in the fifth paddock. Then the animals were transferred back to the first paddock for the second grazing cycle. Thus an animal was tethered to each palm for 12 days per year. The grass/legume mixture had a period of 30 days for regeneration.

In addition to feeding by grazing, the cattle were fed with fresh loppings of ipil ipil and gliricidia at the rate of 3 kg each (Approximately 1000 g dry matter). During the dry season, the animals were allowed to graze for a few hours depending on the feed availability and for the rest of the day they were kept tethered close to the palms. During this period, urea-treated rice straw was fed *ad lib* supplemented with 750-1,000 g (dry weight) gliricidia leaves.

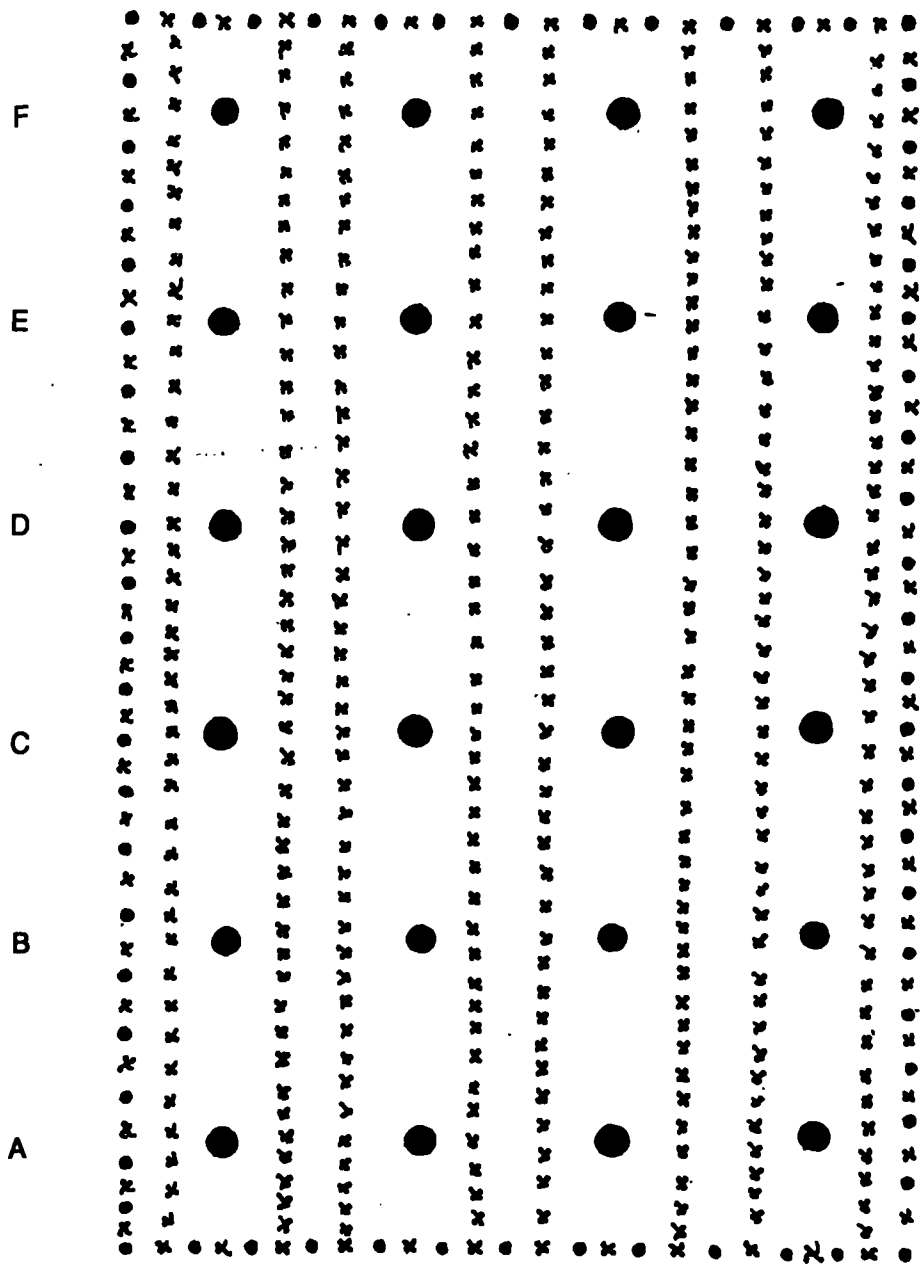
Rotation of animals from palm to palm and from paddock to paddock was continued during this period too. During the entire period, animals had ready access to drinking

water. A commercial mineral mixture containing calcium and phosphorus in 2:1 ratio was given at the rate of 30 g/day to each animal with drinking water.

The average herbage production of pasture grass/legume mixture was estimated around 18 MT of dry matter per year for the system. Legume content in the mixture was 28% during the early stages. However, this was reduced to 12% in the subsequent years. But ipil ipil and gliricidia produced around 15 MT of fodder with two pruning cycles a year. Part of the biomass produced by ipil and gliricidia was used as green manure for coconut. Pasture and fodder production from the system was adequate to feed the cattle without any concentrate feed from outside. However, during dry weather the productivity of pasture was very low. Urea-treated rice straw supplemented with tree fodder proved to be an adequate feed during this season. The overall increase in liveweight of the cattle was 306 g/head/day throughout the first year. At the beginning of the first lactation, the milk yield ranged from 7-10 liters/day for the system.

Coconut Nutrition

Dung and urine produced by the cattle were estimated at around 73 kg fresh cowdung and 30 liters of urine per palm/year, and collectively returned 812 g N, 219 g P_2O_5 and 800 g K_2O per palm/year, which is equivalent to 1.8 kg of urea, 0.8 kg of saphos phosphate and 1.3 kg muriate of potash. However all the nutrients returned through animal excreta may not be available to the palm. Loss of nutrients occurs from the time of deposition of excreta through volatilization, leaching and by other means. Even if a 50% loss of nutrients in dung and urine is assumed, a substantial amount is still available for the palms. In this system, the entire nitrogen requirement and a part of phosphorus and potassium requirements of coconut could be met through animal excreta. This will reduce the cost of inorganic fertilizer for coconut by about 69% annually (see Table 1). In addition, the cost of weeding is also reduced by the system as grass/legume mixture and cattle grazing keep the weeds under control.



- Coconut palms.
- Gliricidia trees.
- x Leucaena trees.

Figure 1: Schematic pattern of Planting Gliricidia and Ipil-ipil with coconut in a paddock.

Table 1: Amounts and Cost of Inorganic Fertilizer applied for Coconut in the Integrated System

Component	Integrated system		Coconut monoculture plot	
	Amount (g/palm)	Cost/palm Rs. cents	Amount (g/palm)	Cost/palm Rs. cents
Urea	Nil	Nil	800	2.92
Sapthosphosphate	180	0.53	600	1.77
Muriate of potash	750	2.66	1600	5.68
Total/palm	930	3.19	3000	10.37
Total/ha	148.8 (kg)	510.40	480 (kg)	1659.20

In order to determine the effects of this integrated system on the performance of coconut, a control/monoculture coconut block was maintained adjacent to this system throughout the period. The nut and copra yield from the integrated system showed a 11% increase over the nut yield of coconut monoculture block. Further, it was revealed that three years after the establishment of the integrated system where inorganic fertilizer was applied to coconut at a lower level compared to the monoculture system, there was no marked difference in nutrient content in coconut leaves, indica-

ting that coconuts in both blocks were in a nutritionally similar state. Improvement of soil fertility level in the integrated system is indicated through the increase of organic matter content, available phosphorus and total nitrogen of the soil by 31.7%, 31.2% and 22.6% respectively, over the coconut monoculture plot.

Performance of this integrated farming system clearly demonstrated its benefits in increasing the productivity of land while reducing the cost of coconut production.