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REHABILITATION AND NATURAL RESOURCE MANAGEMENT IN CHANGED AGRICULTURAL LANDSCAPES AS A RESULT OF DISASTERS

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ABSTRACT

In November 2004, a portion of Quezon and Aurora provinces in the Philippines was the scene of unprecedented loss of lives and properties due to flashfloods and mudflows resulting from heavy torrential rains that induced mountain soil erosion, landslides and overflowing of river systems. The disaster damaged prime agricultural lands causing once productive paddy rice lands to be covered by upland soil and diverse grassland species afterwards. The soil's physical and chemical characteristics of the area, together with the production systems have changed, which in many ways have become a challenge to the affected communities. To address the challenge, a multi-stakeholder partnership was forged where one of the main tasks is to restore and make productive the damaged ecosystem, and to develop an integrated farming system suitable to the area, considering the available resources, the knowledge and capability of the people.

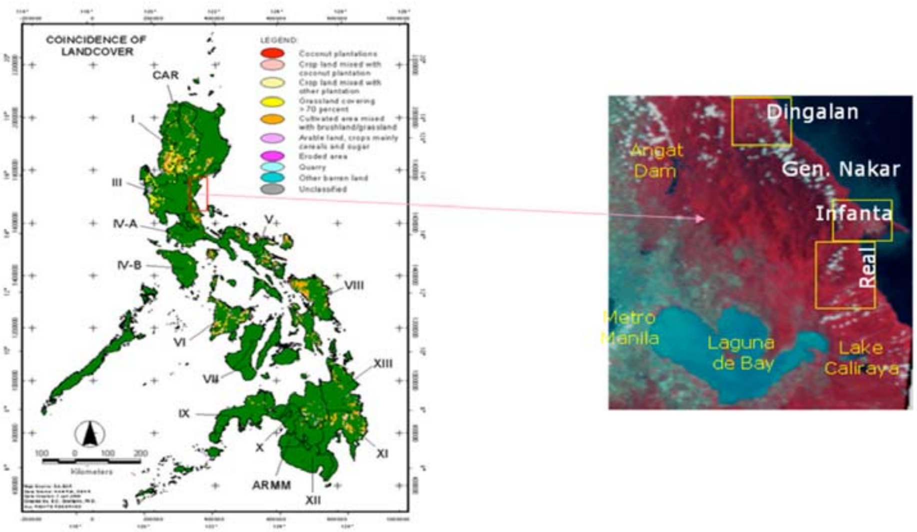
Key words: multi-stakeholder partnership, integrated farming systems, extension delivery system, participatory mechanisms, disaster-affected communities

INTRODUCTION

Disasters, whether natural or man-made can cause destruction to human, social and physical capital and derail economic development of any country (Jovel 1989). In many instances, though, aside from being naturally predisposed, environmental conditions in a country would determine the impact of disasters. Countries with severe deforestation, over-cultivation even of unsuitable areas and over-grazing, tend to be hardest hit when disasters occur (Cuny 1983).

The Philippines is one of the disaster-prone countries in the world, ranking 4th in the number of people killed by floods, tsunamis, typhoons, landslides, volcanic eruptions and man-made disasters. Being located along the usual path of tropical storms, the country is visited annually by more than 20 typhoons.

In one occasion on November 29, 2004, flashfloods and mudflows resulting from heavy torrential rains that induced mountain soil erosion, landslides and overflowing of river systems caused an unprecedented loss of lives and properties in the towns of Real, Infanta and General Nakar (REINA area) in Quezon Province and Dingalan in Aurora Province. These areas are located at the periphery of Luzon Island near the Philippine Sea (Fig. 1). The calamity caused the displacement of more than 1 million people and death to more than 2,000. More than 300,000 hectares of prime agricultural land, mainly lowland rice, were seriously affected and had become upland areas due to the massive landslides (SAC 2005).



Source: E.C. Godilano

Fig. 1. Site of the flashfloods and mudflows in Quezon Province and Aurora Province, Philippines

In the aftermath of responses to the calamity by relief agencies and concerned individuals, it was recognized that “relief assistance” alone does not strengthen the capacity of the affected communities to cope with the next emergency (WFP 2002). Hence, this study and paper aims to establish and develop working arrangements for a multi-stakeholder partnership and strengthen linkages to institutionalize support services and extension delivery system including monitoring and evaluation. Also, it aims to develop collaborative and participatory mechanisms in designing and testing integrated farming system technologies appropriate to disaster-affected communities.

METHODOLOGY

The Study Site

Barangay Boboin, one of the heavily affected villages in the town of Infanta, Quezon was chosen as the study site. As of 2004, it has a population of 1, 589 persons and 266 households. It only occupies a small area, roughly 266 hectares. The village has a Type II climate, characterized by no dry season and with a pronounced maximum rain period from November to January. Average annual rainfall (1971 – 2000) is 4,150.1 millimeters. December is the wettest month while April is the driest (Fig. 2).

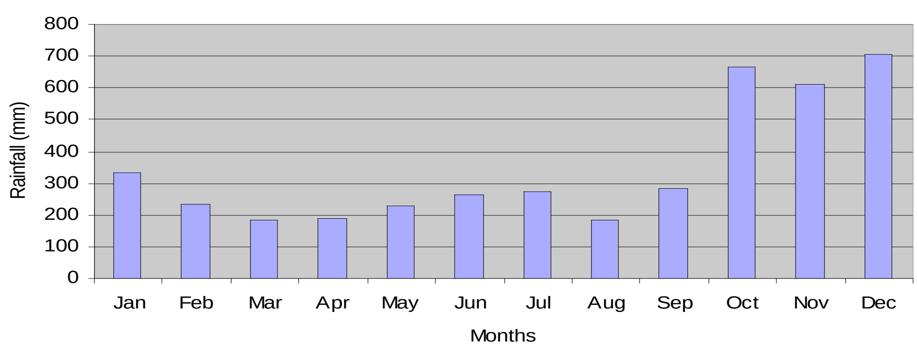


Fig. 2. Rainfall pattern in Boboin, Infanta, Quezon, Philippines

Framework of the Study

The study adopted the concept of "complex adaptive systems" developed by Comfort et. al. (2004) as a theoretical framework to explain the dynamic processes involved in achieving coordinated action among multi-entities to manage complex technical operations in environments vulnerable to risks (Fig. 3).

Following the framework, the multi-stakeholder partnership is an attempt to achieve a coordinated response in rehabilitating the affected farmlands. As more organizations are involved in the system, more interactions will ensue among stakeholders or individuals with different levels of responsibility but focused on a common goal. Under this context, the goal designing technology to support coordinated action requires both technical and organizational planning. Such planning needs to create an awareness of risk in order to define effective action within and among organizations. For agricultural rehabilitation focus, coordination may be achieved more easily with the appropriate design of a socio-technical system, that is, a system that supports the exchange of significant information among technical and organizational entities.

The model can be demonstrated by the general features of the process, to wit:

1. Rehabilitation focus and rebuilding activities are essential in the calamity-stricken areas because the biophysical and socio-economic conditions have abruptly changed in a short period of time;

2. A church-based NGO is at the forefront with spiritual-based transformation as the focal point for strong community participation and action;

3. Implementing integrated agri-livestock-livelihood systems and support mechanisms are necessary since whole/adjacent communities are affected to address a holistic approach of change;

4. There is a need for strong and multi-disciplinary database/information base to ensure multi-functionality of recommendations to be derived;

5. Target beneficiaries have suffered not only loss of agricultural produce as major source of income but also have suffered emotional stress and traumatic experience that affected their total well-being, hence the need for integrated approach at all levels;

6. Partnership at all levels is seen as a strong enabling strategy inasmuch as the target beneficiaries and the affected areas need a holistic assessment and integrated support systems for institutional mobilization;

7. Adaptive mechanisms are provided to cope up with the availability of technology, information resources and favorable conditions. However, the project has to provide adjustment to accomplish desirable output even at less than optimum but substantial level to attain project's goals even at a reduced scale or prolonged duration;

8. The target areas pose risk of recurrence of source of problem, hence, there is a need to integrate coping mechanisms in the strategies;

9. Learning mechanisms are provided not only at the community level but also at institutional levels as well.;

10. Sustainability mechanisms are integrated for enhancing internal capacity and developing strong external linkages. These include linkage mechanisms at all levels with respect to disaster management and rehabilitation of affected areas.

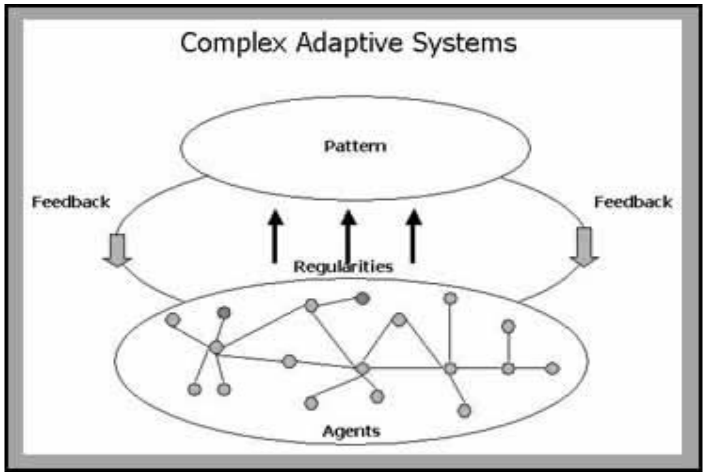


Fig. 3. Theoretical framework adopted by the study from the "complex adaptive systems" developed by Comfort et al

Development of Multi-Stakeholder Partnership

The partnership builds upon collaborative undertakings with defined roles and responsibilities in implementing people-centered rehabilitation and restoration of damaged ecosystem. With this premise, the Social Action Center (SAC), a church-based NGO based in Infanta, Quezon, Philippines, feeling the need for a scientific rehabilitation of the affected area, sought technical assistance from the Commission on Higher Education (CHED), which also referred the matter to the Philippine Council for Agriculture, Forestry and Resources Research and Development (PCARRD). PCARRD then seek collaboration with the University of the Philippines Los Baños (UPLB) for technical assistance (Fig. 4).

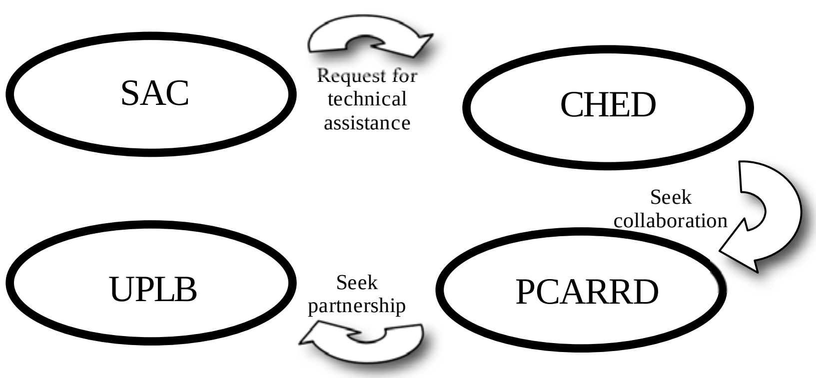


Fig. 4. Relationships and involvement of the different project partners

The first meeting of the project partners was done on September 16, 2006 to discuss areas of collaboration to respond to the request of SAC for assistance in the rehabilitation of affected areas in Infanta, Quezon, Philippines. Being vital parts of the partnership, the Local Government Unit (LGU) of Infanta, Quezon, Philippines, the village council of Barangay Boboin and the community were consulted and involved in the ensuing activities which is a means of strengthening the partnership. Also, identification of the roles of the different partners in the rehabilitation of the area had been done through a series of planning and project inception meetings.

Design and Testing of Integrated Farming Systems Technologies

To facilitate crop production in the new agricultural landscape, crop suitability, particularly for upland rice, and soil nutrient management studies were done in the area. Different varieties of upland rice were introduced and planted in farmers' fields (Table 1**)**. Coupled with this, different fertilizer rates and sources (Table 2) were integrated into the upland rice varietal trial. Fertilizer sources include inorganic and organic (guano and compost) materials. A two-season trial was done before coming up with the suitable upland rice varieties and fertilization that could give acceptable yield levels. Through continuous consultation, farmers also identified other crops aside from upland rice which included corn, vegetables, honeydew melon and watermelon. Latter part of the study had some farmers wanting to integrate *Jatropha curcas* in their production system.

Table 1. Upland rice varieties used during the dry and wet season and days to maturity. Boboin, Infanta, Quezon, Philippines.

Variety	Days to Maturity
V1 - PSB Rc-9	115-123
V2 - AG-5	95-105
V3 - M-45	110-115
V4 - M-108	115-120
V5 - UPL Ri-5	125-130
V6 - UPL Ri-7	116-120
V7 - Red Borong	120-125

Table 2. Fertilizer treatments (rate and kind) used for the dry and wet cropping seasons, Boboin, Infanta, Quezon, Philippines.

Treatment Number	Treatment Description (rate and kind of fertilizer)
T1	Control (no fertilizer)
T2	90+60+60 kg NPK/ha
T3	45+30+30 kg NPK/ha
T4	45+30+30 kg NPK/ha + 2 tons/ha organic fertilizer
T5	45+30+30 kg NPK/ha + foliar fertilizer spray
T6	4 tons/ha organic fertilizer
T7	6 tons/ha organic fertilizer

RESULTS AND DISCUSSION

Development of Multi-Stakeholder Partnership

As a result of consultations among the partners and stakeholders, the roles of those actually involved in the rehabilitation of the area were identified **(**Figure 5**).** This enabled a smooth project implementation and a more focused conduct of activities of each entity. While this is so, continuous consultation, planning and monitoring are regularly done so that any problem that may arise could be readily addressed (ASC and SAC, 2008).

The different stakeholders involved in the flow of information, energy and materials have varying roles and responsibilities, converging to some extent towards a collective gain. The specific and collective outputs are then translated to impacts in terms of the development of sustainable agricultural systems, food security and safety, poverty alleviation, environmental rehabilitation and protection and people empowerment leading to sustainable development. These synergistic relationships involving iterative processes are captured in the system and served as critical inputs to the agricultural rehabilitation project. The convergence on the ground by the different actors (i.e. farmers, local government units, academic institutions, NGOs etc.) through information sharing and pooling of resources (i.e. human, financial and material) resulted in utilizing knowledge adaptable to the local context.

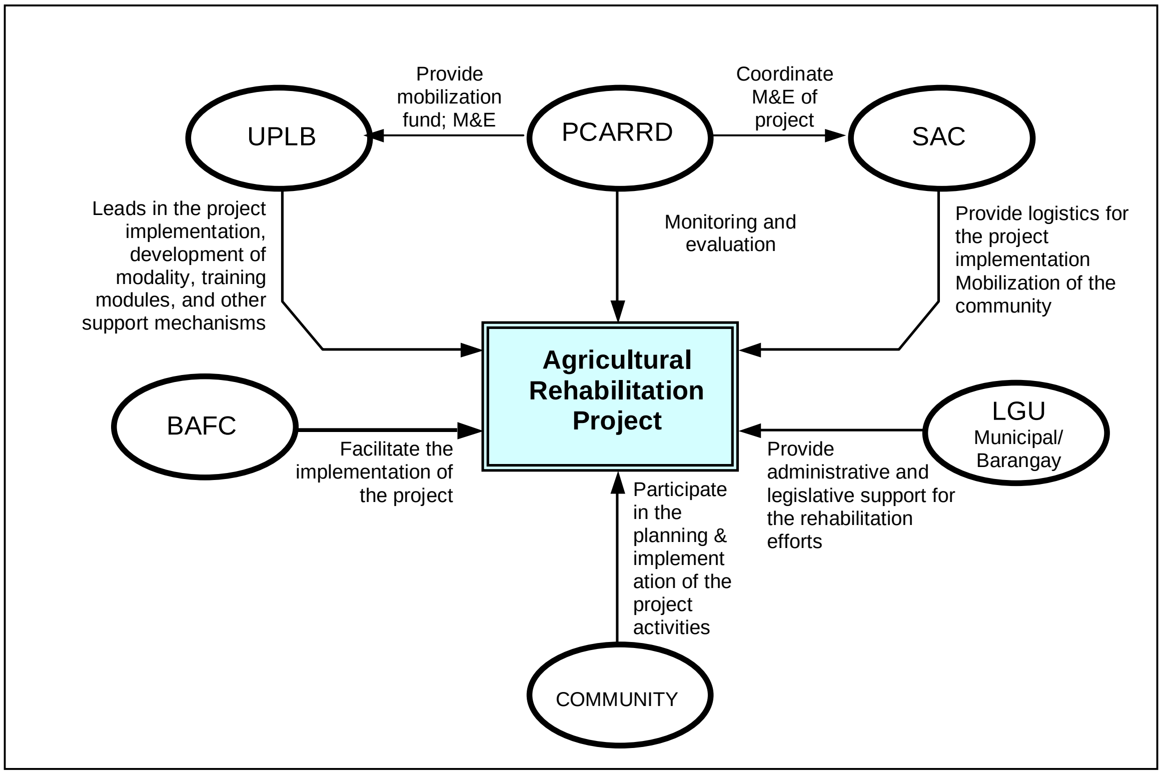


Fig. 5. Roles of the different actors in the project implementation.

Bio-physical and socio-economic assessment of the study site

A detailed assessment was done to ascertain the biophysical and socio-economic characteristics of the affected farmers. Initial activity of the partnership was assessing the area and the agricultural resource base particularly the soil, in order to determine the feasibility of planting food crops in the community through a participatory rural appraisal (PRA).

Assessment activities also involved determining the extent and depth of soil deposition in the village and the soil pH across the area which will be important inputs in identifying what crops can be grown and what strategy to employ to rehabilitate the damaged soil ecosystem. Socio-economic characterization delves more on determining the local farm practices, size of landholdings, status of land ownership, credit sources, input and output market sources and demographic features of the farmers affected by the landslide. Of the area, it was found that about 78 hectares were badly affected with mud deposition ranging from 30-105 centimeters (Fig. 6). It has high infiltration rate because the deposition does not contain enough clay which could increase water holding capacity, making it not suitable for paddy rice production. Also, with the use of a soil test kit to determine soil fertility status in the area, it was found that the soil is mostly acidic and low in NPK (Fig. 7**)**. One year after the calamity, grasses, shrubs and trees dominated the agricultural lands of Barangay Boboin, Infanta, Quezon. Very few patches can be planted to paddy rice and vegetables.

With regards to the depth of soil deposition in the village, a post-calamity land management strategy was developed (Fig. 8) as guide in choosing appropriate interventions and basis in the selection of suitable crops to plant. For areas with thin soil deposition, lowland rice cultivation can still be continued but with some soil amelioration measures including the application of organic fertilizer. For areas with thick soil deposition, where water cannot be impounded because of high infiltration rate, the planting of upland crops was recommended. Upland crops identified include: upland rice, corn, watermelon, and vegetables. The criteria for selecting the crops were: a) farmers' preference, b) can thrive under low soil fertility, c) with ready market, and d) high return.

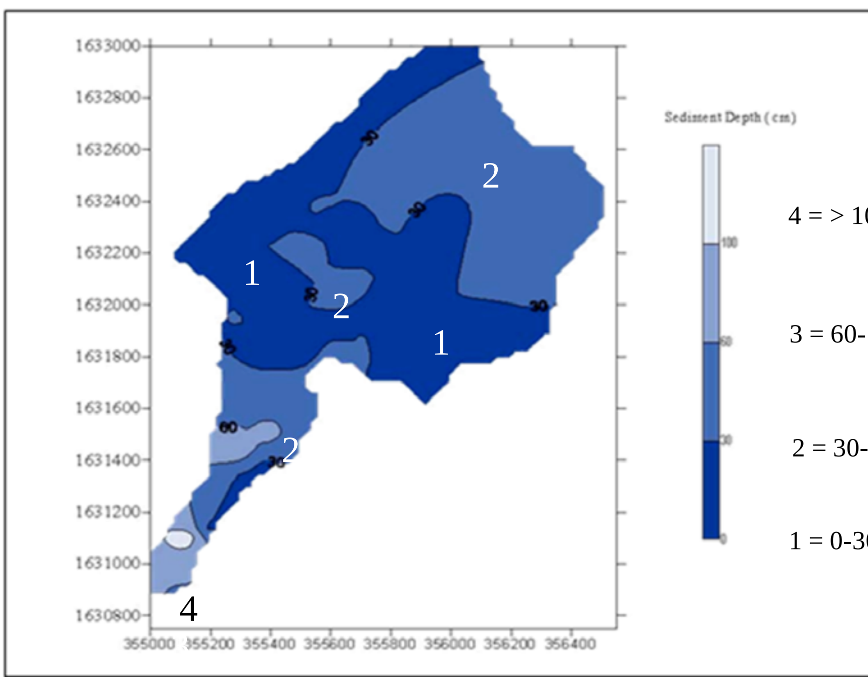


Fig. 6. Depth of soil deposition in Boboin, Infanta, Quezon, Philippines after the landslide.

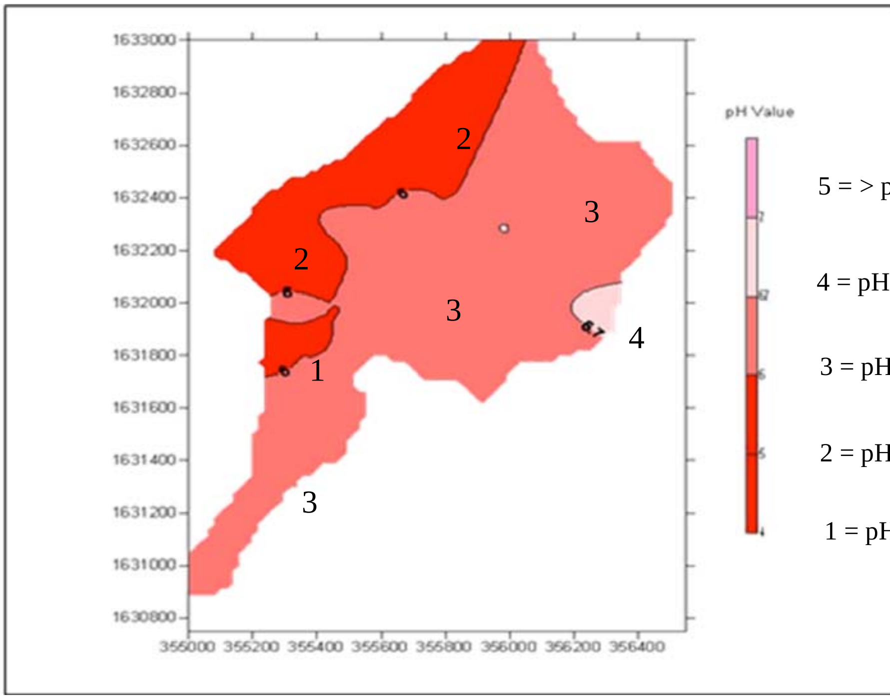


Fig. 7. Soil pH in Boboin, Infanta, Quezon, Philippines after the landslide.

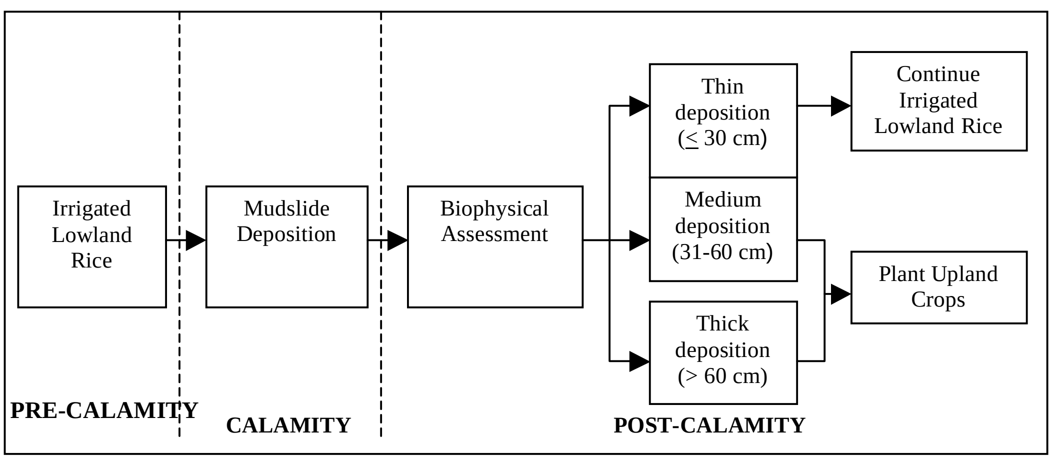


Fig. 8. Post-calamity land management strategy for Boboin, Infanta, Quezon, Philippines.

On-farm Trials of Integrated Farming Systems Technologies

With the new agricultural landscape (change from lowland to upland agro-ecosystem), a lot of things in the community's agriculture also changed: soil pH and fertility were altered and new crops and varieties have to be planted. From these perspectives, the integrated farming systems being designed for the area started with these parameters which included testing the pH of the "new" soil, determining what upland rice varieties could grow in the area and knowing optimum fertilization levels where these crop varieties can give acceptable yields. Hence, various trials were conducted.

For the fertilizer trial, the average upland rice yield for two cropping seasons is presented in Table 3. In general, yields obtained are low compared to average yields that can be obtained under normal conditions, indicating low soil fertility in the area. Plots without fertilizer gave a very negligible yield. Hence, increasing soil fertility will have to undergo a process through time with the use and addition of appropriate fertilizer materials. The data show that the use of inorganic fertilizer gave the highest yield which could be due to faster nutrient availability to the plants. While this is so, it can also be seen from the table that addition of organic fertilizer and incorporating higher rates in the soil can approximate the yield when using pure inorganic fertilizer. Given the availability of organic fertilizer materials in the area and with increasing cost of inorganic fertilizer, the rehabilitation of the soil's fertility can be done in a more-environment friendly way and at less cost if part of the fertilizer requirement usually obtained from inorganic sources will be replaced by organic materials.

Table 3. Average yield of upland rice for two cropping seasons under different fertilizer treatments.

Fertilizer Treatment	Yield (tons/ha)*
T1 - Control (no fertilizer)	0.75 [c]
T2 - 90+60+60 kg NPK/ha	4.00 [a]
T3 - 45+30+30 kg NPK/ha	2.97 [ab]
T4 - 45+30+30 kg NPK/ha + 2 tons/ha organic fertilizer	3.35 [ab]
T5 - 45+30+30 kg NPK/ha + foliar fertilizer spray	2.04 [b]
T6 - 4 tons/ha organic fertilizer	2.34 [b]
T7 - 6 tons/ha organic fertilizer	2.57 [ab]

***** Means followed by the same letter are not significantly different at 5% level of the DMRT test

Upland rice yields from the varietal trial conducted for two seasons to find the variety suited to the area and those preferred by the farmers are shown in Table 4. During the first cropping, variety M-108 gave the highest yield, though not statistically different from the rest except Red Borong. In the second cropping, the farmers selected only four of the original seven varieties for planting. Aside from yield levels, the farmers selected the varieties based on their observations on crop stand, grain size, panicle length and eating quality. Succeeding cropping by the farmers in the village involved only the variety PSB Rc-9. The variety gave the highest average yield during the second cropping and the farmers further observed that it has good grain filling characteristics and tolerance to lodging.

Table 4. Average yield of upland rice varieties tested in Barangay Boboin, Infanta, Quezon, Philippines (tons/hectare).

Variety	1st Cropping (DS) **	2nd Cropping (WS) **
V1 - PSB Rc-9 *	4.98 [ab]	3.0 [a]
V2 - AG-5 *	3.59 [ab]	2.1 [a]
V3 - M-45	3.69 [ab]	-
V4 - M-108 *	5.16 [a]	2.9 [a]
V5 - UPL Ri-5 *	3.52 [ab]	2.3 [a]
V6 - UPL Ri-7	4.30 [ab]	-
V7 - Red Borong	1.75 [b]	-

*****Upland rice varieties selected by the farmers for planting during the 2nd cropping (WS)

******Means followed by the same letter are not significantly different at 5% level of the DMRT test

Every rice cropping season, one of the most important problems encountered by the farmers were weeds. Controlling weeds through hand weeding required high labor input because of heavy weed infestation. A trial on weed control using herbicide was also conducted to help solve the problem. Herbicide applications using herbicides metsulfuron and bispyribac sodium were compared with hand weeding (Table 5).

Table 5. Comparison of upland rice yield under different weed control treatments. Boboin, Infanta, Quezon, Philippines

Treatments	Rice Yield (t/ha)*
T1 - Bispyribac sodium	5.21 [a]
T2 - Metsulfuron	3.36 [b]
T3 - Hand weeding	3.30 [b]

***** Means followed by the same letter are not significantly different at 5% level

Metsulfuron is a herbicide used to control sedges and broadleaves and can be applied either as a pre-emergence or as post-emergence herbicide. It works through both contact and residual soil activity and is not prone to volatilization. Bispyribac sodium on the other hand, is suitable for annual grasses, sedges and broadleaves. It is selective and systemic post-emergence type of herbicide. Bispyribac sodium-treated plots gave the highest yield of 5.2 t/ha, which is significantly higher than the metsulfuron and hand-weeded plots, which have comparable yields. Hence, the herbicide trial has presented to the farmers a tangible option of controlling weeds that will not only reduce time and labor requirements in weeding but will provide a better environment to the rice plant for increased yield levels.

CONCLUSIONS

Disaster response and rehabilitation could be an enormous task both for the affected community and for those who would extend assistance. However, the task is made easier if a multi-stakeholder approach is adopted coupled with the presence of a local organization or group that can immediately respond to the various concerns of the rehabilitation process. Moreover, provision of viable options to the community in terms of livelihood, technologies and other support services is crucial. In so doing, developing the community's capability to respond to the next disaster rather than making them dependent on any kind of assistance extended should be a vital responsibility of any entity providing assistance for disaster rehabilitation. Furthermore, the need for a champion becomes a key component in rehabilitating calamity-stricken areas. This in essence, would lay the foundations of the rehabilitation process, allowing the affected individuals or communities to mount a cohesive effort in restoring their confidence and bringing back to their feet to produce their own food and rebuild their livelihoods. Bringing in appropriate agricultural technologies that can help sustain or alleviate food production is another vital component of the rehabilitation process.

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