A model for mixed cropping

Carefully selected mixes of perennial crops promise viability for smallholders

by K.V.A. Bavappa and V.J. Jacob

The land mass lying between 23.5° north and south of the equator, generally designated as the tropical belt, has 38 percent of the land area of the world shared by a large number of developing countries. Of this, an area of about 1 800 million ha (1975 estimate) is occupied by forests, plantations of cash crops such as tea, coffee, cocoa, coconut, rubber, oil palm, tree spices, etc. In most countries, for centuries, all these crops were generally cultivated as monocrops. This was mainly due to the easiness of management, the low pressure on land, the availability of cheap labour, and the general outlook of the colonial rulers. Moreover, there was no positive thinking toward mixed cropping in perennials. The crops that occupy the land are utilizing the natural resources to a very limited extent, producing less than 10 percent of the potential for dry matter production in the tropics.

However, in the homesteads, mixed plantings of various tree species to meet home needs was being practised. In such holdings, indiscriminate and unscientific planting has resulted in overcrowded stands as seen in the mid-country of Sri Lanka, where they are rightly known as Kandian Forest Gardens.

Smallholdings predominate

Though it is generally believed that the plantation industry is a well-organized agricultural sector, the fact that small farms constitute a sizeable proportion of the holdings in these crops is often overlocked. In India, 86 percent of the tea holdings cover less than 5 ha while 74 percent and 86 percent of the holdings in coffee and rubber respectively are 2 ha and less in area. Nearly 100 percent of the coconut holdings are less than 2 ha in size. In Sri Lanka, home gardens based on perennial crops have an average size of 0.29 ha. The income from well-managed large-sized plantations has been fairly high whereas in small holdings it is invariably low. Even in the case of mixed stands of home gardens, the production levels and net returns are poor. Therefore, the problem facing agriculture in the tropics is one of making these small holdings into high-income viable units.

The potential for crop production, which is the conversion of solar energy into biologically useful dry matter, is maximum in the tropics due to the abundant sunlight, rainfall and other favourable environmental conditions prevalent in this region. Cropping systems based on annual crops can utilize these natural resources only to a limited extent. However, through intensive cropping systems such as relay cropping and intercropping, this can be partly overcome. Perennial crops, on the other hand, with their larger canopies and deep root systems can exploit sunlight, soil moisture and nutrients much better than annuals, provided the crops planted are in compatible combinations.

In the prevailing context of a low land-to-man ratio, the changing social outlook and land policy, the need for self-reliance on the calorie require-

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Overpopulation among a mixed stand of tropic tree species

Scientific selection of mixed crops can make small holdings viable

Mixed cropping of coconut with cocoa in Sri Lanka

Pepper trained on Glyricidia, a popular shade tree

ments of the family and the need to improve the agro-ecological environment of man, it is imperative that integrated cropping systems be developed. There is scope to intercrop coconut and rubber with a variety of cereals, pulses and tubers at different ages of the plantation. Cassava is a very popular intercrop under coconut in India. The bulk of the banana in Jamaica is produced in coconut plantations. Pineapple cultivation under coconut is catching up in Sri Lanka.

Ramie is popular as a mixed crop under coconut in the Philippines. The highest net return from any known large-scale mixed cropping of cocoa with coconut comes from Malaysia. Nearly one third of the cocoa plantings in Sri Lanka are under rubber. Coconut-based animal husbandry programmes have been practised in Sri Lanka for more than a decade. Growing cardamom under forest species is a popular agroforestry technique in India and Sri Lanka. Despite these examples, in most countries, sizeable plantation areas are still given to monoculture and thus available for exploitation through mixed cropping.

It is not correct to assume that the well-managed monocrop plantations of today are at their maximum level of production. For high production efficiency, cropping systems should fully utilize the vertical and horizontal strata of soil, trap solar energy to the maximum, use the air space at the optimum level and recycle organic wastes to the fullest extent.

Net returns increased

A monocrop system will hardly be able to achieve the above. Scientifically laid-out mixed crop populations planted at higher densities have enhanced productivity per unit area both from existing monocrop lands and in new plantings. Growing black pepper on glyricidia, a popular shade tree for tea in the low and mid-country plantations of Sri Lanka increased the net return from US$740 (monocrop of tea) to $2 550 per ha. In Malaysia, the net return from 1 ha of coconut planted with cocoa increased to $652

Annual crops utilize the natural resources of the tropics only to a limited extent

from a low of $79 for coconut alone. Cocoa grown with rubber has brought in an additional return of $500 per ha in Sri Lanka. While these are the returns obtained from farms under average maintenance, still higher income-generating combinations, such as tea and clove, are available for exploitation. Planting cardamom under forest species in higher elevations (agroforestry) is yet another high-return combination. Integration of animal husbandry with coconut-based pasture production has been reported to enhance the net return and gainful employment in India.

Faced with the problem of continued deterioration and low production over an area of about 75 000 ha of tea land in the mid-country, the Government of Sri Lanka embarked upon a diversification programme of such lands into mixed-cropping settlements. A mixed-cropping model involving a dozen perennial crops developed by the UNDP/FAO Minor Export Crops Research Project having an estimated net annual income of $2 000 per ha came in handy for this programme. The model, which has a total population of 3 684 plants/ha, is planted at spacings of 1.25 to 12.5 m, depending upon the size of the canopy of the crop. While choosing the crops, due consideration was given to species to meet the family needs, in addition to generating adequate cash income. Crops such as pepper, coffee, coconut, clove and nutmeg (which number 1 296, 2 000, 36, 12 and 12 respectively) are the major cash crops while mango, jack, avocado and breadfruit are basically for home consumption. The remaining crops — banana, areca nut, papaya and lime — can bring some cash return after meeting the home needs.

In the establishment of this model, certain deviations from the accepted principles of planting were also made. Contour terracing and trenching, which are normally recommended for sloping lands, were not provided. Instead, the ground cover, which consisted of stray tea bushes and mana and napier grass, was left undisturbed, the soil being dug only to make the pits. Soil erosion under such a situation was practically nil in lands having slopes of even more than 50 percent. The ground cover was slashed and used for shading and mulching the plants. This not only cut down the cost of establishment but also helped production of adequate quantities of grass for maintaining 2 to 3 milch animals on this 1 hectare of land.

Self-reliant settlers

The World Bank is supporting the National Agricultural Diversification and Settlement Authority (NADSA) in the execution of this programme. A total of 4 500 landless families are being settled in about 4 000 ha of eroded and unproductive tea land. Each family is given 0.1 ha of homestead and 0.8 ha of farmstead planted with crops of the above model. A house costing about $500 is also provided in the homestead, which is constructed with materials supplied by the executing agency and with the settler's participation. In areas where the production level of tea is good, the homesteads have cropping models involving pepper and clove with tea. The would-be settlers participate in the establishment of their farms and the development of the homesteads as wage earners during the gestation period of the crops. The settlers are also made self-reliant by on-and-off job training, timely inputs supply, marketing support and other community facilities. Thus, the hill ranges of the mid-country, which were on the verge of an ecological crisis, are now the scene of a rehabilitation activity that, in due course, will improve the land and build up a balanced human-plant-animal ecosystem vital for high and stable production.