Coconut Intercropping Guide No. 5

COCONUT-ROOT CROPS
Cropping Model

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1. IMPORTANCE

Growing of intercrops in coconut lands produces more food and agricultural products, ensuring food security of the people in rural and urban areas. At the same time, the practice generates jobs and livelihood, enhancing farm incomes and the purchasing power of people, thus alleviating poverty in farming communities (Magat 2004). Moreover, successful farmers serve as inspiration and enterprise leaders in their communities, eventually treating coconut farming in an agribusiness way to create wealth and more capital resources.

Intercropping root crops under coconut palms is one of the popular intercropping practices in rural areas for many good reasons. Root crops serve as staple food especially in regions or places where cereal grains (such as rice, corn) cannot be grown, people often rely upon starchy vegetables (roots, tubers or rhizomes) to supply most of their energy-calories. Such foods are called starchy staples. While such crops often have high yields, their primary disadvantage is their low protein content [<1%] (http://www.bio.ilstu.edu/Armstrong/syllabi/cassava/cassava.htm). On the other hand, most of the cultivated root crops have other useful benefits in food confectionery as food delicacies e.g., flour, tapioca-gelatinized pellets of cassava starch (http://education.yahoo.com/reference/encyclopedia/entry/cassava; laundry starch from cassava, alcoholic beverage (from fermented cassava roots), herbal medicine as in ginger, raw materials for industrial uses as e.g. gabi (taro), ubi (yam) and sweet potato for feeds, flour, starch, soy sauce, alcohol, wine, vinegar, nata and pectin for local and export markets (http://www.da.gov.ph).

Most of these root crop intercropping practices require short period of planting time, smaller area (vacant spaces between coconut trees), provides additional income to coconut farmers and nutritious food for the farm communities. Root crop intercropping such as cassava, gabi, ubi, ginger, sweet potato etc. is highly recommended under coconuts aged one to six years old or 26-60 years old and 7-25 years (ginger). These root crops can be intercropped in spaces under the inter-rows of coconuts as shown in Figures 1a, 1b, 2a and 2b.
Figure 1a. A farm layout guide of a coconut-root crop intercropping model under square planting system of coconut with spacing of 8-10 meters and root crops (Cassava: 0.75-1.0 m x 0.50-0.75 m, between rows and hills, respectively).

Figure 1b. A farm layout guide of a coconut-root crop intercropping model under square planting system of coconut with spacing of 8-10 meters and root crops (Sweet Potato: 0.75-1.0 m x 0.25-0.50 m, between rows and hills, respectively).
Figure 2a. A farm layout guide of a coconut-root crop intercropping model under triangular planting system of coconut with spacing of 8-10 meters and root crops (Cassava: 0.75-1.0 m x 0.50-0.75 m, between rows and hills, respectively).

Figure 2b. A farm layout guide of a coconut-root crop intercropping model under triangular planting system of coconut with spacing of 8-10 meters and root crops (Sweet Potato: 0.75-1.0 m x 0.25-0.50 m, between rows and hills, respectively).
2. ADVANTAGES AND BENEFITS

Depending on the age or development stage of coconut, a variety of root crops are suitable and productive under coconut stands. Under the three growth stages (I, II, III) from field planting up to 26-60 years old, the proper root crop intercrops had been identified as shown in Table 1. Some of the commonly cultivated root crop intercrops under coconuts are: cassava (*Manihot esculenta*), sweet potato (*Ipomea batatas*), ubi or yam (*Dioscorea species*), gabi and ginger (*Zingiber officinale*, Rosc).

Table 1. Growth duration and productivity periods, levels of sunlight transmission and suitable intercrops (Magat, 2004).

<table>
<thead>
<tr>
<th>Phase (Stage)</th>
<th>Duration</th>
<th>Level of available sunlight/ highly suitable intercrops</th>
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<tbody>
<tr>
<td>I</td>
<td>Field-planting to 6 years</td>
<td>High to Moderate/Highly Suitable Intercrops: Cereals - corn, upland rice Legumes - cowpea, peanut, mungbean, sitao, beans <strong>Root crops - sweet potato, gabi</strong> Fruit crops - pineapple, citrus, watermelon, papaya, banana Vegetables - tomato, cabbage, eggplant, sweet pepper, hot pepper, okra</td>
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<tr>
<td>II</td>
<td>7-25 years¹</td>
<td>Moderate to Low/Highly Suitable Crops: Black pepper, cacao, coffee, tomato, vanilla, ginger, lanzones, rambutan, durian, mangosteen, gmelina tree (for wood and lumber)</td>
</tr>
<tr>
<td>III</td>
<td>26-60 years</td>
<td>High/Highly Suitable Crops²: Cereals - corn, upland rice Legumes - peanut, mungbean, cowpea, beans Vegetables - tomato, eggplant, cabbage, sweet pepper, hot pepper, okra <strong>Root crops - sweet potato, gabi, cassava, ubi, ginger</strong> Beverage crops - coffee, cacao Fruit crops - lanzones, rambutan, durian, mangosteen, citrus (pomelo, calamansi) Wood and Lumber tree - gmelina Fiber crops - ramie, abaca</td>
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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 19-23 leaves); allowing 0.5 meter of cut frond attached to the trunk.

Some of the key benefits of the coconut-root crop intercropping/ecosystem are as follow:

1) Root crops can be intercropped in coconut palms as young as 1-6 years old and when these palms reached 25 years (and beyond). Generally, root crops are heavy nutrient eaters, hence both crops should be supplied with the required fertilizers needed by each crop.

2) Root crops can be planted anytime of the year. They are alternative stable crops being commonly planted in areas where our main staple crops (rice and corn) are not really suitable for their cultivation.
3) Its nutritive value and health benefits are well-known. a) Cassava – rich in carbohydrates (starch), calcium, Vit. A, C, high in calories; b) Sweet potato – cheap and excellent source of Vit. A, carotene, calcium and phosphorus, fair source of thiamine and iron (DA-Eastern Visayas Integrated Agric. Research Center from: http://www.da.gov.ph) (c) ginger – food product, as flavoring agent, herbal supplement (http://health.yahoo.com/drug). Ginger has been used in the treatment and prevention of motion sickness, to increase appetite and to reduce stomach acidity. Likewise, it has been used under medical supervision by some women to reduce severe nausea in pregnancy.

4) Other than food products, they can also be used for other purposes: industrial uses- cassava, sweet potato can be processed into feeds, flour, starch and pectin for local markets(DA-Eastern Visayas Integrated Agric. Research Center from: http://www.da.gov.ph). The flour is further processed into fermented products such as soy sauce and alcohol.

5) Intercropping coconut with different kinds of suitable root crops intensifies land use which increases returns on cash inputs and provides better labor-use pattern and income distribution.

6) From the coconut trees, obtained are many basic food products from nuts (like kernel/meat, coconut milk, coconut oil, coconut water/ juice) and coconut sap (fresh sap, vinegar, coconut nectar/honey and natural sap sugar); non-food raw materials for various high value products (husked-based, shell-based). Many more products are derived from other parts of the coconut trees.

3. MARKET DEMAND AND PRACTICES

3.1 Cassava *(Manihot esculenta)* – has emerged from its traditional image of being a poor man’s crop into an important industrial and food crop (http://www.pcarrd.dost.ph/division/acd or PCARRD Cassava Industry Situationer, 1997). It grows easily even under poor conditions and is major crop component in mixed cropping system in the uplands.

Over the last five years (1999-2003), production of cassava has been decreasing although at a decelerating rate. The year 2000 recorded the biggest decline in volume at 6.5% from the previous year. In 2002, production was down by 0.22% (http://bas.gov.ph/downloads_view.php/Cassava Situationer).

3.2 Sweet potato *(Ipomea batatas)* – Developments in the sweet potato R&D, have transformed the crop from a lowly subsistence staple food to an important commercial crop with multiple uses as complementary vegetable and snack food, ingredient for feed formulation and other diversified industrial products (http://www.pcarrd.dost.gov.ph/acd or PCARRD Sweet Potato Industry Situationer, 1998).

For over a period of five years (1999-2003), sweet potato production posted an increase only in 2002. From 1999 to 2001 and again in 2003, negative growth rates were recorded due to the decline in the production and harvests in Camarines Sur. A processing plant in this province stopped operation in 2003. The downward trend of the area harvested was largely due to the contraction in area in Camarines Sur (1999-2002) and Bohol (2003) [http://bas.gov.ph/downloads_view.php/Camote Situationer]. Farmgate price and retail prices were generally increasing during the reference years (1999-2003).
While wholesale prices showed minimal fluctuations during the same period. The Philippines has not imported any sweet potato during the last five years. Volume of exports had increased from a low of 116 kg in 1999 up to 950 kg in 2003.

3.3 Ubi (*Dioscorea alata*) and Tugui (*Dioscorea esculenta*) are the two most important yam varieties commonly cultivated in the Philippines. They are cultivated in small patches of land, oftentimes less than a hectare, particularly in some regions of the Philippines as Ilocos, Southern Tagalog, Bicol, Central Visayas and Northern Mindanao. Recently, the commercial potential of ubi (*D. alata* Linn.) has been recognized in the country despite its being a minor commodity (http://www.pcarrd.dost.ph/division/acd/ or PCARRD Ubi Industry Situationer, 1998). Ubi is a promising and high value crop because of its growing demand in the industry food sector in both local and export markets.

3.4 Gabi (Taro) – is one of the most important root crops in the Philippines (http://vicarp.lsu-visca.edu.p/technologies.htm). The Philippines has the largest area devoted to taro in Asia proper, apart from China (http://www.fao.org/docrep/005/ac450e/ac450e08.htm). In 1996, about 34,000 hectares of land were devoted to taro, producing tuber root yields of about 117,000 tons (FAO, 1997). Still taro is relatively a minor crop in the Philippines. The food basket is dominated by rice and corn, with root crops as a group coming lower in the order. However, since about the mid-1990’s, a taro export trade has grown up in the Philippines. The export goes mainly to New Zealand and the main operator for now is the DOLE International Company (http://www.fao.org//docrep/005/ac450e/ac450e08.htm). Many taro researches have been conducted at the Phil. Root Crop and Training Center (PRCTC) in Baybay, Leyte (Central Philippines) based at the Leyte State University Campus (former Visayas State College of Agriculture).

3.5 Ginger (*Zingiber officinale*, Rosc) is an important spice crop (mainly harvested for the fresh mature roots) used in cooking, and preparing dishes and preserves, candies and pickled food. It is a raw material in the production of beverage, perfumes and medicines although considered as a minor crop in the Philippines. It is one of the country’s potential high-earning export crop. However, the national average yield is not highly impressive. So far, Farmers’ limited knowledge about proper culture and management plus lack of knowledge for ginger process have largely hindered the industry development ((http://www.pcarrd.dost.ph/division/acd/ or PCARRD Ginger Industry Situationer, 1981).

4. GROWING CONDITIONS AND THE TECHNOLOGY

4.1 Environmental Requirements

To optimize the achievable yield of root crops under the coconut-root crop cropping system, it is essential to provide the suitable conditions (climate and soils) for the two crops. Moreover, the competition for light, soil and water resources usually results in marginal economic returns from one of the component crops or in both.
A. Coconut

Climatic Needs:

<table>
<thead>
<tr>
<th>Factor</th>
<th>Coconut</th>
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<tbody>
<tr>
<td>Altitude (m above sea level)</td>
<td>Less than 600</td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td>24- 29</td>
</tr>
<tr>
<td>Light</td>
<td>&gt;2000 sunshine hours/year</td>
</tr>
<tr>
<td>Total annual rainfall (mm)</td>
<td>1500- 2500 (well distributed)</td>
</tr>
<tr>
<td>Typhoon frequency (%)</td>
<td>&lt; 20</td>
</tr>
</tbody>
</table>

Soil Requirements:

<table>
<thead>
<tr>
<th>Soil Condition</th>
<th>Coconut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Depth (cm)</td>
<td>&gt;75</td>
</tr>
<tr>
<td>Drainage</td>
<td>Moderate to well-drained</td>
</tr>
<tr>
<td>Soil Acidity (pH)</td>
<td>5.5-7.5</td>
</tr>
<tr>
<td>Soil Texture</td>
<td>Sandy, loamy, clayey (with good structure)</td>
</tr>
<tr>
<td>Organic matter content</td>
<td>Medium to High</td>
</tr>
<tr>
<td>Major nutrients</td>
<td>N, K, Cl, S, P, Ca, Mg, B</td>
</tr>
</tbody>
</table>

B. Root crops

B.1 Cassava – Locally known as ‘kamoteng kahoy’ or ‘balinghoy’, this can be grown in all types of soil except in waterlogged, shallow or stony soils (http://www.pcarrd.dost/ph/acd/PR or PCARRD-Phil. Recommends for cassava, 1983). Cassava is a tropical and sub-tropical plant. It grows in regions with more or less evenly distributed rainfall throughout the year. An ambient temperature that ranges from 25-30°C and a soil pH range of 5.5 - 6.5 are required for a productive cassava planting (Phil. Root Crops Information Service, VISCA, Baybay, Leyte- Sharing and Processing of Cassava DA-RFU 9). It also thrives at sea level to 845 meters above sea level. It grows best when planted at the start of the rainy season.

B.2 Sweet potato – locally known as ‘kamote’ is commonly planted in flat to slightly rolling open areas. It can be grown in a wide range of soils, from heavy to sandy. It thrives best in sandy loam soils rich in organic matter with pH ranging from 5-7 and in areas with uniform rainfall and good drainage. The crop can be planted throughout the year but the ideal planting time for best varieties is at the onset of the rainy season or immediately after the rainy season when soil is still moist.

B.3 Gabi – can be grown in a wide range of soil types either as upland (dryland) or lowland (wetland) crop (http://vicarp.lsu-visca.edu.ph.ph/technologies.htm). The term upland refers to gabi production under a non-flooded condition and does not necessarily mean growing in high elevations. Under lowland culture best results are obtained on deep, well drained loam soil. Under lowland cultivation, which is usually in low-lying areas with abundant supply of fresh cool water for irrigation, best results are obtained if the soil is alluvial. In either culture, soil ph ranging from 5.6- 6.5 is
reported to be the best. Gabi is best adapted to a warm and moist environment, a daily average temperature of 27-29°C is ideal for gabi. Below 27°C, yield is reduced. Likewise, above 29°C, the plants are stunted and yield is greatly depressed. For best yield, an annual rainfall of 2000 mm is required throughout the growing period. It grows best at 1,800 meters above sea level (http://www.da.gov.ph/farming_tips).

B.4 Ubi and Yam – are upland crops and they should be planted in well-drained field. Yam requires temperature ranging from 25-30°C, sandy loam to silt loam soil with high organic matter, ample moisture throughout their growing period, particularly from 14-20 weeks after planting when tuber bulking (filling-up) occurs rapidly (http://vicarp.lsu-visca.edu.ph.ph/technologies.htm). Yams respond to length of daylight periods. Short daylights tend to favor tuber formation while long daylights favor vine growth.

B.5 Ginger – grows best in sandy loam, clay loam and lateritic (reddish highly weathered) deep soils of not less than 30 cm (PCA Intercropping Guide, undated).

4.2 Technology

It is very important to apply the best package of technologies (POT) or better still, the site-specific technologies to achieve the maximum economic yield (MEY), highly desirable to obtain the least production cost per unit product or per ha, and the maximum returns to investment under the coconut-root crops production systems.

4.2.1 Root crops

4.2.1.1 Cassava

1) Land preparation – prepare field by plowing 2-3 times, depending on the degree of soil compactness and porosity, followed by harrowing when there is enough moisture. Make ridges with 15-20 cm high and 75-100 cm distance between furrows (Phil. Root Crops Information Service, VISCA, Leyte).

2) Preparation of planting materials – select only fresh, mature or healthy stems - fresh if the latex or sap comes out within six (6) seconds after cutting, mature if the diameter of the pith or cork is not more than half the diameter of the cortex, healthy if it is pest-free and diameter of the stem is not less than 1.5 cm. Obtain stalks from a healthy stand which is at least 8 mos. old. Use a saw or bolo to separate cuttings 20-30 cm long. Keep the stalks for not more than five days, undershade in upright position.

3) Planting – plant cuttings in furrows one meter apart, each cutting set at 0.75 to 1 m apart between ridges and 0.50 – 0.70 m between hills. Replant missing hills 2 weeks after planting. Weed the cassava plant within 2 months after planting. Plant in slanting position at angle of 45° when the soil is fairly dry and in vertical position when planting is done during the wet season. At least 15 cm of the cutting should be buried or covered with soil.

4) Varieties – plant only high yielding varieties and according to needs. For starch, varieties VC-1, VC-2, VC-3, Datu. For food or feed purposes, it is strongly recommended to use only Lakan or Golden Yellow varieties.
5) **Fertilization** – in the absence of laboratory soil analysis, the general recommendation is eight (8) bags (50 kg capacity) of complete (14-14-14) fertilizer per ha. Apply fertilizer 2-6 weeks after planting at 5-10 cm depth and 15-20 cm away from the plant. The use of compost or organic fertilizer is also highly recommended as a soil conditioner and supplementary fertilizer (natural).

6) **Weeding and cultivation** – At least 80% of the failed cropings of cassava is due to inadequate weeding. Weed the plant within 2 months after planting. If possible, do off-barring and spot weeding 3-4 weeks after planting to effectively control weeds, then weed the plant 4-5 weeks after planting. Hill-up ridges 7-8 weeks after planting (followed by spot weeding).

7) **Harvesting** – Cassava is a highly perishable crop. It starts to deteriorate as early as 1-3 days after harvest so harvest cassava at the right time and in the proper way. Harvest cassava at full maturity or 6-7 months after planting. Harvesting too early results in low yield and poor eating quality. On the other hand, leaving the roots too long in the soil exposes them to pests. It also ties the land unnecessarily to one crop. Do not harvest cassava right after a heavy rain or when the soil is too wet. At this time, the roots have high water content which makes them difficult to store. Also, wet soil particles would stick easily to the roots esp. if the soil is clayey, thus making the root hard to clean. Harvest during relatively dry weather so that you can easily remove the soil particles from the roots.

8) **How to harvest**

   8.1) If the soil is compact, loosen it first. Use a wooden tool because this can cause lesser root damage than metal tools.

   8.2) Pull the plant gently and don’t drag the roots, dragging can cause bruises and cuts to roots which may lead to early deterioration.

   8.3) In separating root from the plant, do not just break it off because this method can also cause root damage. Cut each root as close to the stem as possible.

   8.4) After harvesting, don’t leave the roots under the sun. Too much heat causes weight loss and early root deterioration.

9) **How to store cassava**

   9.1) Soil storage method – select a suitable site which is well-drained, preferably shaded and slightly sloping. Do not keep cassava in waterlogged area because roots will decay easily. In selected area, dig trenches measuring one meter in width and 30-40 cm in depth. The length of the trench varies according to the volume of roots to store. A meter long trench can contain 70-80kg roots).

   9.2) Storage of roots in wooden crates

10) **Pest control** – There is no serious pest that attacks the cassava plant and use of the chemical is not practical or economical. To avoid the attack of pest, apply crop rotation or burn all infested or infected plants.

11) **Processing of cassava** – Can produce several food products like flour, starch, tapioca and alcohol etc. Cassava root part has a disadvantage, its fleshy roots contain poisonous compounds (cyanogenic glycosides – compounds that liberate cyanide) that must be removed (http://www.bio.ilstu.edu/armstrong/syllabi/cassava/cassava.htm). Shredding the roots and squeezing
out the juice removes much of the toxic compounds. Heat used to dry the resulting flour removes the remaining compounds. The resulting flour, called farofa is very bland, rather like corn meal and flour. The flour can be mixed with water and the dough cooked on a large griddle to make a large cassava flat-breads).

### 4.2.1.2 Sweet potato

1) **Land preparation** – To have good root yield of the crop, plow and harrow the soil twice until soil is loose and friable. Form ridges or furrows of about 30-40 cm high by using carabao-drawn mold-board plow or tractor-drawn mold board plow or tractor-drawn disc plow with a distance of about 75-100 cms between ridges ([http://www.da.gov.ph.farming tips](http://www.da.gov.ph.farming) [from BPI Sweet Potato Commodity Profile –DA-Eastern Visayas Integrated Agric .Research Center]).

2) **Planting materials and variety** – Use sprouts from roots of previous crop or vine tip cuttings from healthy plants 25 cm long. However, for economic reasons, tip or terminal vine cuttings immediately or you can store them in shaded place but they should be planted within 2 days from the time the they are cut).

The selection of the proper variety to grow is dependent on the purpose for which it is grown. The following 14 varieties are recommended by the Phil. Seed Board: UPL SP1, UPL SP 3, UPL SP5, BPI SP 1, BPI SP 2, PSB SB - 13,14,15,16,17, UPL SP, VSP -5,6,7 ([http://www.da.gov.ph.farming tips](http://www.da.gov.ph.farming) [from BPI Sweet Potato Commodity Profile –DA-Eastern Visayas Integrated Agric .Research Center]).

3) **Planting** – plant vine cuttings diagonally on top of ridges during the rainy season to prevent the crop from being soaked under water, or in the furrows during dry season so that moisture reserve in the soil can be utilized by the crop. Expose 2-3 leaves at the tip at a distance of 25 cms between hills. One cutting per hill is equivalent to 33,000 hills per ha).

4) **Fertilization** –In the absence of soil analysis of the area, follow the general fertilizer recommendation for: poor soil, use 4-6 bags complete (14-14-14) fertilizer /ha, moderate fertile soil – use 4 bags complete fertilizer/ha, for fertile soil, fertilization is not advisable. Apply fertilizer at planting time at 8-10 cms from the base of the plant or broadcast in the furrows and cover subsequently with soil. The use of compost or organic fertilizer at 3 tons/ha is highly recommended).

5) **Cultivation and weeding** – If weeds are abundant, shallow cultivation is done 10-12 days after planting. Hilling-up cultivation is done at 25-30 days after planting. This is to provide enough soil to cover the developing roots and thus, minimize the entry of weevils that may attack the growing roots).

6) **Pest and disease management** – Foliar spraying of fevinthrothion at 0.5% one (1) month after planting and twice at 50 days and 70 days after planting (DAP).

7) **Harvesting** – Most of the recommended varieties are ready for harvest 110-130 DAP. Harvesting can be determined by root sampling and if desired size has been attained, harvesting can be done anytime. Before harvesting, cut and roll the vines like a mat, fork, hoe or pass a plow below the ridges, then
hand pick the roots. Handle the roots carefully to minimize injury. Sort out damage or bruise roots from undamaged ones).

8) Post harvesting operation – If possible, use wooden crates for containers instead of gunny sacks to avoid skin damage during handling and transport. Harvest roots, if properly cured can be stored even for 3 months by keeping them under room temperature of 115°F or 32°C with a relative humidity of 92-95).

9) Post harvesting diseases – Soft rot or ring rot and storage rot are two common diseases after harvesting. Control measures include storage of roots in clean, dry and well-ventilated storage area; care must be taken not to bruise or injure roots during harvest and transport).

4.2.1.3 Gabi

1) Planting Materials – are called setts. A sett is prepared from a plant or daughter plant, i.e, either sucker or rhizome. The setts are prepared by having 1-2 cm tip section of the parent corm and first 15-25 cm of the petiole. The suckers are prepared from pre-sprouted cormels or cut from main corm. Best results are obtained with a sett size of 100-120 g. Smaller-sized setts can be used but maturity is delayed. Planting materials should be uniform in size but if different sizes of setts are used plant together those that are more or less of the same size (http://vicarp.lsu-visca.edu.ph/technologies.htm).

2) Land Preparation - Alternate plowings and harrowing until the soil is thoroughly prepared for planting and weed-free. Irrigation For Lowland culture – irrigation is maintained at least 3-5 cm water depth during the first three months of the crop to produce good quality corms. Drain the field once in a while.

3) Varieties of Gabi (with average yield per cropping):
   - PSB-VG#1 – (7.2 tons/ha)
   - PSB-VG#2 – (6.7 tons/ha)
   - SB-VG#3 – (7.2 tons/ha)
   - PSB-VG#4 – (6.5 tons/ha)
   - NSIC-G-8 – (7.0 tons/ha)
   - NSIC-G-6 – (7.0 tons/ha)

4) Planting Methods

4.1 Lowland or flooded culture. The area is flooded first for three days. Plowing and harrowing is done after flooding. Submerge the field in water for 2 days before planting. The gabi setts are planted in the mud with a spacing of 75 cm between rows and 50 cm between hills. http://www.nomiarc.netfirms.com/pot/gabi.htm).

4.2 Upland or dry cultivativation (culture). More suitable in coconut-based areas. Furrows are prepared at a distance of 75 cm apart and 30 cm deep. The setts are planted at a distance of 50 cm between hills).
5) **Fertilization** - Compost or manure is recommended during planting at the rate of 2 tons/ha. Split application of inorganic fertilizers will be at the rate of 30-30-30 kg NPK per hectare. This corresponds to: 5 bags 21-0-0 or 1.5 bags urea + 3.5 bags 0-18-0 (solophos) + 1 bag 0-0-60). One half of this amount is usually applied 2 weeks after planting and the remaining 1/2 is 2 months after planting.

6) **Weeding and hillling up** - In lowland culture, practically no weeding is needed. Flooding itself provides some degree of weed control. For upland culture, weeding is done during the first two months after planting or before the canopy is sufficient to cover up to the ground. Hilling up should be done 2 months and 4 months after planting.

7) **Storage** - Best temperature to prolong storage is 7°C and gabi can last up to 3.5 months. Gabi stored in pits can last for 6-10 months provided it is minimally exposed to rains.

8) **Pest/Disease Management** - Insect pests like aphids, army worms, hornworms and grasshoppers attacking gabi plants can be controlled by spraying appropriate insecticides. For gabi disease like leaf blight, the application of fungicides is an effective control practice. For plants that show symptoms of virus infection, removing and burning the plants are good control measures.

9) **Harvesting** - Gabi is ready for harvest when matured leaves turn yellow or manifesting signs of senescence. Lowland cultivars mature 7-12 months while the upland cultivars can be harvested 8 months after planting.

4.2.1.4 **Ubi**

1) **Land Preparation** - For a field that has been cultivated previously, two plowings and two harrowings are usually enough for yams. However, plowing should be made deep as yam requires at least a moderately deep loose soil.

   The flat bed and the ridged bed types appear to be preferable to the other types of seedbed. When the latter is used, the ridges should be constructed one meter or 60 cm apart. In the case of sloping or rolling fields, construction of ridges should follow the contour to minimize soil erosion).

2) **Preparation of Setts** - In yams, setts are whole tubers or tuber pieces used for planting. For ubi, whole tubers and tuber pieces are used while only whole tubers are used for tugui. Setts weigh from 60 g to 250 g in the case of ubi and 100 g to 150 g in the case of tugui. As a rule, the bigger the sett used, the higher is the expected yield although the increase in yield for every unit increase in sett weight decreases.

   Setts should be taken from healthy tubers of healthy plants. In ubi, tubers of appropriate sett size are not sliced while larger tubers are sliced into the desired sett size so that each sett has sufficient skin surface area. Thus in ubi, four types of setts are obtained and are named according to their positions on the tuber viz: head setts, middle setts and tail setts for the tuber pieces and whole setts for the whole tubers).

   Cut sides of the setts are treated with ash or with fungicide and air dried. After air drying, setts are either pre-sprouted or planted directly.
3) Pre-sprouting of Setts - Because the emergence period of most freshly prepared setts in the field lasts from three to twelve weeks, it is desirable to pre-sprout the setts before they are planted. This procedure assures the emergence of setts in the field and minimizes expenses on weeding before sett emergence.

A shallow ditch is dug in a clear shaded area under trees, under bananas, or under a shed constructed for the purpose. Setts are placed side by side in the ditch. In cases where no ditch is dug, the setts are placed side by side on the ground instead.

Setts are grouped according to type. For setts cut from large tubers, the orientation is either skin up or crown sideways. Setts are covered with a thin layer of soil and are watered at least once a week until all have produced sprouts.

With sett pre-sprouting, it may be desired to stagger planting and land preparation since setts do not sprout at the same time. In general, whole setts and head setts sprout ahead of other sett types. Planting pre-sprouted setts can also be done at one time.

4) Preparation of pre-sprouted setts for:

4.1 Staggered planting - To prevent sprouts from becoming too long, setts that have already sprouted are removed from the pre-sprouting seedbed and placed on a platform in a shady place. The process is repeated every week until the desired number of sprouted setts is obtained. The sprouted setts on the platform are not watered. Setts are planted before sprouts become very long. The same procedure is performed for setts intended for the second and succeeding plantings.

4.2. Single planting - The procedure followed in single planting is essentially the same as that used in preparing setts for staggered planting. The former is done only after most, if not all, setts have produced sprouts. By this time some sprouts which shall have grown quite long should be trimmed before the setts are planted.

5) Planting - The usual planting time for ubi is March to May and occasionally until June, depending upon the time the tuber dormancy is broken, as indicated by the sprouting of tubers under storage and upon start of rain in a particular area.

5.1 Non-pre-sprouted setts. Setts are planted on the seedbed (ridged or flat) at a distance of 1 m x 50 cm or 60 cm x 60 cm and at a depth of about 10 cm. When planting coincides with a dry spell, setts are planted in any orientation about 15 cm deep if the field will not be mulched. About 20,000 to 27,778 setts are needed for one hectare.

5.2 Pre-sprouted setts. Setts are usually planted at the start of rain if the field cannot be irrigated or will not be mulched. The same planting distance and depth for non-pre-sprouted setts are used. When planting, setts should be oriented so that sprouts are up.

In staggered planting, the field is divided into four up to six sections - a section for a batch of setts ready for planting. The size of each section
and the time each section is prepared is guided by the rate of sprouting of setts.

6) Mulching - In order to reduce soil temperature, conserve soil moisture and suppress weed growth, it is preferable to mulch the field planted to yams. Dry coconut fronds, corn stalks, rice straw and other similar materials may be used as mulch. If rice straw or similar material that rot readily is used, the mulch is made thick (about 10 cm) so that it will not rot completely within four or five months).

7) Weeding - The number of times an ubi field needs to be weeded depends upon the use of pre-sprouted setts, the application of mulch and the rate of weed growth. If non-pre-sprouted setts are used and the field is not mulched, three to five weeding operations are needed before the yam canopy covers the space between rows to partially suppress weed growth. If pre-sprouted setts are used and the field is mulched, at most only two weedings performed about two months apart are needed.

Handtools and animal-drawn implements are used to weed the field. While plants are still short and unstaked or if the stake structure allows their use, animal-drawn implements are used in an unmulched field. This requires that vines that cross the path of the animal be first removed and placed along the rows. However, if the plants have been staked and the stake setup does not allow use of animal-drawn implements or if the field is mulched, only handtools are used.

8) Replanting - Some amount of sett mortality can be expected, particularly in ubi when non-presprouted setts are used for planting. Thus replanting is done, usually about two months after planting). Hills with no sprouts are checked to see if there are rotten setts which should be removed and replaced with new ones. Unsprouted setts that did not rot should not be replaced because they still can produce sprouts).

9) Hilling Up - In the case of unmulched ridge seedbed, rain and handweeding operations often level down ridges. Thus, it is necessary to hill up at least once about two or three months after planting).

When the plants are still short and unstaked, animal-drawn implements may be used in hilling up. In this case, the vines that cross the path of the animal are first lifted and placed along the rows. When stakes are already set up and their presence do not allow the use of animal-drawn implements, handtools, usually shovels, are used.

10) Staking - Plants are staked before vines start crawling on the ground. The recommended stake length is one to two meters and a stake to every plant. Bamboo poles, wood, cassava stalks, talahib stalks or any similar material that can support the yam vines for at least seven months can be used as stakes. If cassava stalk is used, it is set up in an inverted position (top portion buried) so that it will not produce new shoots. There are various methods of staking, three of the more popular ones are as follows).

10.1 Trellis method - This stake setup is not very stable and requires more materials to support the stakes (posts and tie wire). However, weeding and hilling up operations using animal-drawn implements can be done easily under this setup).
10.2 Modified trellis method - With this method, ground spaces under the stake arch need not be weeded as the foliage becomes dense. Also, stakes formed in this manner provide stable support. However, weeding and hilling up operations that utilize animal-drawn implements cannot be done under the arches).

10.3 Pyramid method - This staking method has the advantages and disadvantages of the modified trellis method. In addition, it requires fewer, though sturdier, materials for stake construction and requires lesser amount of labor to construct. On the other hand, it has an additional disadvantage because yams grown under this method usually yield lower than those grown under the modified trellis method).

11. Training the Vines - The ubi vine twines to the right while that of tugui twines to the left. When vines start crawling on the ground, they are trained to climb their respective stakes. They are trained again when long branches start crossing the rows or when weeding and hilling-up operations using animal-drawn implements are about to be done.

12. Fertilizer Application - A hectare of ubi removes about 128 kg nitrogen, 17 kg phosphorous and 162 kg potassium from the soil. These nutrients are equivalent: 6 bags 21-0-0; 2 bags solophos and 5.5 bags potassium chloride (0-0-60). This represents the crop’s average fertilizer requirements (http://vicarp.lsu-visca.edu.ph/technologies.htm). In the case of tugui, no information is available regarding the amount of nutrients it can remove from the soil. However, like other yams, its fertilizer requirements is very likely similar to that of ubi crop).

The level of soil fertility in the field and the amount of fertilizer that need to be applied are determined by the soil analysis (mainly chemical properties) submitted to a proper soils laboratory. The site-specific fertilization management could be determined with the extension assistance of the local Agriculturist or Farm Management Technician.

12.1 Application of inorganic fertilizer - The recommended amount of fertilizer is split into two, one-half applied about one month after emergence and the other half applied about two months after the first application. The band method of fertilizer application is used, with the fertilizer being placed about 10 cm away from the plants).

12.2 Application of compost - Yams respond well to organic fertilizers like compost - a mixture of decayed organic matter composed of plant parts and animal manures. The compost is mixed with the soil while the field is being prepared or it is placed just below the spot where setts are to be planted).

12.3 Covering Exposed Tubers - As tubers elongate rapidly towards the end of the growing period of the plants, some tubers tend to heave, thereby causing them to be exposed to the sun. Heavy rains also expose the tubers. Exposed tubers should be covered with soil to prevent them from greening).

13. Harvesting - Ubi is ready for harvest when its foliage is already yellowing or drying up. In tugui, only the basal leaves turn yellow; the rest remaining green, even when new sprouts have already emerged from the base of the plant. The yellowing or drying up period of the foliage usually starts in late November and lasts until February the following year. In general, ubi matures
ahead of tugui by about one month. Tubers, especially those intended for setts, are harvested at the later part of the period. Tubers intended for consumption or for the market are sometimes harvested earlier, even before foliage yellowing sets in).

A bolo or a similar handtool is used to dig around the tuber to loosen it from the soil. Then the tuber is lifted and clinging soil particles are removed. The vine is cut at the base).

For sandy soil, sturdy stick sharpened at one end is sometimes used to dig out the tuber. For clay soil and for varieties with deeply buried tubers, an ubi harvester devised at PRCRTC may be used. The harvester is used like a shovel. Whatever tool is used to harvest the tubers, it is important that care should be exercised so as not to injure them while digging).

After tubers are cleaned, they are collected and placed in rattan baskets or bamboo or wooden crates lined with soft materials such as banana leaves, paper or grass straw. Healthy and diseased tubers are placed in separate containers. The tubers are arranged in the container in two to four layers, depending upon tuber size, and a soft material that can serve as cushion is placed between layers and in the spaces between tubers in a layer. The container is then covered with paper or banana leaves and a string net is woven over the mouth of the container if the tubers are to be transported immediately to the market. No cover is provided for the container if the tubers are to be transported to a nearby storage place. The tubers should be transported with minimum of jolting using a cart or a sled. (Root Crop Digest, PRIS Vol. 2 No. 4, 1987 ISSN 0116-4325 [http://vicarp.lusu-visca.edu.ph/technologies.htm).

### 4.2.1.5 Ginger

1) Land preparation – Plow and harrow twice or thrice to remove weeds, make furrows 50 cm apart, 2.0 m away from the base of the coconuts).

2) Varieties – Some of the varieties of ginger are: a)Native –small, fibrous and pungent rhizome; b) Imugan – improved native strain, medium–sized rhizomes with prominent leaf scars, resistant to soil-borne diseases and yield 30-70% more than native strain; c) Jamaica ‘oya’ –pleasant aroma, pale, medium-sized rhizomes which turn brownish-yellow when dried; d) Hawaiian – extra large, yellowish brown with pinkish traces (PCA Intercropping Guide).

3) Preparation of planting materials – Procure planting materials from reliable sources, use only fresh and healthy rhizomes. Cut rhizomes into seed pieces of about 20 grams each containing 2-3 bud-eyes. Wash seed pcs in tap water and then soak in solution containing 45 grams Captan per 20 li of water for 10-15 minutes. Plant seed pcs immediately).

4) Maintenance – Fertilize with one (1) tbsp of complete fertilizer (1414-14) eight cm away from hills as side dressing. Gather coconut leaves, rice straws, dried banana leaves, cogon straws and mulch the planted area. Apply 400 kg/ha of complete fertilizer on the 2\textsuperscript{nd} and 4\textsuperscript{th} months).

5) Harvesting – can be done when stalks exhibit yellowing and withering, about nine (9) months after planting. Two methods of harvesting for:
5.1 Small plantation – three (3) laborers may harvest the crop: one digs the hills with spading fork, second pulls out the plants, shakes off the soil and lays them on the ground, third trims off the stems (taking care the rhizomes do not break) and spreads the rhizomes to dry).

5.2 Large scale plantation – plow the ground to loosen soil and rhizomes

6) Curing/storing – Haul harvested ginger to an open shed, spread evenly to air-dry.

7) Pest and disease management – Some of the pests of ginger are mealy bug, black armyworm, aphid, shoot borer and can be controlled by insecticide spraying or by practicing crop rotation. Diseases like leaf spot, soft rot, bacterial, fusarium wilt and root knot attack ginger plant. Control measures are indicated in PCA Intercropping Guide, undated).

### 4.2.2 COCONUT

With the coconut trees are already established and already at bearing stage, the main farming practices are fertilization, underbrushing-weeding, mulching of the main rootzone of coconut (also considered the fertilizing zone at trunk base of trees), and harvesting. Post-harvest and primary processing practices (seasoning of partially immature nuts for 7–10 days, dehusking and copra processing) are common in small to medium scale farms. If sold to coconut desiccating plants, dehusked nuts are immediately marketed. Coconut husks await decortication/defibering, while coconut shells are converted to charcoal and sold to the shell charcoal sellers and the activated carbon processors.

There are two average inorganic/mineral fertilizer recommendations for coconut: 1) using the combination of single fertilizers (ammonium sulfate plus common salt (for potassium-rich soils) or potassium chloride (0-0-60) for soils deficient in K; and 2) using ready-to-apply multinutrient fertilizers as the 14-5-20-0.02 (B), now commercially available like COCOGRO (ATLAS Brand) or Osaka Planters Fertilizers in 25-kg and 50-kg bags.

These two fertilizer recommendations are compatible with the application of appropriate organic fertilizers (compost, cocopeat, commercial organic fertilizers). If capital resources to purchase organic fertilizers is available, any of these organic fertilizers (total N, P and K of at least 5%) may be applied together with the mineral fertilizers (options 1 and 2) indicated below at the rate of 3-4 times of the periodic rates indicated. Organic fertilizers should be applied about a month ahead of the application of the inorganic/mineral fertilizers. Organic fertilizers serve best as soil conditioners and fertilizer supplements to the coconut-vegetable cropping system.

**Option 1**

**Application of Single-Fertilizers (per tree):**

<table>
<thead>
<tr>
<th>Age/Stage</th>
<th>Rate of Fertilizer Combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-planting (FP)</td>
<td>150 g AS + 160 g SC or 200g KCl</td>
</tr>
<tr>
<td>6 months from FP</td>
<td>200 g AS + 200 g SC or 200 g KCl</td>
</tr>
<tr>
<td>1 year</td>
<td>500 g AS + 450 g SC or 600 g KCl</td>
</tr>
</tbody>
</table>
2 years | 750 g AS + 750 g SC or 900 g KCl
3 years | 1.0 kg AS + 1.25 kg SC or 1.5 kg KCl
4 years | 1.25 kg AS + 1.35 kg SC or 1.70 kg KCl
5 years and onwards | 1.50 kg AS + 1.70 kg SC or 2.00 kg KCl

*a* AS – Ammonium sulfate (21-0-0); SC – Sodium chloride (common salt); KCl – Potassium chloride (0-0-60)

**Option 2**
Application of ready-to-apply multinutrient fertilizer (per tree):

<table>
<thead>
<tr>
<th>Age/Stage</th>
<th>Rate of 14-5-20 multi-nutrient Fertilizer <em>a</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Field-planting (FP)</td>
<td>400 g</td>
</tr>
<tr>
<td>6 months from FP</td>
<td>600 g</td>
</tr>
<tr>
<td>1 year</td>
<td>1.25 kg</td>
</tr>
<tr>
<td>2 years</td>
<td>1.50 kg</td>
</tr>
<tr>
<td>3 years</td>
<td>2.00 kg</td>
</tr>
<tr>
<td>4 years</td>
<td>2.50 kg</td>
</tr>
<tr>
<td>5 years and onwards</td>
<td>3.00 kg</td>
</tr>
</tbody>
</table>

*a* contains 14% N, 5% P2O5, 20% K2O plus 15% Cl, 4.5%S, 0.02% Boron, Ca.

### 5. INVESTMENT NEEDS: COSTS AND RETURNS

For one hectare of coconut land or in a pure stand of coconut, only about 25% of the soil mass is actually utilized by the coconut (Magat, 1999). The remaining 75% of coconut land can be productively utilized by planting suitable intercrops e.g. root crops. Thus, if the effective land use index (ELUI) is assumed at: 0.40 ha for cassava, 0.35 ha for sweet potato, the total land use index adds to 1.75 ha or 75% increase in land use intensity (LUI) over 1 ha coconut monocropped. Hence, in the annual cropping cost and return analysis of coconut + root crops cropping model, the ELUI for each intercrop planted with the standing coconuts is used.

Table 5.1 and 5.2 shows the an average cost and return analysis of coconut + cassava + sweet potato cropping model, covering a 3-year production period. For each component intercrop, details of costs involved in the production are indicated. Please take note that the cost and return analysis varies depending on local farm inputs and prices of farm produce, particularly at farm gate price of each component root crop. The same is true with main crop, coconut, the economic conditions and local prices of copra as well as coconut products, usually dictated by global price trends, serves as important basis of profitability in coconut farming.
Table 5.1 An estimated costs and returns analysis of coconut + cassava + sweet potato intercropping system (3-yr cropping period), data for cassava and sweet potato mainly from DA-BAS (2001-03).

<table>
<thead>
<tr>
<th>Crop/Cost item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cassava (0.40 ha)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Cost: (seeds, fertilizers, pesticides, hired labor, other material inputs and expenses)</td>
<td>1,594</td>
<td>1,629</td>
<td>1,781</td>
</tr>
<tr>
<td>Non-cash Cost: (hire-labor paid in kind, harvester's share, lease rental)</td>
<td>301</td>
<td>301</td>
<td>382</td>
</tr>
<tr>
<td>Imputed Cost: (operator/family labor, depreciation, interest on operating capital, rental value of owned land)</td>
<td>2,566</td>
<td>2,648</td>
<td>2,835</td>
</tr>
<tr>
<td>Total Costs</td>
<td>4,461</td>
<td>4,578</td>
<td>4,997</td>
</tr>
<tr>
<td><strong>Returns:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Returns</td>
<td>10,062</td>
<td>9,897</td>
<td>12,562</td>
</tr>
<tr>
<td>Returns over cash costs</td>
<td>8,467</td>
<td>8,268</td>
<td>10,781</td>
</tr>
<tr>
<td>Net Returns</td>
<td>5,600</td>
<td>5,319</td>
<td>7,564</td>
</tr>
<tr>
<td>Yield per 0.40 ha (kg)</td>
<td>3,174</td>
<td>3,132</td>
<td>3,102</td>
</tr>
<tr>
<td>Price per kg (farmgate)</td>
<td>3.17</td>
<td>3.16</td>
<td>4.05</td>
</tr>
<tr>
<td>Production cost/kg</td>
<td>1.41</td>
<td>1.46</td>
<td>1.61</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop/Cost item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sweet potato (0.35 ha)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Cost (seeds/fertilizer/pesticides, hired labor, land tax, fuel, Oil)</td>
<td>2,228</td>
<td>2,354</td>
<td>2,519</td>
</tr>
<tr>
<td>Non-cash Cost (hired labor-paid in kind, Harvester's share)</td>
<td>442</td>
<td>529</td>
<td>536</td>
</tr>
<tr>
<td>Imputed cost (operator &amp; family labor, exchange labor, depreciation)</td>
<td>2,265</td>
<td>2,385</td>
<td>2,532</td>
</tr>
<tr>
<td>Total Costs</td>
<td>4,935</td>
<td>5,268</td>
<td>5,587</td>
</tr>
<tr>
<td><strong>Returns:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gross Returns</td>
<td>7,995</td>
<td>9,827</td>
<td>9,930</td>
</tr>
<tr>
<td>Net Returns over cash costs</td>
<td>5,767</td>
<td>7,472</td>
<td>7,411</td>
</tr>
<tr>
<td>Net Returns</td>
<td>3,060</td>
<td>4,559</td>
<td>4,343</td>
</tr>
<tr>
<td>Yield per 0.35 ha (kg)</td>
<td>1,532</td>
<td>1,570</td>
<td>1,566</td>
</tr>
<tr>
<td>Price per kg (farmgate)</td>
<td>5.22</td>
<td>6.26</td>
<td>6.34</td>
</tr>
<tr>
<td>Production cost/kg</td>
<td>3.22</td>
<td>3.36</td>
<td>3.57</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop/Cost item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Coconut (1 ha):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 2 t copra/ha, @P15/kg or Nuts=8000/ha</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer application</td>
<td>P360</td>
<td>360</td>
<td>360</td>
</tr>
<tr>
<td>Circle-weeding, 4.5 md(^a), 6x/yr</td>
<td>P2,430</td>
<td>2,430</td>
<td>2,430</td>
</tr>
<tr>
<td>Fertilizer cost(^b)</td>
<td>P2,000</td>
<td>P2,000</td>
<td>P2,000</td>
</tr>
<tr>
<td>Cost of harvesting, piling, hauling, dehusking @ P0.35/nut</td>
<td>P2,800</td>
<td>P2,800</td>
<td>P2,800</td>
</tr>
<tr>
<td>Copra making @ P0.12/kg</td>
<td>P960</td>
<td>960</td>
<td>960</td>
</tr>
<tr>
<td>Transport/Handlings, @P0.20/kg</td>
<td>P400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td>Total Cost</td>
<td>P8,950</td>
<td>P8,950</td>
<td>P8,950</td>
</tr>
<tr>
<td>Yield (kg copra/ha)</td>
<td>2,000</td>
<td>2,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Gross Income</td>
<td>P30,000</td>
<td>P30,000</td>
<td>P30,000</td>
</tr>
<tr>
<td>Net Income</td>
<td>P21,050</td>
<td>P21,050</td>
<td>P21,050</td>
</tr>
</tbody>
</table>

\(^a\) man-days
\(^b\) average fertilization: 1.5 kg AS + 1.7 Kg NaCl (common salt) @ P 5/kg and P 4/kg, respectively, @ 135 trees/ha.
Table 5.2 Summary of 3-year average of Costs and Returns of a Coconut + Cassava + Sweet potato in a 3-year period cropping model (Land Use Intensity = 1.75 ha: 1 ha coconut, 0.40 ha cassava and 0.35 ha sweet potato)

<table>
<thead>
<tr>
<th>Economic Index</th>
<th>Coconut (1.0 ha)</th>
<th>Cassava (0.40 ha)</th>
<th>Sweet Potato (0.35 ha)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost</td>
<td>P8,950</td>
<td>P4,679</td>
<td>P5,263</td>
<td>P18,892</td>
</tr>
<tr>
<td>Yield (kg)</td>
<td>2,000</td>
<td>3,136</td>
<td>1,556</td>
<td>6,692</td>
</tr>
<tr>
<td>Gross Income</td>
<td>P30,000</td>
<td>10,840</td>
<td>9,251</td>
<td>50,091</td>
</tr>
<tr>
<td>Net Income</td>
<td>P21,050</td>
<td>6,161</td>
<td>3,987</td>
<td>31,198</td>
</tr>
<tr>
<td>Prodn. cost (per kg)</td>
<td>P4.47</td>
<td>1.49</td>
<td>3.38</td>
<td>9.34</td>
</tr>
</tbody>
</table>

6. **Potential Financing Sources/Credit Facilities**

- Self or In-House Finance (Private)
- Local Government Units (Municipal, Provincial, Congressional)
- Government Banks & Lending Institutions
- Private Banks and Lending Agencies
- Cooperatives
- Foundations
REFERENCES:


Magat, S.S. 1999. Production management of coconut (Cocos nucifera L.) Published by PCA, Diliman, Quezon City. 67 p.

PHILIPPINE COCONUT AUTHORITY (undated). Intercropping coconut with gabi. PCA Brochure.

PHILIPPINE COCONUT AUTHORITY (undated). Intercropping coconut with ginger. PCA Brochure.


From the internet:
http://www.da.gov.ph/updates/farming_tips (cassava, sweet potato, ginger)
http://www.bio.ilstu.edu/armstrong/syllabi/cassava/cassava.htm
http://education.yahoo.com/reference/encyclopedia/entry/cassava
http://health.yahoo.com/drug
http://www.nomiarc.netfirms.com/pot/gabi.htm
http://vicarp.lsu-visca.edu.ph/technologies.htm
http://www.fao.or//docrep/005/450e/ac450e08.htm
FOR MORE INFORMATION AND ASSISTANCE, YOU MAY CONTACT THE FOLLOWING OFFICES SITUATED NEAR YOU:

- **Research & Development, and Extension Branch, PCA, Diliman, Quezon City 1101**
  Telefax: 920-0415 Tel: 426-1398 Email: cbcarpio@mozcom.com or ssmagat@pacific.net.ph or sev_magat@yahoo.com

- **Field Services Branch, PCA, Diliman, Quezon City 1101**
  Telefax: 928-9488 Tel: 929-1590

- **Albay Research Center (ARC), PCA, Banao, Guinobatan Albay**
  Tel: (052) 484-6668 or 484-6685 Email: pcaarcvb@globalink.net.ph

- **Davao Research Center (DRC), PCA, Bago-Oshiro, Davao City, PO Box 80437**
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20 & 27 February 2006