Enhancement of Economic Benefits from Selected Coconut-based Farming Systems (CBFS) Practices and Technologies

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ABSTRACT

Selected coconut cropping systems and primary product diversification schemes are reviewed. Of the coconut + intercrop(s) farming systems, some systems are capable of generating average annual net incomes of PHP85,000 (US$1745.4) to PHP132,400 (US$2,719) per ha, with banana, coffee intercrops and multi-storey [coconut+ papaya, pineapple and peanut (groundnut)], in 3-4 years cropping cycle, respectively. Other farming systems techniques as the SCTN and under-planting of young coconuts for edible pith ('ubod'), generates net incomes 3-5 times higher that the traditional nut production alone (monocropping) or an ROI of 180 – 200%.

Keywords: coconut intercropping, coconut production schemes, coconut sap, toddy, edible coconut pith.

INTRODUCTION

Growing of intercrops in coconut lands produces more food and agricultural products and commodities, providing food security for the people in both the rural and urban areas. At the same time, the practice generates jobs and livelihood, likewise enhancing farm income and purchasing power of the citizens, hence, alleviating poverty in farming communities.

An example of a working definition of CBFS was presented by Magat (1999), as: “a system or practice in coconut production in which the available farm resources like coconut trees, soil and water/rainfall, farm labor, agricultural inputs (seeds, livestock, fertilizers and other agro-chemicals), and farm tools are utilized to produce nuts, food and non-food agricultural produce from the farm, in a productive and profitable way”. In any CBFS, integrated crop management (ICM) of the main crop and intercrops should be followed to achieve optimum productivity, profitability and sustainability of coconut stands to maximize the total productivity and economic benefits of the farm. As very limited studies on CBFS involving livestock and/or fish farming in coconut production have been done in the country, most of the CBFS mentioned in this presentation are for coconut-based cropping systems (CBCS), meaning, that of coconut + intercrop(s).

Among many others concerns, this paper aims to provide relevant research and development findings in the country which focus on increasing the land and/or coconut crop productivity, and social and economic benefits from coconut farming and intercropping practices.

A. Coconut Intercropping Practices

1. Coconut + Corn (Maize) intercropping

Corn (maize) an annual or short-season cereal crop is commonly planted under/between land spaces of coconut palms. To be productive and profitable, the crop is best planted at least 2 m away from the base of coconut trees. Moreover, there is a scarce land resource for planting corn as a
monocrop, coconut lands offer a practical opportunity as the interspaces between rows of coconut can accommodate about 6 -9 rows of corn plants, depending on the spacing of coconut planting. Coconuts in the Philippines are planted between 8 – 10 m in square, triangular or rectangular arrangements. The double-rows close planting of 5 m between trees and spaced wider ( 10 -15 m) between the double rows which allows 220 – 280 palms and 0.35 – 47 ha for intercrops in not yet a common practice in the country (Magat 2004).

**Socio-Economic Benefits:**

Corn crop is either harvested at the “green” or mature stages, depending on the local demand. Corn remains a staple cereal food (30%) in many regions in the country. The remaining 70% is processed mainly as component of swine and poultry feeds. Corn constitutes at least 60% of commercial feed ingredients and contributes about 70% of cost in raising hogs and chicken (DOST-PCARRD). It is also a major material in the manufacture of starch, gluten and ethanol.

Under the coconut + corn cropping, with the achievable yield of coconut of 2 tons copra (8,000 nuts/ha) and 5 tons of corn grains (2 croppings/yr), the annual total investment of PHP22,050 (US$452.7) could generate a net income of about PHP42,950 (US$881.9), and a benefit-cost ratio (BCR) of 2:1 (Magat 2004).

**2. Coconut + Banana intercropping**

Despite a low annual investment level [i.e., PHP 8,000 (164US$) to 11,000 (225US$)] per ha for the ‘Saba’ or cooking banana variety), benefits derived at different levels (farm, community and countrywide) from the coconut-based banana cropping provides substantial advantages, creating immense impact on the social, ecological and economic dimensions. Meaning, the productive and sustainable of this CBFS commonly results in multi-functions/ services. It is an extensively grown fruit in the country, usually grown as a component of different farming systems or as a main crop (under open-field) in big contract farms and commercial plantations in Southern Mindanao, Philippines.

**Socio-Economic Benefits**

Among the key benefits of the coconut + banana cropping system are as follows:

1) Banana can be intercropped with coconut palms as young as 1 -3 year-old and when these palms reached 25 years (and beyond). Generally, banana and coconut crops do not compete for soil resources, except in dry zones;

2) Banana is a fast-growing fruit crop that starts fruiting in 8 – 12 months from field-planting. There is a year-round stable demand ( and still growing) locally and globally for different varieties ( table and cooking banana) for various uses as fresh fruit, chips, catsup, puree, flour, among many others.

3) The banana fruit is high in carbohydrates, minerals potassium, calcium, vitamin C, vitamin B6 (pyridoxine). B6 is essential for maintaining healthy skin and nerves, in the formation of red blood cells, in providing general resistance, and stops the human premature aging;

4) From the coconut trees, a multitude of products can be derived from the basic harvest, the nuts (kernel/ meat, coconut milk, coconut oil, coconut water or juice) and from the coconut sap (fresh sap, natural vinegar, coconut nectar/honey/syrup and natural sap sugar); non-food raw materials for various high value and/or environment and consumer-friendly products (husked-based and shell-based), among many others.
For a 5-year cropping period, the average annual direct investment cost of PHP18,000 per ha generates a total net income of PHP434,000 (US$8911.7)/ha. The BCR increases from year 1 to 5, meaning: at year 1 = 1; year 2 = 4.0; year 3 = 5.7; year 5 = 7.1 (Magat 2004)

3. Coconut Multi-storey cropping (coconut+ papaya+ pineapple+ peanut)

A large portion of the area under coconut, representing over 20% of the available arable land in most coconut-producing countries may be used more productively and profitably with either a single selected intercrop or several intercrops in a multi-storey cropping system, arranged based on a logical and practical manner. With coconut as the tallest crop in this CBFS practice, the selected intercrops are planned in the same piece of land considering the full heights and canopy expanse of each intercrop in achieving productivity and profitability during the long-term cropping period.

An example multi-storey CBFS intercropping is represented by the coconut + papaya + pineapple + peanut cropping system (Figure 1). Papaya and pineapple crops are two of the most common popular food and cash crops for the local and export markets. On the other hand, grain legume peanut is included in the system, preferably during the dry cropping season. In this system, land is prepared for pineapple planting (30 cm x 100 cm or closer) along rows of coconut. Papaya seedlings are next planted at 3m x 3m with 2 rows in between rows of coconuts. During the first year, the annual legume peanut maybe planted in between rows of papaya (6 rows of peanut at 50 cm apart. Papaya is harvested a year after, until the third year. On the second year, pineapple can be harvested and allowed to ratoon until the third year. Coconut harvesting for mature nuts is done an interval of 45 -60 days.

![Figure 1. Field arrangement of mixed cropping model for coconut+pineapple +papaya +peanut cropping system](image-url)
Should more sunlight transmission to intercrops is needed for normal growth and high yield, the coconut leaf pruning technique (CLP) had been developed in the country by PCA researchers. This is done through the removal of older and lower leaves of the tree crown, maintaining the upper 19 -23 leaves, allowing at least 0.50 m of cut frond still undetached from the trunk (Magat 1999).

**Socio-Economic Benefits:**

Aside from the nuts of coconut harvested for various uses, the produce from the intercrops serve diverse food uses. Their nutritive value and health benefits are well known.

1. Papaya is an excellent source of vitamins A, B and C, together with small amounts of calcium (Ca), iron (Fe), thiamine, riboflavin and niacin. Also very significant, papaya contains the multi-function enzyme papain, for digestion, tenderizing and human skin care;

2. Pineapple fruit is rich in crude fiber, Ca, P (phosphorus), Fe, carotene, riboflavin, niacin, vitamin C and thiamine;

3. Peanut is a major source of food shortening, confectionery and other food uses. The protein content of 1 kg peanut is almost equal that of 1 kg pork and exceeds that of an egg and beef;

4. Intercropping coconut with papaya, pineapple, and peanut intensifies land use which increases economic returns on cash inputs and provides better labor-use pattern and income distribution.

5. For a 3-year cropping cycle of this multi-storey CBFS with papaya, pineapple and peanut as component intercrops, covering a total of 2.5 ha effective land cropping area (coconut = 1.0 ha, papaya = 0.50 ha, pineapple = 0.50 ha and peanut = 0.50 ha), with an investment of about PHP 63,838 (US$1310.8) per ha of coconut land, it generates an annual estimated total net income of PHP132,409 (US$2,719) per ha (Magat and Secretaria 2005). Under the production costs and commodity prices used, an average BCR of 3.43 is achievable.

**4. Coconut + Root Crop Intercropping**

Intercropping root crops under coconut palms is one of the popular CBFS in rural areas in the Philippines, particularly those regularly affected by typhoons (eastern areas facing the South Pacific). Most of these root crop intercropping practices requires short period of cropping time, smaller area (vacant spaces between coconut trees), provides additional incomes to coconut farmers and nutritious food for the farming communities.

Among the root crops recommended under CBFS are: cassava, gabi (taro), ubi (yam) sweet potato and ginger under acceptable ages of 1 - 6 years and 26 – 60 years-old trees. These intercrops can be intercropped in spaces under the inter-rows of coconut (8 – 10 m, square and triangular planting arrangements) as well. Spacing followed are: 1) cassava – 0.75 – 1.0 m (rows) and 0.50 – 0.75 m (hills); 2) sweet potato – 0.75 – 1.0m (rows) and 0.25 – 0.50 m (hills).

**Socio-Economic Benefits:**

1. Its nutritive value and health benefits are: a) Cassava – rich in carbohydrates (starch), Ca, vitamin A, C, and energy calories; b) Sweet potato – cheap and excellent source of vitamin A, beta carotene, Ca and P, and moderate source of thiamine and iron; and b) Ginger – food product, as flavoring agent and herbal supplement;

2. More than food products, these root crops can be used for: 1) cassava - industrial applications; 2) sweet potato – livestock feeds, flour, starch, and pectin. Flour is further processed into fermented products and alcohol;
3. From coconut trees, many basic food and no n-food products as mentioned earlier;

4. Based on a hectare basis with a land use intensity of 1.75 ha (1 ha coconut, 0.40 ha cassava and 0.35 ha sweet potato, a total annual net income of PHP31,198 (US$640.6) is generated for this CBFS (Secretaria and Magat 2006)

5. **Coconut + Coffee intercropping**

   Coffee crop is a popular intercrop under mature coconut stands. The shade from the coconut palms provides optimum conditions for coffee trees growth and productivity. The crop is best planted at 2 m away from the coconut trees in 3 rows at 3 x 3m in a triangular arrangement under coconuts distanced 10 x 10 m square or 2 rows at 3 x 3 m in a triangular pattern under coconuts distanced 8 x 8 or 9 x 9 m square.

**Socio-Economic Benefits:**

1. Coconut trees - produce many basic products and non-food raw materials for high value products. If there is a regular or seasonal demand for tender 8 month-old nuts (‘buko’) for tender meat (for dessert and pies) and nut water (‘buko’ water/ juice. Farmers get higher net income compared to the harvested mature nuts. In the Philippines, tender young nuts are priced at least 2 times and 3-4 times higher than fresh mature nuts at farm gate and roadside shops, respectively;

2. Harvested coffee berries are mainly marketed and utilized as: a) green and roasted beans; b) soluble or instant coffee; and c) coffee-based cold drinks and specialty products (Magat 2005);

3. Using coffee excelsa variety grown under coconut (spaced 9 – 10 m square), at full-bearing stage (5 – 6 years), net income from coffee trees (2 tons bean yield/ha per year) is PHP80,566 (US$1,654) or a total net income (coconut and coffee) of: PHP 103,805 (US$2,131) shown by Canja and Magat (2006).

**B. CBFS FARM PRODUCE TECHNOLOGIES IN RECENT YEARS**

1) **The Sequential Coconut Toddy and Nut Production (SCTNP)**

   Many believe that when coconut palms are tapped or coconut sap (toddy) production, the opportunity to produce nuts as young tender nuts ‘buko’ (8 month-old), mature 12 month-old nuts and copra (dried coconut meat) as raw materials for various uses or applications is lost. However, research conduct in the Philippines at the Davao Research Center in 1988 – 1991 (Maravilla and Magat 1993) showed that practicality and viability of producing in sequence toddy and nuts in same unopened spadices of palms, they called the sequential coconut toddy and nut production scheme or SCTNP (Figure 2a and 2b ). This technology mainly involves the tapping for coconut sap (first half of the spathe) and allowing the remaining half to develop normally (eventually producing the 8 month-old ‘buko’ and fully mature 12 month-old nuts.
In summary, the first SCTNP research in the country revealed the following (Magat and Maravilla 1993 cited by Magat 1996):

Figure 2a. Diagram of the five stages of SCTNP, from Stage 1 (spathe ready for tapping) to Stage 5 (harvestable nuts).

Figure 2b. The sequential coconut toddy sap and nut production (SCTNP) scheme with developing nut bunches after half of spathes used for toddy production. Both sap and nuts harvested year-round.

In summary, the first SCTNP research in the country revealed the following (Magat and Maravilla 1993 cited by Magat 1996):
(1) Consistently, year-round coconut sap harvesting (toddy-tapping) of trees produced the highest sap/toddy yield (Figure 3);
(2) Consistently, palms grown for nut production only produced the highest nut yields Figure 4);
(3) Consistently, the SCTNP scheme realized satisfactory levels of sap and nut yields, with higher net income (5-7 times) than the traditional nut production alone.

Figure 3. The traditional toddy tapping, with no nut production year-round.

Figure 4. The usual nut production where only nuts are harvested year-round.

2) Underplanting of Young Palms in existing Mature Stands for Edible Pith ‘Ubod’

The feasibility, profitability and viability of producing edible vegetative coconut pith or ‘ubod’ from young coconuts planted with two plants per hill under adult coconut stands was studied at the PCA’s Davao Research Center (Southern Mindanao, Philippines) in the mid 90’s
by workers Padrones, Secretaria and Magat (1999). The harvesting procedure for edible pith at the Center is shown in Figure 5.

Following were the salient findings:

1) The mean weight of harvested ‘ubod’ from the double planting scheme was 5.9 kg/3 year–old palm and 6.1 kg/4 year-old palm; The total edible pith yield for two harvest years reached 8.9 t/ha;

2) Under the Davao growing conditions, the economic analysis of the production system indicated a total net income (3\textsuperscript{rd} and 4\textsuperscript{th} years) of PHP 129,030 (US$2,649.5) per ha with ROI of 180%;

3) Copra production from adult palm stands of Laguna Tall variety realized a total of PHP 114,675 (US$2,355) for 4 years cropping with an average ROI of 242%; Total estimated farm income (Coconut + ‘ubod’) following the scheme was PHP242,389 (US$4,977.2) and 203% ROI, respectively;

4) This variant of CBFS for ‘ubod’ production clearly indicated that with moderate application of common sea salt (NaCl) on palms, the underplanting of 2 young coconut palms per hill (spaced 2 feet apart at 3 x 3 m distance under coconut stands is capable of increasing farm income by 200% compared to coconut monocropping.

Figure 5. Harvesting of edible pith or ‘ubod’ from young coconuts.
CONCLUSIONS

In recent years, the farm gate price of nuts in terms of copra had increased by 300–400%, thus the appreciable net income of farmers from sale of nuts alone. But, farm income and productivity could still be further enhanced with the adoption of practical and profitable intercropping practices such as the following: 1) coconut + cereal (maize) intercropping; 2) coconut + fruit crop (banana) intercropping; 3) coconut multi-storey cropping (coconut+ papaya+pineapple+peanut); 4) coconut + root crops intercropping and 5) coconut + coffee intercropping.

Moreover, in coconut farming, there are new innovative farm-level production schemes capable of producing other coconut-based farm products (CBFP) such as: 1) the sequential coconut toddy and nut production (SCTNP), producing coconut sap, the raw material for diverse natural and healthy high value products; and 2) underplanting of young palms in existing mature stands for the edible pith ‘ubod’, producing the edible tender coconut ‘cabbage’ for various food variants.

Of the coconut + intercrop (s) farming systems, some systems are capable of generating average annual net incomes of PHP85,000 (US$1745.4) to PHP132,400 (US$2,719) per ha, with banana, coffee intercrops and multi-storey [coconut+ papaya, pineapple and peanut (groundnut)], in 3-4 years cropping cycle, respectively.

Other farming systems techniques as the SCTNP and the under-planting of young coconuts for edible pith ‘ubod”), generates net incomes 3-5 times higher that the traditional nut production alone (monocropping) or an ROI of 180 – 200%.

Finally, in contrast to production systems producing either mainly nuts or sap (toddy) all the way during the year, if the sequential coconut toddy and nut production scheme (SCTNP) as a CBFS is followed year-round, both the economic benefits from food nutrition uses (mainly from nuts and sap-based products) and the ecological (husk and shell-based products, and other biomass) uses or services could result in very significant contribution to the monetary value enhancement in coconut farming system or farm diversification.

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REFERENCES


Appendix Figure 1. Illustration of coconut leaf pruning (CLP) under different levels.

Appendix Figure 2. Coconut products derived from coconut (inflorescence) sap (Magat 1998)

COCONUT SAP/ TODDY (unopened inflorescence)

- Coconut Syrup/nectar
- Fresh non-alcoholic sap juice/drink
- ‘Tuba’ low alcohol toddy

- Coconut Brown Sugar
- Natural Sap Vinegar (fermented by wild yeast)
- Distilled toddy liquor ‘Coconut lambanog’