POINTERS IN PRACTICAL COCONUT-BASED FARMING SYSTEMS (CBFS)

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1. What is CBFS?

A system or practice in coconut production in which the available farm resources like soil and water/rainfall resource, farm labor, agricultural inputs (seeds, fertilizers, agro-chemicals) are utilized to produce both nuts, food and non-food agricultural products from the farm, in a business or profitable way. In CBFS, all management practices and component production systems should be able to maintain the high productivity, profitability and sustainability of the existing stands of the coconut crop to maximize the economic yield of the farm. Many consider CBFS a form or kind of integrating economic activities in the farm, thus in short term coconut integrated farming system (CIFS).

The component production systems could be a combination of one or more systems:

a) Intercropping (short season crops, long-term crops) and Multistorey or mix cropping
b) Livestock raising (cattle, goat, swine, poultry, game birds, etc.), either by grazing or housed
c) Underplanting of coconut (for ubod production)
d) Nursery farm of planting materials (fruit trees, other high value crops and horticultural/ ornamental plants)
e) Aquatic farming (fresh water fish, salt water fish) or Aquaculture

2. MONOCROPPING VS. INTERCROPPING

A hectare of coconut with 100 to 150 trees under average management producing annually 60-90 nuts per tree, (7,000 nuts or 1,750 kg copra) only generates only P21,000 gross income (@ P12/kg copra) or about a net profit of P15,000 (less P6,000/hectare production cost).

While, with integrated farming systems, the utilization of the coconut land and farm labor could be maximized to yield the maximum economic benefit (as high as P100,000/hectare/year).

However, a combination of conditions should be met:

- Suitable environmental conditions (favorable soil and climate)
- Right technology (package of viable technologies)
- Available planting materials
- Right attitude of farmers (hardwork)
- Favorable market of farm produce
- Available working capital (credit resource)
- Timely Extension Service

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3. SCOPE OF INTERCROPPING

Considerable scope exists for intercropping in coconut lands, and this could be attributed largely to several ecological, agronomic and socio-economic considerations.

3.1 Ecological Considerations

1) Land Utilization. The morphological features of the coconut canopy necessitates its planting at a wide spacing. It is an established facts that the active roots of an adult coconut palm are concentrated laterally within a radius of 2 m from the base and vertically between 0.3 to 1.2 m from the surface of soil. Thus, in a pure stand of coconuts only about 25% of the soil mass is actually utilized by the coconut. A proper utilization of the remaining 75% of coconut land could be achieved by the practice of intercropping or farm diversification.

2) Solar energy utilization. Due to large interspaces between palms, a considerable amount of sunlight reaches the ground. It has been reported that a mature coconut palm during the 6 hour peak bright period of the day (10.00 AM - 3:00 PM), actually intercepts only 44% of the total solar radiation. The remaining 56% of the solar radiation could be properly utilized by the canopies of different intercrops. The amount of sunlight available for intercrops varies with the age of the tall palms. Solar radiation is not fully intercepted by the coconut fronds at early stages and after 25 years of ago. Therefore, intercrops can possibly utilize the available sunlight effectively up to about 5 years and in a mature plantation beyond the age of 25 years.

3) Utilization of soil moisture and nutrients. About 74% of the roots of coconut palm do not extend beyond distance of 2 m from the base and also on a depth basis 86% of the roots are concentrated between 30-120 cm. depth from the surface. It has also been reported that there is a moisture gradient from the base of the palm towards the center of the coconut square. A similar trend can be expected in the distribution of nutrients, and moisture. A high efficiency in the use of available soil moisture and nutrients can be achieved by growing intercrops outside a 2 m radius around the base of the palm.

3.2 Agronomic desirabilities

1) Better retention of water. Because of the shade under coconut stand, evaporative demand is very much reduced and intercropping allows a better retention of water in the soil for a longer period.

2) Improvement of soil fertility. There is a gradual build up of organic matter in the soil by the addition of leaf litter, pruned material and by in corporation of post harvest crop residues of intercrops. Beneficial effects of coconut/cacao system have demonstrated. These beneficial effects are due to the increased activity of useful microbeds such as phosphate solubilizers and nitrogen fixers, probably due to the favorable eco-climate and the addition of leaf litter from cacao.

3) Check soil erosion. In high rainfall areas, particularly in the Wet Zone intercropping can be useful to check soil erosion in sloping coconut lands. A large proportion of intercropped coconut holdings (about 60%) had sloping to undulating lands.

4) Better control of weeds. Intercropping gives a better control of weeds in the interspaces of coconut lands, by replacing them with economically useful crops which ultimately minimises costly intercultivation operations.

5) Coconut as a shade tree. Tall coconut palm often serves on a economic shade tree, particularly for shade loving crops such as coffee, cacao, black pepper, ginger and fruit trees.

3.3 Socio-economic considerations

1) Provision of additional income. The long unproductive period (5-7 years) of the coconut palm makes intercropping more attractive as an alternate source of income from young coconut plantations. Intercropping also leads to a higher cash return than from a pure stand of coconut. The additional income from intercrops lightning is particularly useful when there is a loss in coconut yields due to natural causes like drought, etc.

2) Increased employment prospects. Labor inputs required for maintaining a coconut crop are generally low. Intercropping can generate employment prospects by increasing the labor use for a greater part of the year. For example, with intercropping the use of labor can be increased to 350 mandays/hectare/year compared with 60-90 mandays in a pure stand of coconut.

3) Guard against market risks. The variety of crops produced by intercropping can ensure at least a partial guarantee against market risks and price fluctuations of the coconut crop.

4. RECOMMENDED INTERCROPS UNDER THE THREE PHASES OR STAGES OF THE LIFE-SPAN OF COCONUT

In open-fields, the full sunlight intensity is around 6,600 ft-candles (300-330 photosynthetic active radiation or PAR). But in coconut stands (under the tree), it ranges from 1,100-2,500 ft-candles (50-119 PAR), depending on the age and spacing of the trees.

Table 1. Growth Duration and productivity periods, levels of sunlight transmission and suitable intercrops.

Phase (Stage)	Duration	Level of available sunlight/ highly suitable intercrops
I	Field-planting to 6 years	High to Moderate/Highly Suitable Intercrops: Cereals - corn, upland rice Legumes - cowpea, peanut, mungbean, sitao, beans Root crops - sweet potato, gabi Fruit crops - pineapple, citrus, watermelon, papaya, banana Vegetables - tomato, cabbage, eggplant, sweet pepper, hot pepper, okra
II	7-25 years[1]	Moderate to Low/Highly Suitable Crops: Black pepper, cacao, coffee, tomato, vanilla, ginger, lanzones, rambutan, durian, mangosteen, gmelina tree (for wood and lumber)
III	26-60 years	High/Highly Suitable Crops[2]: Cereals - corn, upland rice Legumes - peanut, mungbean, cowpea, beans Vegetables - tomato, eggplant, cabbage, sweet pepper, hot pepper, okra, ginger Root crops - sweet potato, gabi, cassava, ubi Beverage crops - coffee, cacao Fruit crops - lanzones, rambutan, durian, mangosteen, citrus (pomelo, calamansi) Wood and Lumber tree - gmelina Fiber crops - ramie, abaca

[1] Except tomato, usually the suitable crops indicated requires lower sunlight or moderate shade during the pre-bearing stage of the crops, thus field-establishment best done during this stage.

[2] Should more sunlight transmission to intercrops needed for normal growth and high yields, coconut leaf pruning (CLP) technique (removal of older lower leaves of the crown, maintaining the upper 20-23 leaves); allowing 0.5 meter of cut frond attached to the trunk.

5. ORIENTATION IN GROWING INTERCROPS IN TYPICAL STANDS

For efficiency, cost and time effectiveness in CBFS, operations and other farming activities, it is desirable to follow a systematic planting of intercrops as indicated in Figure 1 and 2.

Figure 1. Growing of Other Crops in Coconuts with Square Planting System (8-10 mm)

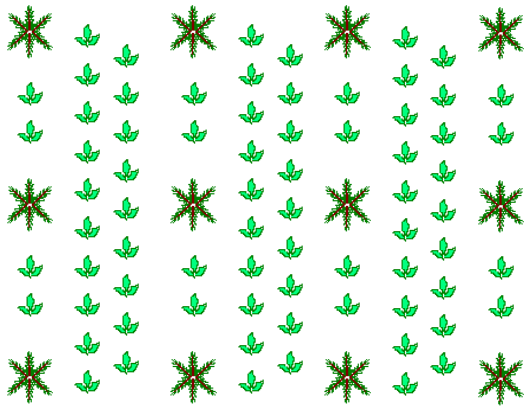
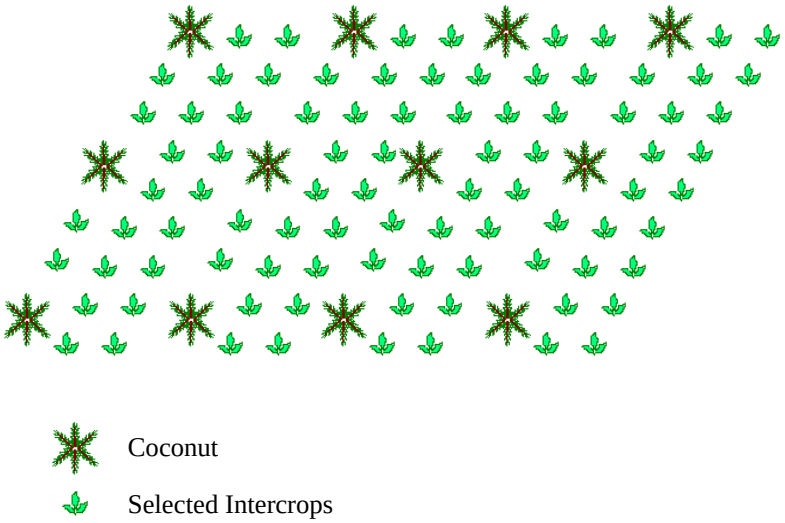


Figure 2. Growing of Intercrops in Coconuts with Triangular Planting Systems (8-10 m)



6. PROJECTED PRODUCTION YIELD, TOTAL COST AND NET INCOME OF SELECTED INTERCROPS OF COCONUT

Table 2. Estimated Annual Yield (t/ha), Total Cost and Net Income (P/ha) of Selected Intercrops

Intercrop	Estimated Yield * (t/ha)	Estimated Cost ** (P/ha)	Estimated Income (P/ha)
Vegetables/Legumes			
Pole Sitao (sitaw)	2-6	20,000	30,000
Cabbage (repolyo)	20-22	27,000	95,000
Mungbean (mungo)	0.2-0.6	20,000	20,000
Okra (okra)	2-4	17,000	25,000
Bust Sitao (sitaw baba)	2-6	25,000	30,000
Cowpea (paayap)	2.5-3.5	25,000	30,000
Onion (sibuyas)	15-18	30,000	90,000
Peanut (mani)	1.0-2.5	20,000	35,000
Musk Melon (melon)	12-15	13,000	70,000
Tomato (kamatis)	15-30	20,000	50,000
Squash (kalabasa)	15-18	15,000	100,000
Eggplant (talong)	7-9	20,000	50,000
Bitter gourd (ampalaya/amargoso)	12-15	65,000	25,000
Spice Crops			
Hot Chili (sili-labuyo)	2-4	20,000	65,000
Sweet Pepper (sili)	20-30	25,000	150,000
Black Pepper (paminta)	0.40-0.85	15,000	25,000
Cereals			
Corn (mais)	3-4	15,000	20,000
Upland Rice (palay tigang)	1.2.1.5	15,000	20,000
Root Crops			
Sweet Potato (kamote)	6-8	15,000	35,000
Gabi (gabi)	10-35	15,000	75,000
Cassava (kamoteng kahoy)	15-20	15,000	60,000
Ubi (ubi)	12-15	15,000	65,000
Arrowroot (arorot)	8-11	12,000	35,000
Ginger (luya)	6.5	20,000	40,000
Fruitcrop/Fruit Trees			
Banana (saging saba)	37.5	6,800	85,000
Durian[1] (duriyan)	19.5[3] (9,750 fruits)	36,800	819,800
Lanzones (lansones)	2.5-4.0	15,000	100,000
Pineapple (pinya)	20-30	50,000	80,000
Rambutan (rambutan)	2.5-4.0	12,000	75,000
Citrus (Mandarin, Pomelo, Calamansi)	15-20	15,000	125,000
Beverage Crops			
Coffee	0.9-1.2 (dry beans)	18,000	75,000
Cacao	0.7-1.5 (dry beans)	30,000	55,000

Reference: Various Sources

[1] P61,540 Year 1 [2] P30/fruit [3] 7-10 years fruit trees

* 1 ton = 1,000 kg

** excludes overhead expenses (land charge, interest on capital)

7. MIXED CROPPING OR MULTISTOREY CROPPING

A cropping system of several intercrops together in same coconut land. Mixed cropping models are combination of crops of different heights and having different types of root systems within the coconut soil environment. These cropping systems are usually successful in the deep soils of wet and intermediate zones where soil moisture from rainfall is adequate, hence competition for plant food (from the soil) and water is minimized or nil.

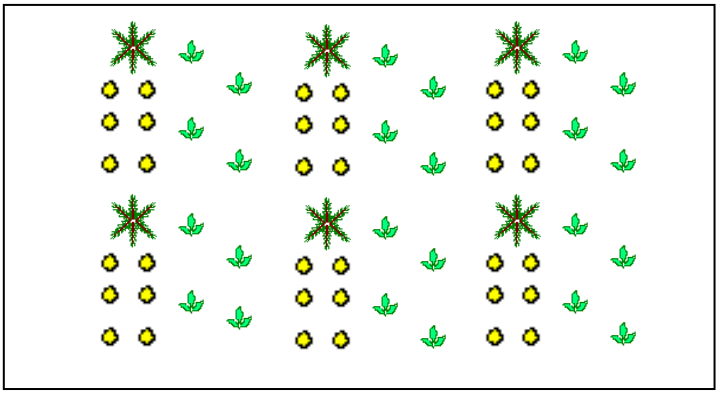
As mixed cropping requires more labor and capital for farm inputs (seed, fertilizer and agro-chemicals), proper selection of site, and crop mix based on agronomic considerations and marketability of crops, adequate planning is a must.

Examples of successful mixed cropping systems are as follows:

1) Coconut + Papaya + Pineapple
2) Coconut + Coffee + Papaya + Pineapple
3) Coconut + Coffee + Blackpepper
4) Coconut + Cacao + Blackpepper + Pineapple
5) Coconut + Banana + Coffee
6) Coconut + Banana + Black Pepper
7) Coconut + Lanzones + Banana
8) Coconut + Lanzones + Pineapple
9) Coconut + Durian + Pineapple
10) Coconut + Durian + Banana

Samples of Field Arrangement of Mixed Cropping Models are presented as follows:

Model 1



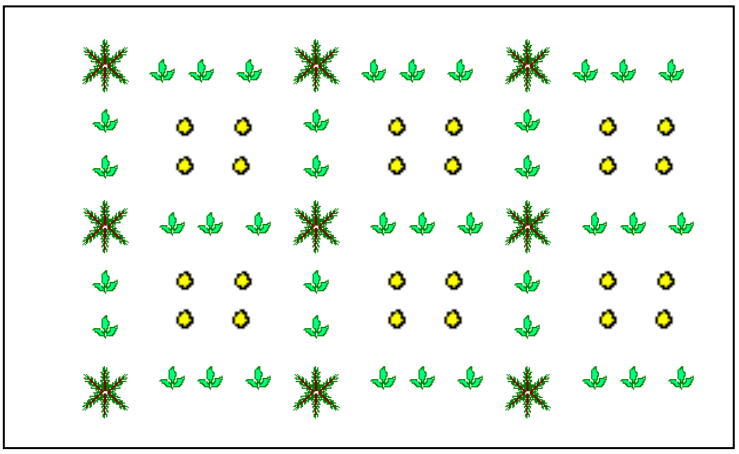
Coconut (preferably 9-10 m spacing)

Papaya/Coffee/Cacao (Select one)

Pineapple/Blackpepper (Select one)

Important: Intercrops planted not closer than 2 meters to the coconuts

Model 2



Coconut (preferably 9-10 m spacing)

Banana

Fruit Tree (Lanzones)/coffee (Select one)

Important: Intercrops planted not closer than 2 meters to the coconuts

8. LIVESTOCK RAISING UNDER COCONUT (PCARRD, 1997)

Animals as cattle and carabao, small ruminants as goat, pig, and poultry and game birds can be raised under mature stands of coconut, singly or in combination. There are several advantages:

1) helps increase family income
2) helps regulate grasses through grazing
3) increases soil fertility through animal manure and urine (one native cow produces 4,200 kg manure and 100 kg urine each year, generating natural or organic fertilizer nutrients: 21 kg N, 17 kg P_2O_5 and 17 kg K_2O, by each cow.
4) coconuts by products, crop residues and forage crops under coconut could supply the required livestock feeds.

For cattle raising, 1-2 animal units per hectare is recommended, but for cut and carry or feed lot system, more animals per hectare is suitable provided adequate pasture grasses and legumes are available year-round.

In case of goat and/or sheep production system, these should be only raised in areas without intercrops. Not more than 12 adult small ruminants per hectare is recommended. Also, the dung and urine of these could serve as cheap source of fertilizer to increase coconut yield. At least P30,000 for 12 animal units, covering an animal shed, fencing, animal cost and working capital is needed.

9. AN ANALYSIS OF THE POTENTIAL FARM PRODUCTIVITY SCENARIO AND INCOME TARGETS IN CBFS

To understand the viability and sustainability of the CBFS, it should be necessary for the farmer to integrate all the component enterprises in his farm. Of course, this should include the coconut production system.

We must be guided by two rational basic equations, as follows:

Equation 1

Maximum Economic Productivity (MEP) = Coconut Yield + Intercrop Yields
(Yield per unit of coconut land, tons/ha) (Intercrops # 1, 2, 3, etc.)

Equation 2

Maximum Economic Benefit (MEB) = Total Net Incomes
(Value of products, net income/ha) (all enterprises: coconut, intercrops, livestock,etc.)

By indicating all the CBFS component enterprises (crop yield, total operating cost: labor and materials, and overhead cost as land charge, interest of capital (if needed), gross income and net income of each component, the summary of the planned or opted enterprise mix is generated. An example is presented:

Table 3. An example of CBFS production system projected scenario/outcome

Index	PRODUCTION COMPONENT (under best technologies)					TOTAL
	Coconut	Intercrop(s)		Livestock		
	(fertilized)	Banana	Pineapple	Cattle	Goat	
Yield (t/ha)	2.50	35	25	2 units	12 units	
Total Operating Cost (P/ha)	8,500	7,000	50,000	10,000	15,000	90,500
Gross Income (P/ha)	30,000	95,000	130,000	40,000	35,000	330,000
Net Income (P/ha)	21,500	88,000	80,000	30,000	20,000	239,500
ROI (%)	252	1,257	160	300	133	2.64
BCR	2.52	12.57	1.60	3.00	1.33	2.65

The table shows the improvement in the productivity and profitability of each component enterprise and total net income with the increase in farm investment of P90,500/ha, generating net benefit of P239,500. The ROI of 264% and BCR of 2.65 indicates soundness, attractiveness and economic viability of the example CBFS.

However, a serious reminder to farmers: Should a coconut farmer decides to go for integrated farming system (combination of coconut intercrops + livestock, etc.), this requires proper and timely planning, higher operating capital, quality managerial skill and maximum days in the field. However, fruits of hardwork is very gratifying through substantial added income.

Finally, if farmers could not be "business integrators", as a combined producer, processor and marketer (of coconut and high value products) who usually get the highest monetary benefit from the coconut business, probably the only remaining option for him to stay as an active player in the industry is to practice CBFS --- to gain the most from his coconut land and achieve a better quality-of-life. A dedicated and hardworking farmer should not be deprived of the opportunity in making the best of his farm resources, but certainly, an adequate operating capital at affordable interest rates is a must. Would the other sectors of the industry, financial institutions or the government willing and capable of assisting the resource-limited farmers?

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