# ARECANUT BASED CROPPING SYSTEM

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Small and marginal holdings of less than one hectare dominate in arecanut tract. Despite it's commercial status, the profitability is not assured for farmers due to recurrent problems like price fluctuations, pests and diseases, water logging and drought resulting in considerable yield losses. So, the emphasis should be to increase the productivity per unit area per unit time. The practice of well planned and executed inter/mixed cropping is fundamental for increasing the productivity and income per unit area. Extensive research work on multiple copping systems at Central Plantation Crops Research Institute resulted in development of economically and environmentally viable cropping models to empower small and marginal farmers.

## 1. Scope for cropping systems in arecanut plantation

When planted at a recommended spacing of 2.7 m x 2.7 m, 61% of all the roots and 51% of fine roots are confined within 50 cm distance and depth from the trunk of arecanut palm, indicating only 2.27 $m^2$ (40% of land area) of land out of 7.29 $m^2$ area available is being used by the crop. Further, 43% of the incident light only is intercepted by arecanut and this can be increased to 95% by growing mixed crops in arecanut garden. The compact nature of arecanut crown, raised well above the ground (10 to 15 m), allows more sunlight to transmit to ground and maintains high humidity which, in turn, favours excellent growth of shade loving intercrops/mixed crops. The space occupied by component crops (47 per cent) was higher than that occupied by arecanut (16 per cent). All these points indicate that arecanut as a sole crop does not utilize fully the natural resources such as soil, space and light. There is an excellent opportunity for temporal and spatial distribution of crop species in arecanut gardens for achieving higher resource use efficiency and increased income. The assured irrigation in arecanut gardens has greater potential for multiple cropping.

## 2. Suitable crops for multiple cropping

Compatibility of different crops is an important factor in the success of any cropping system. The criteria for selection of component crops are 1) the ability of the crop to grow under shade 2) ability to withstand heavy dripping during monsoon 3) availability of local market and 4) local weather condition. A large number of annuals, biennials and perennial crops have been screened for their suitability as component crops in arecanut garden at Regional Station and Research Centres of Central Plantation Crops Research Institute. Crops like banana, ginger, chilli, colocasia, turmeric, elephant foot yam, diascorea, flowers, and vegetables can be cultivated as intercrop in the initial years of arecanut garden. However, as the age of the garden advances, only few crops like pepper, cocoa, banana, acid lime, betel vine, medicinal

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& aromatic plants and shade loving flowers can be grown profitably as mixed crops. Cardamom is an important mixed crop in arecanut tract of North Kanara District of Karnataka and Wynad District of Kerala. There was perceptible increase in arecanut yield (7-21 per cent) with intercropping. This can be attributed to the favourable microclimate created by intercropping and recycling of large quantities of organic matter resulting in improved soil fertility.

### 3. Benefits of multiple cropping system

Evaporation, air and soil temperatures are lower in mixed cropping than in sole arecanut and open conditions. The least diurnal variation in microclimate within the mixed cropping is an important feature besides lower evaporative demand, reduced wind velocity and higher soil moisture content. This is very important as the synergistic effects of wind and solar radiation can cause mechanical injury in shade plants like cocoa. The arecanut palms provide excellent protection to the intercrops against wind and vice versa. Crops like cocoa and banana limit the damage of sun scorching effect in initial years.

Increased root proliferation in arecanut due to intercropping would increase organic matter content in soil. Intercropping legumes increases the content of available nitrogen and other nutrients in arecanut plantation. Fixation of N, recycling of nutrients in the soil profile, prevention of soil erosion and improved soil fertility are some of the advantages of intercropping with leguminous green manure crops or cover crops in arecanut. It was further noticed that cover crops with *Pueraria javanica* and *Mimosa invisa* in arecanut gardens could add on an average 10 kg green manure per palm which could meet 69 to 89 per cent of N requirement, 28 to 43 per cent P and 29-38 per cent of K. Maximum biomass recycling in the form of pruned biomass and litter fall is possible in arecanut + cocoa mixed cropping system. Increase in soil pH was noticed due to inter/mixed cropping. Thus, cropping system approach is important for soil acidity management of laterite soils in arecanut belt.

The trials on high density multispecies cropping system involving arecanut, pepper, cocoa and banana indicated that recycling of organic matter from the system could meet 50 per cent N and 50 per cent P requirement of the system. Similarly, a six year study to quantify the feasibility of economising the fertilizer use in the cropping model involving arecanut-banana- cocoa - pepper revealed that the fertilizer requirement could be scaled down to 66 per cent of the recommended dose. Generally, mixed cropping/multiple cropping does not increase the water requirement. The transpiration losses may increase in mixed cropping but evaporation and runoff losses are likely to be reduced because of crop cover and presence of residues with increased soil moisture storage and water use efficiency. No serious pest and disease problems are observed due to inter/mixed cropping in areca plantations.

### 4. Arecanut + cocoa mixed cropping system

For optimum productivity of both arecanut and cocoa in mixed cropping system, ideal spacing and pruning regime are important to avoid competition. Combination of 2.7 m x 2.7 m for arecanut and 2.7 m x 5.4 m for cocoa is preferable over 2.7 m x 2.7 m for both the crops

in view of the operational advantages. Pruning regime of 16-20 $m^3$ canopy is recommended for grafts both from the yield point of view and agronomic advantage. Productivity increase by growing cocoa with arecanut is about 650-900 kg/ha. The net returns per rupee invested in arecanut+cocoa cropping system is 1.66-1.83.

### 5. Arecanut + banana intercropping system

Banana is usually grown as nurse or shade crop in arecanut plantations. Suitable banana cultivars for intercropping are Robusta, Mysore poovan, Red banana and Karpuravally. The variety Red banana gives maximum net returns without any adverse effect on yield of arecanut. Banana fetches interim revenue in the initial years, which will help the farmers in cash flows.

### 6. Arecanut + pepper intercropping system

Pepper is raised exclusively as mixed crop in homestead gardens in Kerala and Karnataka and over 90 % pepper is trained on coconut and arecanut trunks. Pepper is the most compatible perennial spice crop with arecanut and can be profitably grown. There is no detrimental effect on the yield of arecanut palms due to training black pepper on them. Further, it helps to augment the income of the farmer by mixed cropping of black pepper. The performance of pepper cultivars, Panniyur-1 and Karimunda are better. Karimunda gives maximum yield followed by Panniyur-1. The cultivars Uddakare and Malligesara are poor yielding ones in arecanut. On an average one kg of dry berries can be obtained from one vine which will be around 1300 kg/ha. Thus pepper is highly profitable crop when grown as mixed crop with arecanut.

### 7. Intercropping of medicinal and aromatic plants (MAP)

Medicinal and aromatic plants can be grown successfully in arecanut with higher net return per rupee investment. Shatavari (*Asparagus racemosus*), Vetiver (*Vetiver zizanoides*), Long pepper (*Piper longum*), Brahmi

(*Bacopa monnieri*), *Nilagirianthus ciliatus*, Periwinkle (*Catharanthus roseus*), Aloe (*Aloe vera or barbadensis*), Lemon grass (*Cymbopogon flexuous*), Palmarosa (*Cymbopogon martinii*), Basil (*Ocimum basilicum*), Davana (*Artemisia pallens*) and Patchouli (*Pogostemon cablin*) perform better as intercrops in arecanut. Senna (*Cassia anguistifolia*), Safed musli (*Chlorophytum borivillianum*), aswagandha (*Withania somnifera*) and geranium (*Pelargonium* sp.)do not come up well as intercrops in arecanut. These crops contribute to productivity increase of 11 - 53 % in arecanut. In terms of net profit per rupee investment, all the medicinal and aromatic plants are superior (1.95-4.25) and system productivity can be considerably enhanced with intercropping. It is advisable to grow variety of medicinal plants in small areas based on local demand and advice of State Medicinal Plants Board. As the market demand for aromatic plants is huge, it is advisable to grow them in large areas.


*Asparagus racemosus*


*Vetiveria zizanoides*

*Nilagirianthus ciliatus*

*Bacopa monnieri*

*Ocimum basilicum*

*Cymbopogon flexuous*

*Catharanthus roseus*

*Artemisia pallens*

*Cymbopogon martinii*

*Piper longum*

*Pogostemon cablin*

*Aloe vera*

**8. Intercropping of annuals/biennials/short statured perennials**

Crops like banana, ginger, chilli, colacasia, upland paddy, turmeric, elephant foot yam and Dioscorea are more adapted for intercropping in arecanut gardens. In low rainfall plain regions of Karnataka, Dioscorea and elephant foot yam are ideal intercrops in arecanut but yield decline of ginger and turmeric is noticed due to continuous cultivation. All the results suggest the need for crop rotation when exhaustive tuber and rhizome crops are intercropped. Turmeric and sweet potato perform better with higher yield levels at 60% population intensity than at 40% intensity without affecting arecanut yields. In majority of the studies in different regions, no deleterious effect of intercropping on arecanut is noticed. In plains of Karnataka, yield increase of 37% is reported in arecanut due to intercropping with cinnamon. Further the authors reported that intercropping of four varieties of coffee (arabica S-6, arabica S-1936, San Ramon and robusta) have shown similar effects on yield of arecanut.

**9. Intercropping of vegetables, flower crops and turmeric**

Among vegetables intercropped in arecanut in Assam, the net return per rupee investment on labours is maximum for brinjal followed by cabbage and radish. The pooled data indicated that economic efficiency (per day return basis) is highest in cabbage followed by cauliflower and radish. Net return per rupee investment varies from 4.61 to 6.25 in flower crops like gladiolus, chrysanthemum and marigold and the economic efficiency is highest for gladiolus followed by chrysanthemum. Better labour utilization and economic efficiency is possible by growing vegetables like brinjal, cabbage, cauliflower and radish and flower crops like marigold and chrysanthemum under young areca plantation in view of the market demand. Medicinal and aromatic crops like

patchouli, long pepper and vanilla can be grown successfully in arecanut garden under Assam conditions.

In sub Himalayan West Bengal, screening of summer and winter vegetables as intercrops in arecanut plantation indicated that spinach yields (20 tonnes/ha) better registering maximum benefit cost ratio of 1.39 than other leafy vegetables amaranthus and mustard in winter. Spinach can also be taken as ratoon crop with a total of 4-5 cuts. Among the root crops, maximum yield (65 tonnes/ha) is registered in radish followed by turnip and carrot with benefit cost ratio of 2.33 (radish), 2.09 (turnip) and 1.64 (carrot). Among cole crops, maximum yield is recorded in cabbage (43.7 tonnes/ha) with a benefit cost ratio of 3.44. Solanaceous vegetables like tomato, brinjal, chilli and capsicum can be grown successfully with benefit cost ratio of more than one. Among leguminous vegetable crops, maximum benefit cost ratio is noticed in dolichos bean (1.39) followed by french bean (1.08). Powdery mildew problem is observed in french bean and cowpea.

During the summer season, different gourds like pumpkin (Rs. 65,480/ha), ash gourd (Rs. 27,225/ha), bottle gourd (Rs. 25,962/ha) and snake gourd (Rs. 24,850/ha) are ideal for intercropping in arecanut due to higher cash outflows and benefit cost ratios (1.17- 2.39, 1.59, and 1.53). When intercrop and sole crop yields are compared on unit area basis, vegetables like spinach, mustard and snake gourd are better yielders in arecanut garden than in the open condition. The yields of vegetables like, basella, cauliflower and knol khol are similar in both the conditions. Though the performance of flower crops like gladiolus, aster, halychrysum, calendula, anthurium, French and African marigolds, sunflower and salvia is not as good as in open condition, the positive BCR of all the crops indicated that cultivation of these crops is profitable in arecanut garden. Cultivation of pine apple and turmeric in the inter space of arecanut is profitable but not arrowroot in irrigated and un-irrigated conditions in sub Himalayan Terai region of West Bengal.

**10. Arecanut based High Density Multispecies Cropping System**

It is a system where more than two crops are grown simultaneously with main crop. Arecanut based high density cropping systems

having component crops like cocoa, pepper and banana is self-sustainable and application of N and P through inorganic fertilizers could be reduced or skipped when the recyclable wastes from the system are recycled as vermicompost. The system improved the soil physico-chemical and biological properties of the soil which enhanced the productivity from unit area of land. But the system proved exhaustive with respect to K availability. The exhaustion of K indicates the necessity of including K in the fertilizer schedule of the system. The increase in productivity from growing of pepper+cocoa+banana with arecanut is about 2250 kg/ha. The net returns per rupee invested in this system is 4.5 which indicates the economic advantage of cropping system in arecanut.

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