PALAYAMANAN: A RICE-BASED FARMING SYSTEMS MODEL FOR SMALL-SCALE FARMERS

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The Palayamanan model of diversified integrated rice-based farming system developed and established by the Philippine Rice Research Institute (PhilRice) is composed of synergistically compatible farming ventures such as rice, onion, poultry, livestock, and aquaculture. The model farm has been established in six state colleges and universities and a research center in the country. The system employs practical, cost-saving and yield-enhancing management practices. The system includes microbial technology as an added dimension of the management practices to facilitate farm operations, improve the resource base and reduce overall operational costs. The system aims to maximize the utilization of resources, reduce farming risks, enhance sustainability, productivity and profitability, and improve economic stability, food security and hopefully better relationship among members of a farm family. A one-hectare diversified farm can sustain most of the daily food requirements, incidental expenses from fast-growing crops, and provide considerable income from animals, fish, and seasonal field crops. Maximum utilization of on-farm biomass residues for nutrient sources and animal feeds using microbial technology improves the efficiency of the system and also reduces the operating expenses. Three workers or a family of six members can operate the farm.

aquaculture, crop production, diversified farming system, family on farm, microbial technology, model farm, on-farm biomass residues, Palayamanan, sustainable farming

INTRODUCTION

Palayamanan is a term coined from the words palayan (ricefield) and kayamanan (wealth), which then refers to a field where more wealth is created based on rice as well as some other crops. In the model established at PhilRice Maligaya, the concept is translated in terms of diversified rice-based farm operations. The Palayamanan diversified farming system has been designed as an alternative system of production that may solve some of the major concerns related to intensive rice production. According to Pingali et al (1999), intensive rice production leads to long-term biophysical changes that threaten the ecological sustainability of farming as reflected in the loss of diversity, declining productivity, falling profitability, input inefficiencies, and environmental and health risks. All these factors have serious implications for economic sustainability (Kabir 1999). Productivity of most multiple cropping systems is higher in terms of harvestable products per unit area given with the same levels of management as those of sole crops (Steiner 1984, Francis 1986). Total biomass is also higher and helps to increase sustainability of the farm (Clawson 1985, Francis 1986). Animal integration into the farm system is important in increasing food security by diversifying the food-generating activities of the farm and transforming nutrients and energy between animals and crops. Farm diversification into livestock extends the risk reduction strategies beyond multiple cropping and thus increase the overall economic stability of the farm (Reijntjes et al 1995).

The low income generated from conventional farming systems (Abon 1999) due to the increasing cost of rice production relative to the price of paddy rice makes it necessary for farmers to look for other
alternative sources of income elsewhere to meet their food and cash demands. Attractive wages from industrial and service sectors lure most family members to migrate temporarily or permanently away from the farm, potentially leading to family degeneration and discontinuance of agriculture as an occupation in the future (Prasad et al 1999).

Palayamanan model farms have been established in 6 state colleges and universities and a research center in Zambales, Tarlac, Bulacan, Bataan, Nueva Ecija, Aklan, and in the Bicol Region (Pablico 2004). The potential for the creation of more wealth from the same farm can be seen in the data. Thus, in one Palayamanan research site, in the wet season of 2002, the total earnings from crops and fish in the model farm was P172,243 in Currimao, Ilocos Norte (Cuevas 2004).

This paper describes strategies employed and features of the different components of a rice-based diversified model farm as a guide to farmers, entrepreneurs, and other interested individuals.

Establishment Of The Model Farm

Establishing a diversified farming system model farm requires a considerable sum of investment and broad knowledge on the interrelationships of the different farming components. The strategies that we followed in the establishment of the model farm discussed here were: (a) establishing individual components on a staggered basis depending on the available resources, (b) availing ourselves of the services and financial assistance offered by government agencies and developmental organizations, (c) requesting from the municipal government the construction of the small farm reservoir; and (d) obtaining the fish stock from BFAR, seeds from seed companies and government organizations, and technical advices from different specialists.

Features Of Palayamanan

The Palayamanan model was established at PhilRice Maligaya in Muñoz, Nueva Ecija, in a 1-ha area representing a small-scale farm. The area was divided into a residential area (0.05 ha), field crop production area (0.75 ha), and farm reservoir area (0.20 ha). Three farm workers equivalent to a family of six members operate the farm.

Residential Area

While it is referred to as the residential area, it actually includes the farmhouse, nursery, animal production area, and backyard garden. The farmhouse has a floor area of 25 m² and is constructed with light materials, ie, wood, bamboo, and nipa (Nypa fruticans). The farmhouse is used as a work & rest area in the farm. A parking lot and ornamental garden are situated in front of the farmhouse.

The nursery is about 20 m² and shaded with a trellised passion fruit vine, which provides aesthetic effect and produces edible fruits. The nursery is used in growing seedlings.

The vegetable garden has an area of about 600 m² with 50 cm-wide raised beds made up of garden soil, compost, rice hull, and carbonized rice hull. It is sheltered with a fine net that serves as rain shelter for seedlings and sensitive vegetables during the rainy season.

The multi-animal-one-roof shed has an area of 50 m² including the chicken grazing area. The animal shed can house 2 cows, 10 goats, 5 pigs, 50 chickens and 50 ducks. The system maximizes space and reduces time in tending the animals compared to scattered housing of individual animals. The floor is covered with mulch beddings made up of a mixture of rice hull and carbonized rice hull instead of cement. Other organic materials such as coir dust, sawdust, chopped rice straw and leaf droppings can also be used as beddings.

The advantage of using mulch bedding is that it does not require daily cleaning. The manure and urine are mixed in the mulch bed and slowly converted into good quality organic fertilizer. The initial mulch bed is about one foot thick. Additional bedding materials are added regularly depending on the wetness of the bed. The mulch bedding is harvested and replaced every 2 months or when the bed reaches about 1 meter in thickness.

Proper management is required for mulch bedding to reduce the foul odor. Minimal water is required for bathing the animals to avoid too much wetness. The microbial inoculant EM-1 is mixed with the drinking water and to the water for bathing the animals to reduce the foul odor. The microbial inoculant also enhances decomposition of the mulch beddings and improves the quality of the organic fertilizer.
Field crop production

The crop production area is composed of sites for rice-upland crop, cash crop, continuous vegetable and rice-fish production, a total of 0.75 ha. The bunds and irrigation canals are also planted with economic crops.

The rice-upland crop production area is 0.25 ha. An organic-based production system is followed in the site. Special rice varieties are planted during the wet season followed by onion and other cash crops during the dry season.

The allocated area for continuous vegetable production is about 1,000 m². On 1-meter raised beds of mixed rice hull, carbonized rice hull, compost, manure or other organic materials, vegetables are grown even during the wet season. Different kinds of vegetables are planted in relay or in sequence to maximize production and resources.

The area intended for cash crop and seed production is about 1,500 m². Cash crops such as green corn, soybean and peanut, are planted in sequence. Open pollinated crops are also planted for seed production to ensure a continuous supply.

The rice-fish-gabi culture plot is composed of two paddies with a total area of 0.25 ha. A small pond fish refuge 1 x 1 x 1 meter is constructed on one side of each paddy. About 2,000 tilapia fingerlings are released in the rice paddies after planting rice. The tilapia stock is harvested at the same time with the rice. Gabi is planted around the paddies after land preparation; it is harvested 5 to 6 months after planting.

Small farm reservoir (SFR) area

The SFR site includes water catchments and drainage canals with a total area of about 0.20 ha. Fruit trees are planted around the SFR and along the drainage canal. Tilapia is stocked in the SFR during the wet season. The water in the pond is used as supplemental irrigation during the dry season. The grasses growing in the site are collected as animal feed.

DISCUSSION

Cost-Saving & Environment-Friendly Practices

Modern and traditional cost-saving practices are employed in the operations to maximize resources, reduce operational cost and to enhance the efficiency of the whole farming system.

EM (effective microorganisms) technology. It is a technology that utilizes beneficial microbial inoculants to maintain soil health, improve plant growth, recycle biomass residues, control pest and bioremediates toxicants (Higa 1995, Corales 2000). The EM microbial base inoculant is extensively used in the different components of the farm system. The inoculant developed by PhilRice together with the activated EM solution is used in nutrient cycling (in-place composting) for soil improvement, production of organic fertilizer, and reducing the foul odor arising from the waste materials generated by the animal component. Plant extracts used in pest control, feed supplement from kitchen garbage and vegetable rejects, and antibiotics from medicinal plants, are all processed through fermentation using the EM technology.

Controlled irrigation. To conserve water, intermittent irrigation is employed in rice production and furrow drip irrigation is resorted to for dryland crops.

Mulching. The use of organic mulches such as weeds and rice straw in vegetable production conserves moisture, reduces weeds and enhances soil organisms.

Nutrient cycling. Biomass residues are either applied directly into the field or fed to animals, and the manures are used as organic sources of nutrients. This approach reduces the use of chemical fertilizers.

Pest control. Biological control methods used to reduce insect damage and costs include enhancing the development of predators and parasite, releasing Trichogramma parasitoids and NPV application; use of botanical pesticides, fruit wrapping, removal of infested plants and plants and parts, traps and limited pesticide application.

Feed supplements. Raw or fermented feed supplements come from weeds, vegetable discards and rejects and kitchen garbage.

Mulch beddings. Organic materials are good mulch beddings for animals. Mulch beddings have the advantage that they do not require daily cleaning of animal pens; meanwhile, the organic residues are converted into quality organic fertilizers by the animals.

Automatic feeders and waterers. The use of automatic feeders and waterers reduces time in tending the animals.
Animal Production

Animals are important to integrate in the farm system as they provide subsistence security by diversifying the food-generating activities of the farm and transforming potential nutrients and energy from crops into animal products. Different animal species supply different products and security. Chickens often provide immediate cash for the household; goats, sheep or pigs are sold to cover intermediate expenses while larger animals are sold for major expenditures (Reijntjes et al 1995). The animals themselves can be considered savings accounts with the offspring as the interest.

The animal component of the model farm in PhilRice Maligaya has not been fully completed. It started with 20 head of improved chicken, 5 head of pigs and 1 head of goat in February 2002. Another animal cycle started with the same number of chickens and pigs in August. The pigs and chickens were marketed after 4 months. The weight of the pigs upon the disposal ranged from 65 to 75 kg/head while the chicken ranged from 3.5 to 4 kg/head.

Crop Production

To optimize the viability of farming, it is important to choose and mix crops. The production of rice and some cash crops are very definite as dictated by the growing conditions. In the case of vegetables, the ideal times mostly preferred are based on maximizing yields. However, such ideal growing periods usually cause an oversupply of certain commodities, resulting in low prices. Off-season vegetable production usually produces lower yields than the ideal season but the prices are much higher. On-season and off-season productions are both necessary; thus, for attaining a better supply of food and cash flow, proper planning is necessary.

Different crops make an important contribution in unstable and variable environments to harvest security (Jiggings 1990). Total biomass is also higher, increasing sustainability of the farm (Clawson 1985, Francis 1986). Reijntjes et al (1995) mentioned that as several crops are grown, failure of one crop to produce enough or earn enough can be compensated for by other crops.

Accordingly, it may be necessary to alter the combinations of crops to make more efficient use of resources such as nutrients, water, and labor to restore soil fertility, or to decrease populations of pests. Some suggested techniques are staggered planting, sequential cropping, relay cropping, rotation and succession (Reijntjes et al 1995).

Economic Analysis Of Different Components

Animal Production

Although the animal component of the model farm has not been fully completed, it has already

Table 1. Analysis of the animal components for one-year cycle. 2002

<table>
<thead>
<tr>
<th>Animals</th>
<th>Gross Income (P)</th>
<th>Expenses (P)</th>
<th>Net Income (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feb-June 2002</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigs (5 head)</td>
<td>19,500</td>
<td>11,522</td>
<td>7,978</td>
</tr>
<tr>
<td>Chicken (20 head)</td>
<td>6,300</td>
<td>3,840</td>
<td>2,460</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>25,800</strong></td>
<td><strong>15,362</strong></td>
<td><strong>10,438</strong></td>
</tr>
<tr>
<td><strong>August-Dec. 2002</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pigs (5 head)</td>
<td>15,600</td>
<td>16,680</td>
<td>(1,080)</td>
</tr>
<tr>
<td>Chicken (20 head)</td>
<td>7,170</td>
<td>4,862</td>
<td>2,308</td>
</tr>
<tr>
<td><strong>Sub-total</strong></td>
<td><strong>22,770</strong></td>
<td><strong>21,542</strong></td>
<td><strong>1,228</strong></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>48,570</strong></td>
<td><strong>36,904</strong></td>
<td><strong>11,666</strong></td>
</tr>
</tbody>
</table>
generated a net income of more than P11,000 for the two cycles in one year (Table 1). A net income of more than P10,000 obtained during the first cycle was attributed to the reduction in feed expenses. The vegetable surplus supplemented almost 50% of the feed consumption. The loss incurred in the surplus production of the vegetables was absorbed by the animal component. According to Reijntjes et al (1995), animal keeping extends the risk reduction strategy beyond crop production, and thus increases the potential for economic stability of the farm.

During the second animal cycle (August-December), a negative income from the pig production was attributed to high feed consumption and drop in the market price. The animals were mostly fed with commercial feeds during the growing period because of limited feed supplement coming from the crop production component. The loss incurred in the pig production was compensated by the income derived from the chicken production; thus, a certain income was still realized from the animal component.

As added benefits, animals transform biomass into quality organic nutrients more quickly than the natural system. Organic fertilizers harvested from the mixture of mulch beddings, animal manure and urine is about 100 bags per cycle or 200 bags per year.

**Vegetable production**

The economic analysis of the different crop production components is shown in Table 2. Rice as the major component of the system can still generate a lucrative income despite controlled pricing by certain sectors. Several strategies can be employed such as planting special rice varieties, or employing production management which command higher prices like an organic-based production system. The production of special rice varieties and an organic-based system is feasible

<table>
<thead>
<tr>
<th>Component</th>
<th>Yield (kg)</th>
<th>Gross (P)</th>
<th>Expenses (P)</th>
<th>Income (P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice-Onion</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>1,500</td>
<td>18,000</td>
<td>2,955</td>
<td>15,045</td>
</tr>
<tr>
<td>Onion</td>
<td>2,400</td>
<td>24,000</td>
<td>6,800</td>
<td>17,200</td>
</tr>
<tr>
<td>Sub-total</td>
<td>42,000</td>
<td>9,755</td>
<td></td>
<td>32,245</td>
</tr>
<tr>
<td>Rice-Fish (2 cycle)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice</td>
<td>2750</td>
<td>26,250</td>
<td>5,500</td>
<td>20,750</td>
</tr>
<tr>
<td>Fish</td>
<td>233</td>
<td>8,155</td>
<td>3,800</td>
<td>4,355</td>
</tr>
<tr>
<td>Gabi</td>
<td>1,000 pc</td>
<td>3,000</td>
<td>900</td>
<td>2,100</td>
</tr>
<tr>
<td>Sub-total</td>
<td>37,405</td>
<td>10,200</td>
<td></td>
<td>27,205</td>
</tr>
<tr>
<td>Cash crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn (green)</td>
<td>900</td>
<td>9,000</td>
<td>3,750</td>
<td>5,250</td>
</tr>
<tr>
<td>Vegetables</td>
<td>21,210</td>
<td>6,363</td>
<td></td>
<td>14,847</td>
</tr>
<tr>
<td>Sub-total</td>
<td>30,210</td>
<td>10,113</td>
<td></td>
<td>20,097</td>
</tr>
<tr>
<td>Grand Total</td>
<td>109,615</td>
<td>30,068</td>
<td></td>
<td>79,547</td>
</tr>
</tbody>
</table>
under the diversified farming system because of the limited area. In the model farm, we planted PJ lines and the Mestizo hybrid rice, special rice varieties, coupled with an organic-based system. Normally, the command price is more than P1 premium price per kilo over the ordinary rice. Much higher benefit can be obtained when the rice is sold as milled rice.

Another crop, onion is one of the most attractive crops after rice because of its high yield and high net income. However, it is becoming unpredictable due to the volatility of the price. Thus, green corn is a more probable crop planted after rice. It can also provide a good income with lesser inputs.

Vegetables also provide good income especially during their off-season. Vegetables planted during the dry season obtain higher yields but again they are subject to price fluctuations. In our experience, tomato is one of the volatile crops during the dry season because of very extreme low prices when the supply becomes too much for the market to absorb.

Gabi production is an added dimension of the overall farming system because it can be planted around the rice paddies and irrigation canals. It interferes the least with rice, needs minimal management, and is self-sustaining. Taro can be sold P3-5/plant farmgate price. The suckers are sold at P0.25-0.50 a piece. One of the farmers with diversified farm mentioned that the income generated from gabi was higher than that from the rice.

In general, the crop production components can obtain considerable income much higher than in rice production alone despite some of the failures such as damaged crops, less production due to weather and pest, and low prices inflicted to some of the crops especially vegetables. This shows that the diversification of crops can buffer losses incurred in some individual crops. Moreover, the synergism of crop production to animal production plays an important role in the revaluation of some product outputs such as discards. Normally these are wasted; they can be converted into nutrients for the benefit of succeeding crops. Value added can be produced by converting discards into animal feed supplements before they are brought back into the farm in the form of manure or organic fertilizer.

**Fish production**

The integration of fish production intensifies the use of natural resources in a sustainable manner through species diversification and nutrient cycling (Reijntjes et al 1995).

Fish production is synergistic with rice production. Fish help in the control of weeds and insects. Their movements enhance aeration and probably scare rats as indicated by lower rat damage, and help in nutrient cycling. Fish in ponds add income and food to the family. Fish is an important source of protein in the diet (Alders et al 1991).

The income obtained from the two-cycle fish production in the rice-fish culture area is about P4,000/year (Table 2). This amount is very little, but if the fish is utilized as food of a farm family, it may mean a lot. In this report, income from the fish from the SFR was not included because they were still small when the water level of the pond became critical and they had to be transferred to another pond outside the model farm.

**Fruit Tree Production**

Woody species can contribute to the viability of a farming system as sources of food or income if sold, as protection (windbreaks and shade), and by enhancing soil fertility by extracting nutrients from the deeper soil layers (Reijntjes et al 1995). Fruit trees such as mango, citrus, chico, tamarind, Java plum, pummelo, and papaya have been planted around the SFR and drainage area. Most of the fruit trees were planted in 2002 WS.

The cost in the establishing the fruit tree component is mostly the cost of purchasing the seedlings and some maintenance costs such as weeding, fertilizer application and watering.

**CONCLUSION**

The Palayamanan model farm shows how enterprises can be integrated in the same farm so that the overall operations becomes profitable and sustainable. Diversified farming systems can sustain most of a family’s food requirements, incidental expenses and generate reasonable net income from the different crops and animals. The application of cost-saving and yield-enhancing practices enhance the efficiency of operations in the farm, making it more economically stable. Regular evaluation of the performance of each component is important to make necessary adjustments to fit the local conditions and stability of the system.
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