

## Integrated coconut farming system for stable income

Coconut gardens offer excellent opportunities to exploit the interspace potential for maximizing return per unit area. Coconut-based cropping/farming systems involving cultivation of compatible crops in interspaces of coconut and integration with other enterprises like dairying offer considerable scope for increasing production and productivity per unit area, time and inputs by more efficient utilization of resources like sunlight, soil, water and labour. In humid tropics, higher efficiency of utilization of the basic resources of crop production, land, solar radiation and water can be achieved by adopting intensive cropping systems. Cropping/farming system aims at crop diversification and intensive cropping in the interspace available in coconut to increase the per palm productivity as well as productivity of unit holding in a system approach wherein the available farm resources like soil and water/rainfall resource, farm labour, agricultural inputs (seeds, fertilizers, agro-chemicals) etc. are utilized to produce both nuts, food and non-food agricultural products from the farm, in a business or profitable way. Under such a cropping/farming system, all the management practices and component production systems should be able to maintain high productivity, profitability and sustainability of existing coconut palms to maximize economic yield of the farm. Sustainability is the main objective of farming system, where production process is optimized through efficient utilization of the inputs in safeguarding the environment.

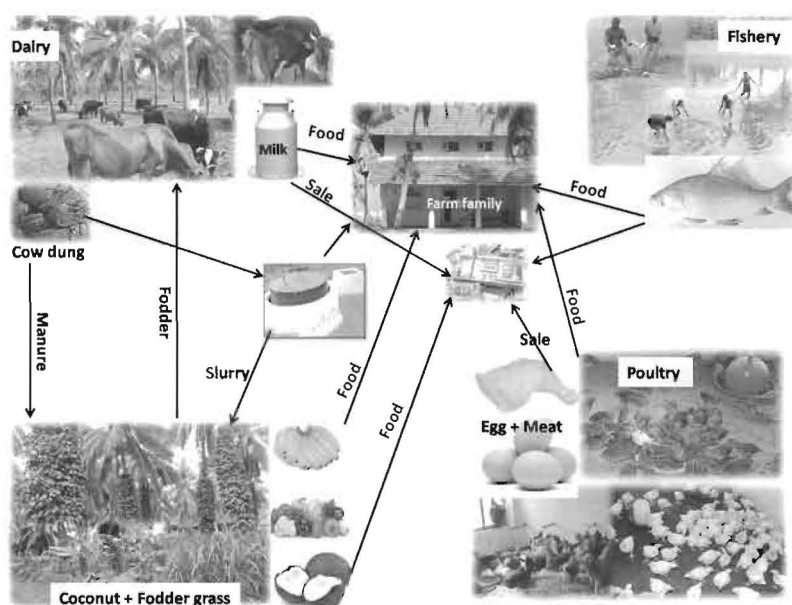
IN India, 98% of the coconut holdings are lesser than 2.0 ha in size and more than 90% of them are lesser than 1.0 ha and these small holdings are mainly committed to a monocrop of coconut, which normally occupies the land for about a century. Most of these holdings neither provide gainful employment opportunities for family labour throughout the year nor generate sufficient income to meet the family requirement. In present condition where coconut growers are more exposed to economic risks and uncertainties owing to high price fluctuations, it is the need of the hour to emphasize the importance of crop diversification in coconut gardens.

### COCONUT-BASED CROPPING

The planting method and growth

habit of sole coconut palms spaced at  $7.5 \times 7.5$  m use only 22.3% of land area effectively, while average air space utilization by canopy is about 30% and solar radiation interception is 45-50%. However, effective root zone of the adult palm is confined laterally within a radius of 2 m around the base of the palm and over

95% of the roots are found in the top 0-120 cm, of which 18.9 and 63% of roots are confined to top 0-30 cm and 31-90 cm depth, respectively. Making use of the underutilized soil space and solar radiation in pure stands, a variety of crops having different stature, canopy shape and size and rooting habit can be inter planted to form compatible combinations. Such intercropped plantations will



Interaction of different components in coconut-based farming system



Cocoa as intercrop in coconut garden

intercept and utilize light at different storey's and forage soil at different strata maximizing biomass production per unit area of land, time and inputs.

### Coconut Growth and Development

**Planting (5-8 years):** A major portion of the solar energy is not being intercepted by coconut leaves, good transmission initially, as the palm canopy develops with age, the percentage of utilization increases progressively during the pre-bearing period, with a corresponding decrease in transmission of light. The suitable crops are cereals, grain legumes, vegetables, spice crops, flower crops, fruit crops like banana, pineapple etc.

**Young palms (8-25 years):** Maximum ground coverage and low canopy – moderate to poor light availability – not congenial for multiple cropping. The suitable intercrops are black pepper, chillies, beverage crops like cocoa, coffee, flower crops, fruit crops like rambutan, mangosteen, citrus etc.

**Adult palms (more than 25 years):** Increase in trunk height; reduction in crown size - light transmission increasing with age (high light levels) - the amount of slant rays of sun falling on the ground increases and consequently, the apparent coverage of ground by the canopy of coconut decreases progressively. Ideal for raising annual and/or perennial crops as multiple and multi-storied cropping models.

### Productivity in Littoral Sandy Soil

These soils constitute a major portion in coconut-growing regions. The fodder grass (96 tonnes/ha/year), vegetable crops (cowpea(6 tonnes/ha), ridge gourd(9 tonnes/ha), snake gourd (8 tonnes/ha), pumpkin (10.12 tonnes/ha) and ash gourd (9.2 tonnes/ha)), tuber crops (elephant foot yam (20 tonnes/ha)) and fruit crops (banana and pineapple (15 tonnes/ha)) could be successfully grown as intercrops in coconut gardens under coastal sandy soil. The pre-treatment yield of



Coconut-based HDMCS (Kasaragod)



Coconut + Pineapple (Kasaragod)

coconut was 40 nuts/palm/year which increased to 120 nuts/palm under coconut + vegetable intercropping system, followed by coconut + pineapple (107 nuts/palm), coconut + fodder grass (102 nuts/palm) and monocropping (98 nuts/palm). The economic analysis performed for different coconut-based intercropping system under coastal sandy soil indicates that all cropping systems had realized higher net returns as compared to monocrop. The net returns had ranged from ₹45,771/ha/year in coconut monocrop to ₹1,03,010/ha/year in coconut + pineapple intercropping system.

**Coconut-based High-density Multispecies Cropping System (HDMSCS)**

The HDMSCS is growing of number of compatible crops in a unit area to meet the diverse needs of a farmer such as food, fuel, timber, fodder and cash. This system aims at maximizing production per unit of land area and is ideally suited for smaller holdings. The sustainability of

production is well-addressed in this system through efficient utilization of natural resources and biomass recycling.

**Productivity in HDMSCS:** The productivity of land increases in high-density multispecies cropping system due to crop diversification and intensification. HDMSCS at Kasaragod with coconut+black pepper+nutmeg+banana+pineapple+annual crops like ginger, turmeric has resulted in higher system productivity and income. Nut yield of coconut under different nutrient management system is 177-188 nuts/palm/year compared to pre-experimental yield (2005-07) of 142-152 nuts/palm/year. The net return (fully organic with recycling biomass



Coconut + Vegetables (Kasaragod)

(vermicompost) + biofertiliser + green manuring + vermiwash + husk burial + mulching) is (₹3,54,500/year), followed by other nutrient management treatments (₹3,30,000/ha).

At Aliyarnagar Centre, cropping system of coconut + cocoa + banana + pineapple with integrated nutrient management of 75% of recommended NPK coupled with organic recycling with



Coconut-based Cropping System model at Arsikere

vermicompost recorded higher net income of ₹3.77 lakh/ha, followed by fully organic treatment (₹3.46 lakh/ha), whereas monocrop of coconut recorded the lowest net income (₹1.24 lakh/ha). At Arsikere (Karnataka) Centre, the cropping system of coconut + cocoa + lime + drumstick recorded higher net returns under fully organic nutrient management (₹2.95 lakhs/ha) followed by 50% of recommended NPK + organic recycling with vermicompost + vermiwash application + biofertilizer application and *in situ* green manuring (₹2,84,410/ha) whereas monocrop recorded the lowest net income (₹1,104,410/ha).

### Coconut-based Integrated Farming System

The sustainability and profitability of coconut based farming system comprising coconut, black pepper trailed on the coconut trunk, banana in the border of the plots, fodder grass (Hybrid Bajra Napier Co 3) in the interspaces of coconut, dairy unit (7 cows of Holstein Friesian and one Jersey

cross breed), poultry (100 broiler birds/batch), Japanese quails (100 layers) and aquaculture (1,000 fingerlings) are assessed in a coconut stand of 40 years old maintained in the soil type *Arenic paleustult* of ICAR-CPCRI, Kasaragod. The coconut palms maintained under CBIFS receiving integrated nutrient management practices, i.e. organic recycling and 50% of the recommended chemical fertilizer recorded higher yield (140 nuts/palm) which was comparable with other nutrient management treatments and also higher than coconut monocropping (114 nuts/palm). The integrated farming system improved the soil fertility, physical

properties of soil, viz. bulk density, water holding capacity and hydraulic conductivity which are required for sustainability of the system. Hybrid Bajra Napier CO 3 and Co 4 as intercrop in coconut resulted in average yield of 117 tonnes and 114 tonnes green fodder/ha/year, respectively. Such a coconut based farming system resulted in the net returns of ₹5,17,900/ha during



Coconut + Banana (Kasaragod)



Dairy animals in the mixed cropping system

the year 2014-15, which indicates the profitability of the system.

**Coconut-based farming systems:** The practice of CBFS can provide:

- Food security through food sufficiency;
- Nutritional foods rich in vitamins and minerals (nutrients);
- Employment generation from farm diversification; and
- Ecological stability (environmental protection).

Social benefits are the food and nutritional functions of fresh nuts of coconut and coconut products, and crops produced under CBCS, which includes; 1) cereals (as source of carbohydrates, protein, fats and oils); 2) root crops (as source of carbohydrates and minerals); legumes (as source of protein and vegetable fats and oils); 4) fruit crops (as rich source of vitamins and minerals, and carbohydrates); 5) leafy and fruit vegetables (as rich source of vitamins, minerals and dietary



Fodder grass in coconut garden

fibres); 6) spice crops (food flavouring, and vitamins and minerals); 7) coffee and cocoa (beverage and stimulants); 8) natural fibre crops (clothing materials and paper and packaging); 9) wood and timber (housing materials, pulp and paper).

#### SUMMARY

This system maximizes production per unit area and is ideally suited for

smaller holdings. It ensures food, nutritional security, gainful employment for farm families besides environmental protection. The sustainability of production is well addressed in this system through efficient utilization of natural resources and biomass recycling.

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