# PHILIPPINE RICE R&D HIGHLIGHTS 2012

PHILRICE LOS BAÑOS

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# PhilRice Los Baños

Branch Manager: DG Ramos

The PhilRice Los Banos (PhilRice LB) station based at the University of the Philippines Los Banos (UPLB) was the cradle of PhilRice's operations before its transfer to Nueva Ecija. It was the Institute's principal office and became a branch station in March 1990. Situated in a prime science community, PhilRice LB has since served as the front-liner in developing and implementing projects in coordination with a scientific network that includes its research-giant neighbors, the International Rice Research Institute (IRRI) and UPLB.

In support of the National Food Staples Sufficiency Program (FSSP), the station focuses its work on the development and packaging of location-specific technologies for rainfed and upland areas. It has activities on plant breeding, crop protection, agronomy and soils, rice chemistry and food science, and technology promotion and development. The station is also designated as in-charge of the hybrid nucleus and breeder seed production initiatives of PhilRice.It was instrumental in the diversification of the germplasm base of the rice breeding program by using wild rice species. The station's strong partnership with Los Baños scientific community and local government units brought about a number of location–specific technologies and innovations, the most popular being the Minus–One Element Technique, a diagnostic tool to determine soil nutrient deficiency.

## I. Rice genetic improvement for rainfed lowland rice and drought-prone environment through the integrated application of the conventional and non-conventional breeding methods

VC Lapitan

Rice is cultivated under diverse ecosystems from irrigated to rainfed upland to rainfed lowland. In the Philippines, rainfed lowland and upland areas are considered important system of growing rice. They have great potential in increasing rice productivity and hence, in helping attain the country's goal of self-sufficiency (Francisco, 2010). However, these areas which occupy about 38% of the total cropped rice area, contribute only 21% to total rice production (Khush, 1997). Primarily, the lower productivity in these areas is caused by the frequent occurrence of drought due to a failure of rain or a long spell between two rains. Likewise, rice blast, caused by the fungus Pyricularia oryzae, has been reported to occur intermittently in most rainfed lowland environments and can contribute to high yield losses especially when plants have been subjected to drought stress.

The need to address the constraints affecting yield is very important to cater to the continual demand by the country's population growing at 2.3% per annum and to provide the need of many rural poor who rely on rice farming under rainfed and upland conditions. The continued application of conventional breeding and the recent developments in non-conventional approaches offer significant potential for improving yield growth and durable resistance to blast for upland and drought prone rainfed lowland rice environments.

**Genetic improvement of drought tolerance with high yield and good grain qualities for rainfed ecosystem**
VC Lapitan

Drought is a major production constraint of rainfed lowland rice. Damage from drought may occur at the seedling and tillering stages. On some occasions, the damage is also severe at the reproductive stage. Yield losses caused by drought at the combined anthesis and seedling stages were about double those caused by weeds, which was the second-ranked constraint (Widawsky and O'Toole 1990). These yield losses, and the severe poverty of most rainfed rice farmers, limit the scope for increasing yields through the intensification of input use. Irrigation enhancements can be employed to mitigate drought stress. However, drought tolerant varieties developed through plant breeding are more accessible to farmers than these interventions that might require them large investments.

For varietal improvement, the continued application of conventional breeding and utilization of biotechnology tools such as anther culture technique offer significant potential for improving yield growth in rainfed lowland rice environments. This study aimed to develop rice varieties with high and stable yield and good grain quality for rainfed and drought prone environments through the integrated application of the conventional and dihaploidy breeding methods

Highlights:

- From a total of 258 rice accessions acquired and evaluated for biotic and abiotic resistance/tolerance and other value-added traits since 2011, fifty potential parents were selected for breeding for rainfed drought-prone environment.

- One thousand two hundred sixty F3 lines were selected from the 36 F2 populations evaluated during the 2012 DS. Out of these lines, 750 were selected and advanced to F4 population. These F4 lines are being evaluated under both irrigated lowland and upland conditions (drought-stressed) this 2013 DS.

- For the second batch of hybridization in 2012 DS, a total of 38 parent materials were assembled and able to generate 40 crosses. Out of these, 32 F1s are being evaluated in the field this 2013 DS.

- Twenty seven "recalcitrant" genotypes were evaluated for anther culturability and 12 were identified responsive to AC. Among the genotypes, NSIC Rc288 was the most responsive followed by PSB Rc10 and 60. Salumpikit was the most responsive among the five TVs evaluated. Two out of five callus induction media were selected (modification was focused on the nitrogen content of the media). Anther culture efficiency was increased from 0 to 1.8%.

**Development of rainfed lowland rice lines with durable resistance to rice blast**
NM Angeles, VC Lapitan

Constant and rapid adaptation of blast fungus results in breakdown of plant's resistance to the disease. Plants with one resistance gene have been reported to be effective at some point. But because of the nature of blast fungus, plants need to have quantitative resistance which is thought to delay pathogen evolution because of its polygenic nature. A combination of major genes and minor genes is believed to contribute to durable disease resistance. SHZ-2, a Chinese cultivar, has been reported to carry durable resistance genes. This study aims to develop rainfed lowland rice lines with SHZ-2 alleles for durable resistance to rice blast.

Highlights:

- Around 700 BC2F1 seeds were generated.

- BC2F1 seeds were planted to generate BC2F2 seeds.

- Reinoculated F2 to confirm 18 SSR markers for foreground selection; genotyping in progress.

- SNP genotyping through Bead Express will be employed for background selection.

**II. Increasing lowland rice productivity in Regions IVA, IVB, and V through pest and nutrient management**
JRM Vergara

This project focused on addressing rice production problems in the region through rice research on irrigated and rainfed lowland. It aimed to improve the lowland rice farming practices in Regions IV and V through proper pest and nutrient management.

Specifically:

1. Characterized the biophysical and agro-climatic conditions of rainfed lowland areas in selected provinces of Southern Tagalog and Bicol Region.

2. Improved rice yields in irrigated lowland areas through efficient nutrient management, and utilization of nutrient management research (e.g. eMOET) in Regions IV and V.

3. Increased yield through proper pest management in rainfed lowlands by identifying and understanding the role of the natural enemies/biological control agents attacking the different stages (egg, nymph/larva and adult) of the rice insect pest.

4. Corrected and identified the effect of multi nutrient deficiencies of lowland rice farms in the region.

**Characterization and survey of rainfed lowland rice soils in Regions IV and V**
JRM Vergara, CP Mamaril

Soil biophysical, and agro-climatic characterization of rainfed lowland areas in selected provinces of Region IV and V was done to develop management technologies to increase the yield of rainfed lowland farmers, in terms of nutrient management. Possible researchable areas in rice science will be identified as a result of characterization. The study will help the extrapolation of identified PhilRice technologies by identifying the characteristic of rice areas in the region.

Highlights:
2012 DS

- Seven soil samples were collected from three major rice municipalities of Marinduque and two samples from rainfed rice areas of Infanta, Quezon.

- Nine samples were analyzed in UPLB ASL for texture, organic matter, N, P, K, Zn, and Cu. The data showed that lowlands soils of Marinduque have great risk of heavy metal contamination. The table showed the chemical analysis of soils in Torijos, Marinduque, the largest rice area in the province. The Cu level is higher than the critical toxicity level of 50 ppm. Zn is also at toxicity level with a critical value of 4 ppm.

**Table 1.** Chemical analysis of soils in Torijos, Marinduque

| Parameters | Lowland Soils | Upland Soils |
|---|---|---|
| pH | 5.5 | 4.4 |
| % OM | 2.72 | 0.46 |
| Available P ppm (bray) | 6 | 18 |
| Exchangeable K | 0.09 | 0.09 |
| %N | 0.12 | 0.04 |
| Zn ppm | 9 | 4 |
| Cu ppm | 193 | 155 |
| $SO_{4\ ppm}$ | 2554 | 339 |
| Texture | Silt loam | Sandy loam |

- Interviews were conducted with seven farmers on their management practices.

- Infanta's rice area is potassium-deficient due to its soil texture. Soil analysis is still in progress.

- Another general bio physico-chemical characterization was done in rice areas of Polillio, Quezon. Most of the rice areas were now irrigated thru the SWIP NIA project. In terms of nutrients, N, P, K, S, and Cu deficiencies were identified. HEALS and DA-RFU collaborates for a municipality wide project that uses MOET in assessing nutrient deficiencies. Though MOET can identify deficiencies, proper trial should be conducted for specific nutrient recommendations that will suit the needs of clay soil with low organic matter (1.7 %) and farms with fertilizers and pesticides access problems. In depth characterization on pest and biodiversity was done under LBL 006 003 study.

2012 WS

- General characterization on rainfed lowland environments (drought prone, saline prone, and flood prone) was done in three municipalities of Camarines Sur.

- Hypotheses of the mechanism of drought in Buhi, salinity in Calabanga, and flooding in Nabua were identified and formulated.

- Thru focus group discussion, the group that included researchers, LGU staff, and DA RFU staff identified some important factors that should be monitored to characterize and develop rice management in the said adverse rice ecosystems.

- For drought prone, rainfall, depth of water table, soil moisture tension, and soil moisture characteristics were identified. Rainfall pattern will be gathered to identify the possibility of cultivating other high value crops when water is limiting.

- For flood prone areas, it is important to identify the mechanism and time of flooding. Soils in the Nabua were analyzed using MOET. The results showed that the soil exhibits N, slight K, and severe Zn and S deficiencies that must be corrected.

- In saline prone rice areas, it is important to analyze the dynamics of rainfall, evapotranspitation rate, fresh water hydrology, tide occurrence, salinity of sea water coming into the field, salinity level of the soil, elevation, and distance from sea water. MOET tests were conducted prior to planting but, unfortunately, plants dried up due to salt effect. Soil samples were submitted to UPLB ASL for analysis. Piezometer was installed in a farm in Belen, Calabanga. Water samples were collected weekly from July to September 2012 and salinity was tested using EC meter. Rainfall data was also gathered. The results showed that during the monitoring, salinity ranges from 0-630 ppm, way below the salinity tolerance of rice which is 2560 ppm or 4dS/m.

**Development, evaluation, and promotion of eMOET software**
JRM Vergara

MOET kit provides a general recommendation for nutrient management of lowland rice on the basis of amount of nutrient taken up by the plants to produce a ton of palay. Rice should absorb 17 to 20kg N, 8 to 10kg P, 17kg K, 3 to 5kg S, 40 to 60g Zn, and 5 to 7g Cu to produce a ton of grain per hectare, (Yoshida, 1989). This recommendation was plotted to software to help the farmer identify the amount of fertilizer to be applied after knowing the limiting nutrient and farm size.

Through MOET, the farmer can supply the rice crop with the right kind of nutrient at the right time to ensure proper nutrient management. With the development of eMOET, the software can easily compute the right fertilizer rate based on their land area, target yield, and nutrient deficiencies.

eMOET was developed using the Microsoft Visual Basic. The study validated the effectiveness of its recommendation in experimental and farmers' field. Also further improvement in the recommendation was identified.

**Highlights:**
2012 DS

- Validation in experimental site in CES UPLB for hybrid (NSIC Rc202H) and inbred (PSB Rc82 ) was done. Target yield testing started from 5 to 7 tons for inbred; and from 5 to 9 tons for hybrid. Soil was analyzed using MOET and showed deficiency in N and S. Table 2 shows the yield at 14% moisture content given the treatments.

**Table 2.** Yield of NSIC Rc202H and PSB Rc82 to different nutrient application.

| **Treatment/target yield** | **Nutrient Applied** kg N, kg S, and kg K | **Yield (t/ha)** | |
|---|---|---|---|
| | | Inbred (PSB Rc82) | Hybrid (NSIC Rc202H) |
| Control | 0 | 3.95 c | 3.86 c |
| 4 tons | 80 , 20 | 4.98 ab | |
| 4 tons + 30 kg K | 80 , 20 | 4.89 ab | |
| 5 tons | 100, 25 | 4.56 b | 5.52 b |
| 5 tons +30 kg K | 100, 25,30 | 4.64 ab | |
| 5 tons +60 kg K | 100, 25,30 | 4.82 ab | |
| 6 tons | 120,30 | 5.06 a | 5.71 b |
| 6 tons + 30 kg | 120,30,30 | | 6.10 ab |
| 6 tons +60 kg | 120,30,60 | | 6.10 ab |
| 7 tons | 140,35 | 5.07 a | 6.7 a |
| 8 tons | 160, 40 | | 6.1 ab |
| 9 tons | 180, 45 | | 6.87 a |
| CV % | | 5.80 | 9.99 |

- Result showed that inbred (PSB Rc82) had a maximum yield of 5t/ha at the maximum level of 140kg N applied while hybrid (NSIC Rc202H) yielded 6.8t/ha at the maximum level of 180kg N.

- Additional K application at the rate of 60kg K2O showed significant yield increase in hybrid but not in inbred. The recommendation should consider the nutrient efficiency of rice to have a better yield prediction.

2012 WS

- The validation experiment showed no significant response in hybrid yield during WS 2012. The field was slightly affected by stem borer causing the greater CV of hybrid plots.

**Table 3.** Yield response of PSB Rc82 and NSIC Rc202H to different nutrient applications.

| **Treatment/target yield** | **Nutrient Applied** kg N, kg S, and kg K | **Yield (t/ha)** | |
|---|---|---|---|
| | | Inbred (PSB Rc82) | Hybrid (NSIC Rc202H) |
| Control | 0 | 3.51 b | 3.11 a |
| 4 tons | 80 , 20 | 4.20 a | |
| 4 tons + 30 kg K | 80 , 20 | 4.03 ab | |
| 5 tons | 100, 25 | 3.93 ab | 3.58 a |
| 5 tons +30 kg K | 100, 25,30 | 4.00 ab | |
| 5 tons +60 kg K | 100, 25,30 | 4.26 ab | |
| 6 tons | 120,30 | 4.16 a | 3.61 a |
| 6 tons + 30 kg | 120,30,30 | | 3.26 a |
| 6 tons +60 kg | 120,30,60 | | 3.58 a |
| 7 tons | 140,35 | 3.67 ab | 3.33 a |
| 8 tons | 160, 40 | | 3.21 a |
| 9 tons | 180, 45 | | 3.21 a |
| CV % | | 9.15 | 10.8 |

- Pre-test in 1,200 m2 plot in Infanta, Quezon, using PSB Rc122 was done in a farmer's field. It yielded 680kg of fresh palay (5.6t/ha), greater than the target yield of 5t/ha.

- In terms of software improvement, nutrient efficiency during wet and dry season was not considered in computing the recommendation. It is better to include it in the computation.

- Many factors should be considered in estimating the yield response of rice to nutrient management. Further studyon those factors should be done for a better yield estimate.

**Diversity of rice insect pests and its natural enemies in selected rainfed areas in Regions IV and V**
MAA Capricho

The rice plant is subject to attack by more than 100 species of insects which cause economic damage. Stem borers, leafhoppers, and planthoppers (which cause direct damage by feeding and transmitting viruses); leaf defoliators (mainly lepidopterans); and grain-sucking bug complex are among the field pests that cause significant yield losses. With the introduction of high-yielding modern varieties, distinct changes have occurred in the insect pest complex of rice. Some species considered as minor have become major pests when the conditions are favorable for their build-up. Spraying insecticides is the farmers' common practice to control pest. It is well-known that the application of insecticides causes harm to the environment, thus affecting the beneficial species living in the rice ecosystem and surrounding environment.

The rice ecosystems have a rich diversity of natural biological control agents. These natural biological agents are important in rice insect pest management, thus preventing pest outbreaks.

Highlights:

- Three hundred bottled samples of rice arthropods were collected during periodic sweep net sampling in selected rainfed areas in Region IV and V.

- Collected samples were processed in the laboratory. The most tedious part of taxonomic processing (sorting and identification) is still in progress.

- The research study had to adopt the concept of morphospecies due to lack of taxonomic literature and experts. Thus, each morphologically different individual in a sample was assumed to belong to a different species.

- As a result of the periodic monitoring of pests, an emerging rice pest was observed in the field. Specimen samples were collected and identified to be a lygaeid bug. Dr. Victor P. Gapud, a hemipterist, identified the bug complex to species level.

**Impact of nutrient management in the improvement of rice grain yield and quality in multiple nutrient deficient soils**

ACM Baradas, APP Tuaño, JRM Vergara, CP Mamaril, BO Juliano

Lowland rice yields in many irrigated areas of the country are still on the average of about 3t/ha despite the adoption of modern package rice production technologies. Some fairly large irrigated lowland rice areas are found in marginal lands with inherently low soil fertility due to their acidity, alkalinity, and peat nature. Even with the use of certified seeds of high yielding varieties, the application of the nationally recommended rates of Nitrogen (N), Phosphorus (P), and Potassium (K) fertilizers do not bring about yields more than the national yield average of 3.7t/ha. The identification of the specific nutrient limitations in these soils is one important step toward recommending appropriate soil and fertilizer management practices to improve yields in marginal areas to at least 5t/ha. Raising yield levels will not only help alleviate poverty in the rural areas but will also contribute toward sufficiency of rice food supply.

It is also imperative that results from grain quality studies are at hand to serve as guide for producers on the impact of certain nutrient management practices on improving/maintaining the grain quality of their produce.

**Highlights:**

- Five sites were visited to do site characterization and soil sampling collection. Farmers were interviewed regarding their farm practices and management. Two sites were selected and land preparation of these sites is now ongoing for the coming planting season.

- Deficiencies were identified using the MOET test. Two sites appeared to have more than two deficiencies and will be used for experiment setup.

- Experiment site was established at Brgy. Bubuin, Infanta, Quezon. The area appeared to be deficient in N, P, and K. Transplanting was done on June 18, 2012. First fertilization was done two weeks after transplanting. Peizometer and observation well were installed in the experiment site.

- Grain yield were significantly higher in treatment with complete application of nutrients compared to other treatments shown in Figure 1.

- Generally, grain quality had no significant differences between properties like brown rice yield, total milled rice yield, head rice yield, and immature grains. It appeared that in percent chalkiness, different treatments have different response in each variety.

- Grain yield at 14% moisture content at farmer's field in Pila and Infanta was increased from reported 4t/ha and 3t/ha, respectively, to 5t/ha.

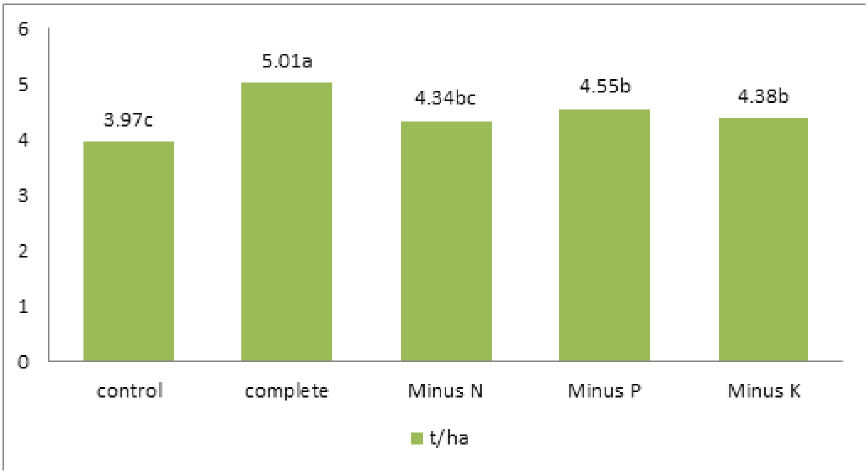


Figure 1. Mean grain weight at 14% moisture content.

**III. Development of Integrated Crop and Nutrient Management for Upland Ecosystem in Regions IV and V**
MB Castillo

The research aims to develop appropriate crop and nutrient management for soils grown with upland rice in Regions IV and V. The objectives of the study were to (1) characterize the climatic, physical, and chemical characteristics of the soil, and socio-economic condition of the upland rice areas; (2) validate and utilize the upland MOET as a diagnostic tool in determining the nutrient deficiencies of upland soils; and (3) develop an integrated crop and soil nutrient management for upland using both organic and inorganic fertilizer sources.

**Integrated crop and nutrient management for upland rice**
MB Castillo, CP Mamaril

The study expected to develop (1) location-specific fertilizer recommendation for upland rice (target yield of 2t/ha or more for traditional and modern varieties, (2) technology options for increased productivity of upland rice, and (3) upland MOET refined for diagnosing nutrient limitations of upland soils. A total of 15 field trials on upland rice were conducted during the 2012 WS. Six upland rice varietal x fertilizer management trials were established in Ligao, Albay; Dasmariñas, Cavite; Malvar, Batangas; Los Baños, Laguna; Catanauan, Quezon; and Abra de Ilog, Occidental Mindoro. One varietal trial consisting of three modern and seven traditional varieties was established in Mansalay, Oriental Mindoro. Furthermore, one demonstration trial of upland rice varietal x fertilizer management was conducted at Torrijos, Marinduque. Moreover, seven field trials on Bio N, inorganic fertilizer level, planting method, foliar, organic, seeding rate, and pest management were conducted at Block A10, UPLB CES, Los Baños, Laguna.

**Highlights:**

- A fertilizer recommendation of 20-30-30 can significantly increase the yield of NSIC Rc11 (modern variety) while Inipot-Ibon (traditional) was not responsive to fertilizer application.

- Bio N showed inconclusive results while foliar fertilizer application was found ineffective in increasing the yield of upland rice.

- Commercial organic fertilizer at the rate of 1t/ha and 2t/ha did not increase the grain yield of NSIC Rc9 compared to inorganic fertilizer while both organic and inorganic fertilizers did not increase the grain yield of Inipot-Ibon.

- The planting methods which allow spacing between rows such as row-seeding and dibbling, broadcast then furrowed instead of broadcasting, were effective in NSIC Rc9. Inipot-ibon was not affected by the different planting methods.

- No significant difference in grain and straw yields was observed in 40, 50, 60 and 80kg/ha seeding rates, thus, 40kg/ha is sufficient for upland rice. Seeding rate of 40kg/ha is sufficient for upland rice.

- Total rainfall of at least 682 to 1,547mm distributed in the critical growth stages of rice growth is sufficient to improve upland rice growth and yield, however, total rainfall of 998mm but unevenly distributed greatly contributes to reduction in yield.

- The conventional practice of pest management which involves application of pesticides when necessary and IPM using shrimps as attractant were comparable and significantly increased the straw yield of NSIC Rc9 and Inipot-ibon.

- The yields obtained in Dasmariñas, Cavite were quite high. This was evident from the grain yields of NSIC Rc192, NSIC Rc13, and

Minindoro with yields that ranged from 3 to 3.4, 2 to 2.9, and 2.9 to 4.0t/ha, respectively. Nevertheless, there was no conclusive trend on the effect of fertilizer management on the three varieties used.

- In Abra de Ilog, Occidental Mindoro, grain and straw yields were not affected by the varieties (NSIC Rc11, NSIC Rc9, and Kamuros) used. However, the application of inorganic fertilizer significantly increased the grain and straw yields while organic plot and control were comparable. The low yields ranging from 0.32 to 0.73t/ha was due to unfavorable weather condition, pest (i.e. root aphids), and disease (i.e. blast and brown spot) problems.

- In Mansalay, Oriental Mindoro, the varietal trial with blanket fertilizer application of 30-20-20 was conducted to evaluate the yield and growth performance of three modern varieties and six traditional varieties. The yields obtained from modern varieties ranged 4.1 to 4.7t/ha while traditional varieties ranged from 2.5 to 3.6t/ha. Kinandang Puti and Kamuros which yielded 3.6 and 3.5t/ha, respectively, were comparable to the modern varieties, NSIC Rc9 (4.7t/ha), NSIC Rc11 (4.1t/ha), and NSIC Rc192 (4.6t/ha). Pinalawan yielded 3.4t/ha while Tabuno yielded 3.3t/ha. The traditional varieties which yielded the lowest were Dumali, Inipot-Ibon, and Ninaic at 2.7, 2.5, and 2.5t/ha, respectively.

- In Torrijos, Marinduque, inorganic fertilizer at the rate of 30-20-20 significantly increased the straw yield of NSIC Rc9 and Rc11 compared to organic fertilizer at the rate of 1t/ha equivalent to 26-76-41kg NPK.

- Varietal x fertilizer trial conducted in Batang, Ligao, Albay (PhilRice Bicol) produced low yields due to unfavorable weather condition, pest, weed, and disease problems.

- Four upland soil samples from Laguna, Albay, Quezon, and Occidental Mindoro was subjected to upland MOET, however, results of analysis based on MOET and lab analysis were not similar in the sense that more limiting nutrients are detected using the laboratory analysis compared to upland MOET. This maybe because the upland MOET setup was maintained at field capacity moisture content, therefore, it does not reflect the actual condition of the soil under upland or aerobic condition. Further study needs to be conducted.

- Some of the problems/constraints in upland rice production are: (1) poor germination of seeds especially those stored for a long time, (2) poor land preparation due to heavy weed infestation during crop growth, (3) water and heat stress after sowing and during the critical growth stages of the crop, (4) heavy rain, floods, and windy condition during flowering and ripening stages, (5) erosion in sloping areas (low yields obtained), (6) small parcels of upland rice areas located in mountains surrounded by dense vegetation are prone to pests, (7) weeds such as Cyperus rotondus (mutha), cogon etc., (8) pests such as white grubs, mole cricket, rice bug, birds, rats, root aphids, and (9) diseases such as blast, brown spot, BLB etc.

- Some of the solutions to constraints are: (1) sun drying of seeds before sowing to break dormancy especially for traditional varieties, (2) thorough land preparation to prevent weed infestation, (3) use of pre- and post-emergence herbicides with manual weeding, (4) construction of canals for waterlogged areas, (5) sowing along contours in sloping areas and planting of vegetables or other crops as hedgerows to avoid erosion, (6) treating seeds with insecticides before planting or immediately after sowing to prevent infestation of whitegrubs and mole cricket, (7) use of insect repellants such as shrimp, crushed golden snail, and dead frog to control rice bug or pesticides when necessary, (8) rat baits such as racumin or zinc phosphide mixed with rice grains, (9) avoid planting too early when the field has no enough moisture to ensure good germination of seeds, (10) avoid too much application of herbicides because this can also cause impairment to the growth of the rice crop, and (11) maintain the cleanliness of the field, that is, remove/eliminate the weeds to avoid competition for water and nutrients with the rice crop.

**Diversity of Rice Insect Pests and Its Natural Enemies in Selected Upland Areas in Regions IV and V**
MAA Capricho

The rice plant is subject to attack of more than 100 species of insects that cause significant yield losses. These are stemborers, leafhoppers and planthoppers (which cause direct damage by feeding as well as by transmitting viruses); leaf defoliators (mainly lepidopterans); and grain-sucking bug complex. The introduction of high-yielding modern varieties led to distinct changes in the insect pest complex of rice. Some species have become major pests under favorable conditions for their build-up. Farmers' common practice to control the pest is to spray insecticides. However, insecticides cause more harm to the environment, thus affecting the beneficial species living in the rice ecosystem and surrounding environment.

The rice ecosystems have a rich diversity of natural biological control agents. These natural biological agents are important in rice insect pest management, thus preventing pest outbreaks.

The study aimed to: (1) identify the natural enemies/biological control agents attacking the different stages (egg, nymph/larva and adult) of the rice insect pest; (2) understand the role played by these natural enemies; (3) investigate the pest status in the selected rainfed rice ecosystem; and (4) determine factors that trigger pest.

**Highlights:**

- Several upland areas were visited in Cavite, Batangas, Quezon, Mindoro Occidental, Mindoro Oriental, Marinduque, Albay, and Sorsogon.

- Sweep net sampling and collection of rice arthropod were conducted in established upland fertilizer field trial in Ligao, Albay; Dasmarinas Cavite; Bangwayin , Torrijos; Catanauan, Quezon; Mansalay, Mindoro Oriental; and Abra de Ilog, Occidental Mindoro. Periodic sampling was done at 45, 60, 90 DAS, and maturity stage of the rice plant. Individual sampling were done in every plot in relation to pest X fertilizer interaction. Samples were properly labeled. Aside from pest damage assessment, other observations such as presence of weeds were also considered and noted.

- Collected samples of rice arthropods were brought in the laboratory for processing. The most tedious part of laboratory processing (sorting and identification) is in progress. The concept of morphospecies had to be adopted by the research study due to lack of taxonomic literature and experts. Thus, each morphologically different individual in a sample was assumed to belong to a different species.

- Among the arthropod sorted from the samples and observed in the field are the following: at seedling to maximum tillering stage - white planthopper (Cofana sp.), tiny flea beetles, green leafhopper, brown planthopper, leaf folder, ladybird beetle, tiger beetles, and numerous rice bugs at milking stage to harvest. These tiny flea beetles were observed scraping the leaf tissues and further investigation of this particular organism which may have a potential of becoming a pest if left unattended. Heavy infestation of white grubs was observed in Roxas, Palawan and root aphid infestation in Catanauan and Abra de Ilog. The observed lygaeid bug considered as emerging rice pests was also observed and collected in Ligao, Albay; Dasmarinas, Cavite; Bangwayin, Torrijos; and Macalelon, Quezon but not in Catanauan, Quezon.

## IV. Socioeconomic and policy research on rice in Southern Luzon

JLM Ocampo

A socioeconomic benchmarking and analysis of the rice and rice-based industries covered by PhilRice Los Baños station is crucial in formulating policy recommendations linked to research and technology developments introduced in the areas of Regions IV-A, IV-B, and V. A proper documentation of its socioeconomic conditions is needed to clearly assess the situations the rice farm households and other stakeholders in the regions face. This project aims to conduct rice socioeconomic and policy research in Southern Luzon covering Regions IV-A, IV-B, and V by supporting the technical researches of the station and assess the economic feasibility of technologies for farmers' adoption. As part of the station-based project, a socioeconomic baseline characterization was conducted in two major research and technological studies: (1) baseline characterization of rainfed lowland rice farms and (2) farmers' specialty rices in selected provinces of Regions IV-A, IV-B, and V. Final analysis of the two studies are currently being conducted aimed for publication  afterwards.

### Socio-economic characterization of rainfed lowland rice farmers in selected provinces of  Region IV-A, IV-B, and V

JLM Ocampo, FS Aguilar, JRM Vergara, CP Mamaril

Among the popular contributors to the crop yield is its soil productivity, which could be mostly observed in the cases of rainfed lowland ecosystems. PhilRice Los Baños Socioeconomics Team (SET) worked hand in hand with the Integrated Crop and Nutrient Management Division (ICNM) which leads in testing the biophysicochemical characterization of soil.  Determining the baseline socioeconomic characteristics of rice farming in rainfed lowland areas would serve as information for development of nutrient management in the areas selected. In addition, the data gathered could be used in the formulation of recommendations for the targeted sites. Application of appropriate nutrient management techniques can help increase the productivity and profitability in rainfed lowland target sites. A total of 102 baseline household surveys were conducted in barangays Casa Real, Kabulusan, and Casinsin in the municipality of Pakil, Laguna and in barangays Poctoy and Marlangga in Torrijos, Marinduque. Baseline socioeconomic profiling of rainfed lowland farmers in Pakil and Marinduque was aimed to undertake a holistic method of farm characterization.

**Highlights:**

- In Pakil, farmers planted on different mono-cropping periods, whereas respondents from Marinduque practiced bi-cropping. Most of the farmers obtained high yields during the wet seasons in Pakil as observed in Kabulusan, where 81% of the respondents obtained yields higher than 3t/ha in 2011 WS. Moreover, mean rice yields across seasons were at a range of 1.4t/ha in Casa Real to a high of 4t/ha in Casinsin. On the other hand, average rice yields across Marlangga and Poctoy were low ranging from 1.3 to 2.9t/ha during 2011 WS and 2012 DS. Drought was the major reason for the low yields obtained by farmers in Marinduque and Pakil.

- Physical input data utilized by respondents was also collected. Inorganic fertilizers and farmer chemicals were commonly used by farmer-respondents inPakil and Marinduque, seeds were used in small and large volumes across seasons, and pre-harvest and total labor were intensive. Farmers in the sites used a lot of farm inputs despite lack in irrigation resource and financial support.

- Average farm gate per unit income in Pakil ranged from a loss of P9.75 to a gain of P8.16 across the three barangays and across seasons. Whereas, wholesale level per unit income was from a loss of P4.13 to a gain of P10.98. Based on these results, profitability was further enhanced when farmers mill the rice they produce and sell at the wholesale market, primarily due to the higher price of milled rice except in Casa Real as there were very small yields compared to the costs. Getting palay yield greater than 3t/ha implies cost efficiency and higher profitability across barangays.

- Using the mean gross income by source and the adjusted provincial food threshold (P65,792/year) and provincial poverty threshold (P93,651/year) in Laguna, corresponding carrying capacity (CC) ratios across barangay sites, income sources, and municipality were derived. Based on the results, the general observation was that income from rice farming alone was not able to cover both the food and poverty thresholds. As with the aggregate agricultural-based income, only Kabulusan was able to meet both thresholds. These were characterized by low agri-based income which in turn is a consequence of low hectarage and low cropping intensity. Lastly, the results pointed to the ability of having diversified income sources (agri and non-agri-based) for Kabulusan and Casinsin to attain food and poverty thresholds.

- Further assessment of the existing nutrient management techniques of the respondents will be done to complete the data analysis of the study.

**Profitability and supply chain analysis of farmer's specialty rice**
FS Aguilar, JLM Ocampo, APP Tuaño, BO Juliano

Rice plays an integral role in the economy of the Philippines. Farmers cultivate rice, primarily through traditional farming practices. Rice is their major source of income, yet the rice sector in the country faces some significant constraints. Breeding program of rice varieties is essential in improving its quality by tapping the existing traditional rice varieties known to farmers as specialty rice's because of their distinct characteristics (like aromatic, soft to medium cooked rice and with good physical attributes). Baseline socioeconomic household and miller surveys were conducted which aims to present the supply chain of this farmer's specialty rice and evaluate its profitability and identify different activities, constraints and factors affecting it based on the list provided by the Rice Chemistry and Food Science Division of the station covering municipalities of Dasmariñas City, Cavite; Tagkawayan and Buenavista, Quezon; Torrijos, Marinduque; and Pili, Camarines Sur. Data analysis on Torrijos and Pili survey is ongoing to come up with consolidated report and paper.

**Highlights:**

- A total of 303 farmer-respondents cultivating mostly of traditional rice varieties interviewed across all study sites. Mean age of farmer-respondents across all sites ranged from 42 to 54 years of age. Majority of the farmer-respondents completed elementary education with an average of seven years in schooling. Farmer-respondents were into rice farming for 30 years and support a family of six to seven household members. Households were dominated mostly of male farmer-respondents. Majority of the farmer-respondents were married, followed by single, widowed, and few separated respondents.

- Average landholdings of all farmer-respondents range from 0.5 to 1.2ha . Majority of the farms cultivated for rice alone were rainfed followed by a few irrigated areas. Sixty percent of the farmer-respondents own their land while 31% are shareholders, 7% amortizing owner, and few leasehold farmer-respondents. Due to lack of irrigation facilities, most of the farmer-respondents practice direct seeding as their method of crop establishment during wet season.

- Majority of the farmer-respondents produce the seeds they use as planting materials. They also exchange seeds with other farmers. They keep their produce for own consumption and as seeds for the next cropping season. Farmers in Cavite and Quezon sometimes sell their produce at high market price.

- Mean rice yield levels in Cavite, Quezon, and Marinduque were low with less than or equal to 3t/ha in Bosigon, Quezon and a range of 0.5t/ha to 2t/ha in Maligaya, Quezon. Moreover, Sibuyao in Torrijos recorded a seeding rate of three bags per hectare and Bosigon in Tagkawayan at 1.5 bags per hectare.

- Some of the farmer-respondents' fspecialty rice varieties cultivated across study sites are shown in Table 4. This indicates that farmers preferred these varieties for their distinct characteristics, physical attributes, and good eating quality despite the presence of modern released rice varieties in the area. Actual supply chain was generated, showing that farmer-respondents' chain ended in traders and consumers for their personal consumption and/or as seeds for next cropping season (Figure 2). Rice millers in Quezon and Cavite were interviewed; three from Dasmariñas City, Cavite; two from Buenavista; and another two from Tagkawayan, Quezon. Data analysis on miller's survey in Marinduque and Camarines Sur is ongoing.

**Table 4.** Documented Farmers' Specialty Rices of Respondents in Regions IV-A, IV-B and V

| PROVINCE | FARMER'S SPECIALTY RICE VARIETIES |
|---|---|
| Cavite | C1 Pula, C1 Puti, Binirhin, Minindoro, Jasmin, Dinorado, Gininto, Sebador, Perurutong Azucena, Kirikiri, Palawan, Malagkit |
| Quezon | Kamuros, Bininbin, Blondie, Balibod, Inipot-Ibon, Dinurado, Binuhangin, Minantika, Nagdami, Binat-ang, Sinawa, Iningkanto, Kabugok, Dinalune, Tinumbaga (Malagkit), Binulaw, Waray, Kinamalig, Kinarangkang, Binayawak, |
| Marinduque | Dinorado, Pinansit, Azucena, Kabuno, Inintsik, Bud-uy, Gininto (Malagkit), Kilabo, Everlasting, Tinano, TintangPasakaw, TintangMalagkit, Kinabayo, Pinorsige, Inipot-Ibon, Kinastilyas, Solpak, Kalibu, Pinilik, Sinimbalang (Malagakit), Hingunhon |
| Camarines Sur | Blondie, Tiramas, Gurong-gurong, Paroy, |

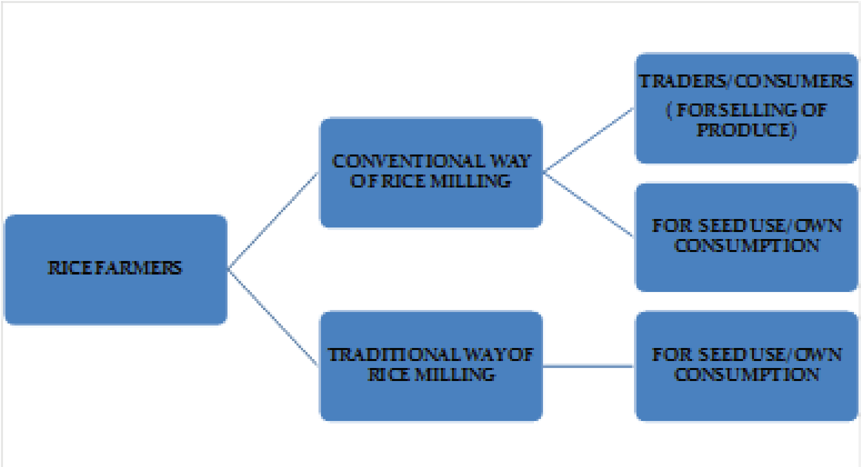


**Figure. 2.** Actual Supply Chain of Farmer's Specialty Rices in Regions IV-A, IV-B and V.

**V. Research, development and promotion of Location-Specific Technologies (LST) for Southern Luzon, Regions IV and V**
IDG Olvida

To reach diverse rice stakeholders, the project focused on harnessing the rice garden to enhance rice awareness for the urban dwellers, especially the students. It also tried to reach and enhance the capabilities of the marginalized Mangyans of Mindoro and evaluated and validated location-specific technology recommendations for irrigated and rainfed ecosystems.

**Harnessing the rice garden in promoting and enhancing rice awareness and appreciation in the urban setting**
MM Movillon, N Deseo, FS Aguilar

Rice Garden is a simulation of actual traditional and modern varieties of rice rice plants at different growth stages, for the different rice-growing environments, and for various consumers' needs and preferences. The project was envisioned to educate the general public about rice and its importance to Filipinos; its whole production spectrum from breeding to harvesting, recent technological improvements that can improve rice farming and enhance the quality of life of the Filipino farmer. The target audiences in particular were the youth, who are the country's future leaders, and the city dwellers who are less knowledgeable on rice farming and are often most vocal during rice crises.

Highlights:

- On its 10th year, the Rice Garden at the Rizal Park, Manila conducted a successful ceremonial rice harvesting on November 26, 2012. PhilRice Los Baños led the activity which was attended by 13 schools (five elementary schools and eight high schools) from Manila and from other institutions and cooperating agencies. Along with this event, PhilRice also had NCR Launching of the National Year of Rice 2013 led by Dir. Eufemio T. Rasco, Jr (Figure 3).

- The event also initiated the idea of establishing smaller Rice Gardens in schools starting 2013 in cooperation with DepEd, thru Secretary Br. Armin A. Luistro. This will also be part of the promotion of NYR 2013.

- The total number of participants in the event increased from 300 in 2011 to 600 this year.

- The Rice Quiz Bee and Rice Trivia held as part of the program helped increase knowledge and better awareness of the students about rice and other rice-related products and information.

- The 300-m2 rice garden was planted in July 2012 with high-yielding (NSIC Rc288), hybrid (Mestiso 20), and traditional (Inipot-Ibon) rice varieties to showcase to the people in the urban area.

- DepEd will adopt the concept for implementation in 15 Manila llementary and high schools.

**Figure 3.** Agriculture officials among other rice stakeholders attended the ceremonial harvesting in Luneta.

**Enhancing the capabilities of Indigenous Peoples (IPs) through integrated- and diversified farming systems approach:Customizing the Palayamanan Model for the Mangyan of Occidental Mindoro**

MM Movillon, IDG Olvida, MFQ Austero

Thru the Palayamanan concept, rice is integrated with various crops (vegetables, field crops, fruit trees), livestock, among other products. Integration and diversification harness and maximize the use of local resources. In the process, farmers are capacitated and empowered to determine and adopt farming technologies/strategies adaptable under their local conditions, to increase farm productivity and profitability and contribute to food security.

The Mangyans of Mindoro are indigenous people spread out in the islands who need timely government intervention to uplift their socio-economic conditions and address their needs. Many are situated in the unfavorable rainfed and upland environments, with generally low farm productivity, with a growing number of household members to be fed. Mangyans were dependent in upland farming which they grew root crops to feed their family.

For the past years, PhilRice RSOs were deployed to Occidental Mindoro. Some of the Mangyans participated in the Farmers' Field School. It facilitated the organization of the IP Palayamanan participants and easier access to the community. The two sites have the most Iraya-Mangyan inhabitants. The Palayamanan technology intended to showcase resource allocation options to augment or maximize IP framer's income. Planting of fruit trees/tree crops in barren hills in the sloping portions of their upland fields was expected to supply the needed fruits and shade, while vegetables and other field crops can be made available year-round for every household in the village.

**Highlights:**

- A three-day capacity enhancement activity was conducted in two sites in Abra de Ilog, an IP community which shows interest in adopting the Palayamanan System. The activity was participated by 70 pax with 50 Mangyans and 20 Tagalogs in Sitio Bagong Baryo, and 47 Mangyans in Sitio Pambuhan on the first quarter of the project.

- Two Palayamanan sites (Sitios Pambuhan and Bagong Baryo). Planting started with nine types of vegetables namely pechay, pole sitao, ampalaya, tomato, eggplant, pipino, squash, and bottle gourd, and were planted in plots. A demo field of varietal and nutrient management demo for upland rice, and a nutrient demo for corn with STIARC were also established. Yields were influenced by the season, water supply , and pest incidence.

**Table 5.** Yields in the Palayamanan sites

| CROP | AREA ($m^2$) | YIELD (t/ha) |
|---|---|---|
| Vegetables | 2535 | |
| • Pechay | | 11 |
| • Pole Sitao | | 11.5 |
| • Ampalaya | | 26 |
| • Tomato | | 15 |
| • Eggplant | | 22 |
| • Pipino | | 20 |
| • Squash | | 19 |
| • Bottle Gourd | | 20 |
| Rice* | 1200 | |
| • Kamoros | | 0.92 |
| • NSIC Rc9 | | 0.60 |
| • NSIC Rc11 | | 0.38 |
| Corn | 3024 | 3.2 |

- Results showed that Kamoros had the highest yield at 0.92t/ha followed by NSIC Rc9 at 0.60t/ha, and NSIC Rc11 with 0.38t/ha. In terms of fertilizer management, plots with organic fertilizer produced more yield with 0.83t/ha, followed by organic plots at 0.56t/ha while control had the lowest at 0.51t/ha. The relatively lower yield can be attributed to various factors such as pest and disease infestation especially with modern varieties.

- Demo fields served as the training ground for the IPs in crop production. A customized Farmer Field School was conducted alongside the demo field, participated by 27 and 24 Mangyans in Bagong Baryo and Pambuhan, respectively. Speakers were from STIARC, PHILRICE, MLGU and PLGU.

- FGD, data gathering, and monitoring along with the FFS in the area were also done. The following information were gathered:
  - Majority of the participants were farmers planting upland rice.
  - In dry season, farmers' income comes from selling cogon..
  - They seek advice from the elders.
  - Some were tenants and laborers in the field of Tagalog.
  - The vegetables planted are pechay, radish, sitao, and ampalaya.
  - Other crops they plant include rice, corn, cassava, and banana
  - They get their drinking water from river and springs.
  - Some went to high school but most are elementary graduates.
  - Most of them do not have experience or training crop

production.

- The year-end project assessment with the Mangyan elders and participants shows that the participants wish to continue their participation in the project which they say have helped them enhance their capacity in crop production.

**Evaluation and validation of Location Specific Technology (LST) recommendations for Southern Luzon**

IDG Olvida, KAMP Balingit

The threatening condition of rice production versus the demand of skyrocketing population continues to challenge different sectors in our country. The national government set down the blue print on how to increase and sustain rice production to feed 90 million Filipinos whose staple food is rice. Through collaboration with its umbrella agencies, the Department of Agriculture came up with the Philippine Rice Master Plan 2009-2013. One of the strategies identified to meet rice self-sufficiency is to invest in and develop technologies which can contribute up to 25% of the target increments. PhilRice, a national agency which spearheads rice and rice-based research and development, plays a vital role in providing opportunities for all rice stakeholders to generate useful and practical farming technologies and innovations. The PalayCheck® system of the agency has proven that farmers can enhance the profitability in rice farming through increasing yield while reducing costs of production. However, the lack of knowledge of farmers on using the PalayCheck® system and the diversity of arable lands in the country hinder incremental targets in focus provinces. Hence, PhilRice customized these systems through the implementation of location-specific technology development (LSTD) in 2009 WS. PhilRice started the LSTD project to scale-up a community-based PalayCheck® technology platform by adopting a more location-specific or customized approach to train farmers and information support service in irrigated farms where rice yields are below 4.2t/ha, in rainfed areas with below 2.9t/ha, and in upland rice areas with below 2.0t/ha. This should be strengthened to support the national rice and other staples self-sufficiency program. LSTD provides opportunities both for farmers and agricultural extension workers to work together in generating recommended farming practices suited in the locality. It also hastens the adaptation and adoption of other technologies through experiential learning. This study aimed to field-validate the LST recommendations for rainfed and irrigated ecosystems and come up with corresponding recommendations, as well as lessons learned in developing location-specific technology recommendations.

**Highlights:**

- LST packages were collected from Rice Sufficiency Officers (RSOs) assigned in Naujan and Calapan for Oriental Mindoro; and Pitogo, Macalelon, Guinayangan, Infanta, and General Nakar for Quezon.

- Two 1,500sqm techno demo farms (TDF) were established in Brgy. Pinagbayanan, Macalelon Quezon and in Brgy. Batino, Calapan, Oriental Mindoro. Both sites undergone location-specific Technology Development – Farmers' Field School (LSTD-FFS) during 2011 dry and wet seasons. The varietal trials location was chosen due to the strong LGU support based on previous LSTD implementation.

- Split-plot design was used for the statistical analysis of data after the end of each season. Five varieties – NSIC Rc222, Rc216, Rc214, Rc212, and PSB Rc18, were planted. Initial yield data for the TDF sites were were shown in Tables 6 and 7.

**Table 6.** Actual yield data of TDF in Brgy. Batino, Calapan, Oriental Mindoro, WS 2012.

| | **Location Specific Technology Recommendation (LST)** | **Farmers Practice (FP)** |
|---|---|---|
| NSIC Rc214 | 6.73 | 7.13 |
| NSIC Rc216 | 5.5 | 5.5 |
| NSIC Rc222 | 7.23 | 6.93 |
| PSB Rc18 | 7.9 | 7.9 |

*NSIC Rc212 has low germination (40%).
*NSIC Rc214 recorded higher FP yield than LST. NSIC Rc216 and Rc18 had equal yield. It happened because the hired laborers for transplanting mistakenly mixed the varieties in majority of the plots, despite supervision of farmer-cooperator (FC).

- Most of the time, the FC was also engaged in other municipal activities and recently, in a NIA project. Thus, the FC had a hard time managing the crop leading to error in determining the actual harvest.

**Table 7.** Actual yield data of TDF in Brgy. Pinagbayanan, Macalelon, Quezon, WS 2012

| | Location Specific Technology Recommendation (LST) | Farmers Practice (FP) |
|---|---|---|
| NSIC Rc 212 | 7.62 | 5.63 |
| NSIC Rc214 | 7 | 5.64 |
| NSIC Rc216 | 4.78 | 4.55 |
| NSIC Rc222 | 7.25 | 5.99 |
| PSB Rc18 | 7.6 | 6.76 |

*The area was properly managed by the farmer cooperator since he was fully devoted to farming, in addition to being the full time manager to his farm. The TDF located in Macalelon showed better yield results.

- Series of presentations will be done to promote the results and recommendations from the validated LSTs. Farmer and LGU adoption of LST recommendations will be evaluated and validated to know the importance of LST in rice farming. The recommendations will be implemented in selected LSTD areas. Corresponding adoptions of LGUs will also be evaluated. This will further help in the development of LSTs fit for the location.

## VI. Development of integrated crop and nutrient management for upland ecosystem in Region IV-A

MB Castillo

The project which focuses on Region IVA aimed to develop a nutrient recommendation for upland rice with target yield of 2t/ha by 2015. It also aimed to come up with a guide for rice pest identification with corresponding management recommendation for upland rice. The objectives of the study were (1) to characterize the climatic, physical, and chemical characteristics of the soil, and socio-economic condition of the upland rice areas in Region IV-A; (2) to validate and utilize the upland MOET as a diagnostic tool in determining the nutrient deficiencies; (3) to develop an integrated crop and soil nutrient management for upland using both organic and inorganic fertilizer sources; and (4) to package mature technology on upland rice for the benefits of our upland rice farmers.

**Integrated crop and nutrient management for upland rice Region IVA**
MB Castillo, CP Mamaril

The expected outputs of the study were to develop (1) location-specific fertilizer recommendation for upland rice (target yield of 2t/ha or more for traditional and modern varieties) and (2) upland MOET refined for diagnosing nutrient limitations of upland soils.

**Highlights:**

- Thirty farmers were interviewed and 24 soil samples were collected from the provinces of Quezon (Gumaca, Macalelon, Catanauan), Laguna (Los Baños), Batangas (Malvar, Tanauan, Calaca, Lemery, Tuy, Agoncillo), and Cavite (General Trias, Maragondon, Magallanes, Alfonso, General Aguinaldo, Dasmariñas, Silang)

- The yields obtained were quite high. This was evident from the grain yields of NSIC Rc192, NSIC Rc13, and Minindoro with yields that ranged from 3 to 3.4, 2 to 2.9, and 2.9 to 4.0 respectively . Nevertheless, there was no conclusive trend on the effect of fertilizer management on the three varieties used. This may be due to the uneven fertility of the soil caused by the bulk application of chicken manure applied to the crop prior to upland rice experiment (Dasmariñas, Cavite).

- Grain and straw yields at 1.1 to 2.9 and 4.0 to 5.4t/ha was not affected by varieties, NSIC Rc9 and Inipot-Ibon. Although it was evident that inorganic fertilizer application with or without additional organic fertilizer increases the straw yield, it was not clearly seen in the grain yield since the control was comparable with the inorganic fertilizer treatments (Los Baños, Laguna).

- No significant results were obtained from the grain yields of NSIC Rc9, NSIC Rc13, and Binuhangin applied with different organic and inorganic fertilizer treatments. The yields were very low which ranged 0.09 to 0.20t/ha. The earlier flowering of these modern varieties compared to Binuhangin attracted pests such as rats and birds which fed on their grains during the booting to hard dough stage. The windy condition during flowering and heat stress also caused sterility and unfilled grains (Catanauan, Quezon)

- There was no data on grain and straw yields because the experiment was terminated due to very poor crop growth. Plant height and tiller counts were measured at 62 DAS. No significant differences were found among the fertilizer treatments. In terms of varietal differences, NSIC Rc11 was observed to have significantly smaller plants compared to NSIC Rc192 and Kinardo. On the other hand, Kinardo had lower number of tillers than NSIC Rc11 and NSIC Rc192 (Malvar, Batangas).

- Two upland soil samples from Laguna and Quezon were subjected to upland MOET. However, the results of analysis based on MOET and lab analysis were not similar. More limiting nutrients were detected using the laboratory analysis compared to upland MOET test. This maybe because the upland MOET setup was maintained at field capacity moisture content, thus, most of the nutrients were present in their available form.

**VII. Development of integrated crop and nutrient management for upland ecosystem in Region IV-B**
MB Castillo

The project which focuses on Region IVB aimed to develop a nutrient recommendation for upland rice with target yield of 2t/ha by 2015. It also aimed to develop a guide for rice pest identification with corresponding management recommendation for upland rice. The objectives of the study were (1) to characterize the climatic, physical, and chemical characteristics of the soil, and socio-economic condition of the upland rice areas in Region IV-B; (2) to validate and utilize the upland MOET as a diagnostic tool in determining the nutrient deficiencies; (3) to develop an integrated crop and soil nutrient management for upland using both organic and inorganic fertilizer sources; and (4) to package mature technology on upland rice for the benefits of our upland rice farmers.

**Integrated crop and nutrient management for upland rice in Region IVB**
MB Castillo, CP Mamaril

The expected outputs of the study were to develop (1) location-specific fertilizer recommendation for upland rice (target yield of 2t/ha or more for traditional and modern varieties) and (2) upland MOET refined for diagnosing nutrient limitations of upland soils.

One varietal x fertilizer trial on upland rice was conducted at Abra de Ilog, Occidental Mindoro during 2012 WS. Another varietal trial consisting of three modern and seven traditional varieties was established at Mansalay, Oriental Mindoro. Furthermore, one demonstration trial of upland rice varietal x fertilizer management was conducted at Torrijos, Marinduque.

Highlights:

- Twelve farmers were interviewed and nine soil samples were collected from Occidental Mindoro (Abra de Ilog, Rizal), Oriental Mindoro (Mansalay, Gloria), Marinduque (Torrijos).

- Grain and straw yields were not affected by the different varieties (NSIC Rc11, NSIC Rc9, and Kamuros) used. The application of inorganic fertilizer increased significantly the grain and straw yields while organic plot and control were comparable. The low yields ranging from 0.32 to 0.73t/ha was due to unfavorable weather condition, pest (i.e. root aphids), and disease (i.e. blast and brown spot) problems (Abra de Ilog, Occidental Mindoro).

- The varietal trial with blanket fertilizer application of 30-20-20 was conducted to evaluate the yield and growth performance of three modern varieties and six traditional varieties. The yields obtained from modern varieties ranged from 4.1 to 4.7t/ha while traditional varieties ranged from 2.5 to 3.6t/ha. Kinandang Puti and Kamuros which yielded 3.6 and 3.5t/ha, respectively were comparable to the modern varieties, NSIC Rc9 (4.7t/ha), NSIC Rc11 (4.1t/ha), and NSIC Rc192 (4.6t/ha). Pinalawan yielded 3.4t/ha while Tabuno yielded 3.3t/ha The traditional varieties which yielded the lowest were Dumali, Inipot-Ibon and Ninaic at 2.7, 2.5, and 2.5t/ha, respectively (Mansalay, Oriental Mindoro).

- Grain yields were not affected by the varieties used, NSIC Rc11 and NSIC Rc9 as well as the fertilizer management, organic and inorganic which ranged from 1.4 to 2.0t/ha. On the other hand, inorganic fertilizer at the rate of 30-20-20 significantly increased the straw yield of both varieties compared to organic fertilizer at the rate of 1t/ha equivalent to 26-76-41 kg NPK (Torrijos, Marinduque).

- One upland soil sample from Occidental Mindoro was subjected to upland MOET and laboratory analysis. The results from upland MOET showed N deficiency only, however, the laboratory analysis showed Ca, Fe, and Mg deficiencies aside from N.  This maybe because the upland MOET setup was maintained at field capacity moisture content, thus, most of the nutrients were present in their available form.

**Establishment of Palayamanan model farms in the uplands of Mindoro, Marinduque, and Palawan**
IDG Olvida, MM Movillon, JLucas, SM Angeles, AJoy Acierto, MT Carido, MF Austero, KAM Balingit

The development of the upland rice ecosystem is an opportunity to augment the country's rice supply as this is located in the fringes of the rural areas. Adapting the Palayamanan platform will help promote sustainable farming systems and practices in the upland communities, capacitate upland farmers and farmer organizations, Agricultural Extension Workers (AEWs) in upland crop production, and other Palayamanan components. The actual site will have to be recommended and validated with the local partners based on potential for crop diversification, accessibility and visibility to the community/general public, and existence of farmer/farmer's group/ community organization willing to participate, cooperate and provide counterpart like land use, labor, modest initial capital, and share generated information.

**Highlights:**
Recommended/Targeted and validated sites (some have farmer cooperators already):

- Occidental Mindoro (Abra de Ilog, Brgy. Siapo, Sta. Cruz)
- Oriental Mindoro (Mansalay, Bongabong)
- Marinduque (Brgy. Malibago, Torrijos, Brgy. Balaring, Boac)
- Palawan (Sofronio Espanola, Roxas)

**VIII. Development of integrated crop and nutrient management options for irrigated lowland, rainfed, and upland rice environments in Southern Luzon (624A)**
MB Castillo

The project consisted of four studies which covered three rice ecosystems, irrigated lowland, rainfed, and upland including (1) Development of crop nutrient management for irrigated and upland rice ecosystems in Southern Luzon; (2) Diversity of rice insect pests and its natural enemies in selected rainfed and upland areas in Region V; (3) Development of biopesticide for natural management of important seedborne fungal and bacterial diseases of rice; and (4) Development of simple guide to soil series identification as tool in the delivery of technology to individual farms.

**Development of integrated crop nutrient management for irrigated and upland rice ecosystems in Southern Luzon**
MB Castillo, KLS Tafere, ACM Baradas, CP Mamaril

The study consisted of two sub-studies titled: "Integrated Crop and Nutrient Management for Upland Rice" and "Fate of Nitrogen from Organic and Inorganic Fertilizers under Irrigated Lowland and Upland Rice Conditions". The objectives of the study were (1) to characterize the climatic, physical, and chemical characteristics of the soil, and socio-economic condition of the upland rice areas of Region V; (2) to validate and utilize the upland MOET as a diagnostic tool in determining the nutrient deficiencies of upland soils; (3) to develop an integrated crop and soil nutrient management for upland using both organic and inorganic fertilizer sources; (4) to determine the amount of nitrogen (15N) absorbed by the crop, retained in the soil, and possible loses during the cropping season; and (5) to determine the effect of different fertilizer management strategies on the transformations of tagged N (15N).

**Sub-study 1: Integrated Crop and Nutrient Management for Upland Rice**
MB Castillo, CP Mamaril

The expected outputs of the study were to develop (1) location-specific fertilizer recommendation for upland rice (target yield of 2t/ha or more for traditional and modern varieties), (2) soil fertility map and suitability analysis of upland rice in Southern Luzon, (3) upland MOET refined for diagnosing nutrient limitations of upland soils, (4) clarify concerns regarding nutrient efficiency using different fertilizer sources and their combination on irrigated lowland rice, and (5) provide farmers the appropriate fertilizer recommendation in sustainable and productive farming under irrigated lowland and upland conditions. One field trial on upland rice was conducted during 2012 WS at Ligao, Albay.

**Highlights:**

- Results of the field experiment conducted in Batang, Ligao, Albay during the dry season (February – June 2012) showed that NSIC Rc192 gave the highest grain yield with 1.63t/ha. Though NSIC Rc11 had similar grain yield with NSIC Rc192 having 1.03t/ha, it was not significantly different with the traditional varieties Dinurado and Pinalawan both yielding 0.55tha. The effect of fertilizer management was not conclusive as there was no significant difference among the fertilizer treatments and the coefficient of variation is quite high at 130%. The very low yield obtained even with fertilizer management was due to the unavailability of moisture during the reproductive stage of the rice crop. Other constraints include infestation of white grubs, birds, and weeds. Leaf wilt occurred even at the early stage of crop growth due to heat stress. Moreover, the arthropods encountered in the samples collected and observed in the field are the white planthopper (Cofana sp.) at seedling to maximum tillering stage, tiny flea beetles, green leafhopper, brown planthopper, leaf folder, ladybird beetle, tiger beetles, and numerous rice bugs at milking stage to harvest. The tiny flea beetles were observed scraping the leaf tissues, thus, further investigation of this particular organism is necessary because of its potential of becoming a pest if left unattended.

- One upland soil sample from Albay was subjected to upland MOET and laboratory analysis. The upland MOET test did not show any deficiency, however, the laboratory analysis showed N, K, Ca, and Mg deficiencies. This maybe because the upland MOET setup was maintained at field capacity moisture content, thus, most of the nutrients were present in their available form.

**Sub-study 2: Fate of Nitrogen from organic and inorganic fertilizers under irrigated lowland and upland rice conditions**
ACM Baradas, KLS Tafere, CP Mamaril

Issues addressing health and global warming are the main focus nowadays in different sectors in the Philippines and all over the world. The most popular controversy concerning both issues is the extensive promotion of organic agriculture. There is a strong belief that organic matter application enhances the efficiency of inorganic fertilizer usage. Tracer study using 15N tagged fertilizer will be conducted to determine the fate of nitrogen from the different fertilizer sources and their combination in both irrigated lowland and upland rice conditions. With this study, we can quantify the amount of nitrogen that is taken up by the plant, remain in the soil, or even loss during the cropping period. Many studies were done using this technique but validation in our present soil condition will be very helpful in clarifying and supporting the previous data that we have collected. This study helped us understand the role of these fertilizers so that proper fertilizer management practices will be generated.

**Highlights:**
Bicol Station Experimental Site WS 2012

- Lowland experiment was established from August to December 2012. As a result of the experiment, Figure 4 shows that treatment with inorganic fertilizer only (full recommended rate- FRR) is significantly higher compared with organic fertilizer treatments [chicken manure only (CM) and pureganic only (PG)]. No significant difference was observed between treatments with FRR and ½ FRR. This could mean that application of FRR is not necessary because high yield can be managed with the application of ½ FRR. Based on the result, combining CM and ½ FRR can enhance the yield of CM alone.

- Upland setup was established at PhilRice Bicol, adjacent to lowland experiment, with seven treatments namely: (1) control; (2) full inorganic recommended rate (FRR); (3) chicken manure (CM); (4) pureganic (PG), commercially organic fertilizer; (5) half FRR + half CM; (6) half FRR + half PG; and (7) half FRR. Each treatment was replicated four times. Setup was in good condition until grain filling but it was reported that there was a severe rat infestation despite building a rat fence around the experiment area, making no harvest last season.

- Establishment of lowland and upland setup is ongoing for 2013 DS on new area to prevent previous infestation.

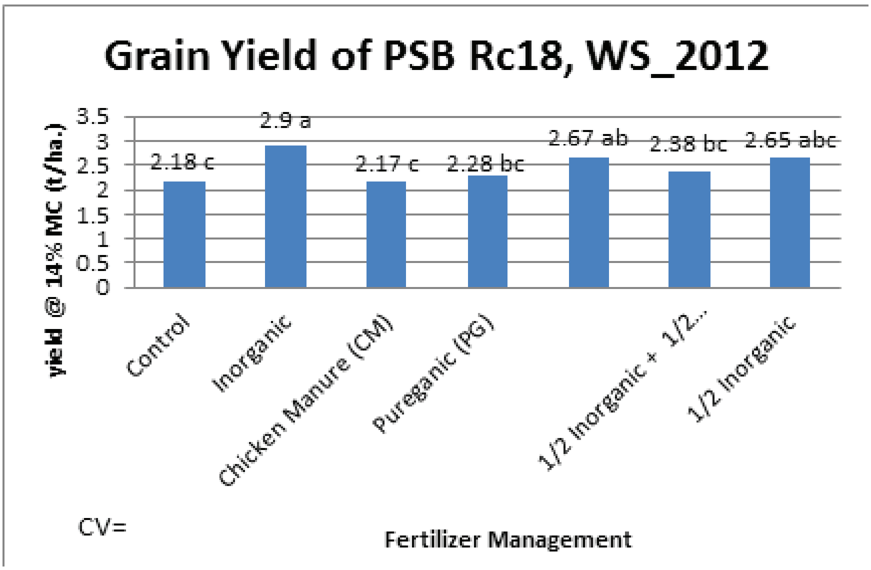


**Figure 4.** Grain yield in lowland experiment of PSB Rc18 during 2012 WS.

## IX. Energy in rice farming: The potential of nipa palm for alcohol production

VCLapitan

Fossil fuel will run out, sooner or later. The fast approaching end is suggested by the increasing prices of fuel on a global scale. To prepare for this, the Philippine government is committed to the search for alternative fuels, one of which is alcohol. In the Philippines, nipa palm has been identified as an important source of biofuels because it produces high amount of sap that can be converted to alcohol. It can yield alcohol at least three to four times that of sugar cane, the main source of ethanol in the Philippines. Ethanol production is limited by low yield. Research must be done to improve ethanol yield using biotechnology or conventional breeding. Once yield improvement of ethanol from nipa is realized, bioethanol as alternative fuel source will become more feasible.

### Studies on breeding for high sap yield and tissue culture for mass production of Nipa Palm (Nypa Fruticans Wurmb., Arecaceae)

VC Lapitan, KLC Nicolas, ETRasco, Jr.

Nipa palm (Nypa fruticans Wurmb.) has been identified as an important source of biofuels in the Philippines due to its ability to produce high amount of sap that can be converted to alcohol. Alcohol productivity is at least three to four times higher than sugar cane, the main source of ethanol in the country.

Nipa propagates naturally by seed, which is believed to be highly cross-pollinated. This pollinating habit, combined with the millions of years of accumulated mutations in the absence of artificial selection, explain the diversity of nipa today. In 2009, a study conducted by Rasco and his team in Camarines Norte and Surigao, identified substantial variations in sap production and yield-related parameters between the plants and between locations they studied (Rasco et al, 2012). Seeing the potential of this plant for ethanol production and the substantial variability in its population, developing superior plants can be a promising endeavor to increase the plant's alcohol productivity. However, propagation of nipa by seeds takes a lot of time but employing tissue culture techniques to vegetatively propagate this plant can be a promising possibility to produce large quantities of uniform planting materials with superior quality within a short period of time. This can also be utilized to produce uniform parent materials for breeding programs.

Since there were no established tissue culture protocols for nipa, this study was conducted to develop a reliable cloning method for this plant. This study presented the first attempt to develop in vitro clonal propagation technique for nipa using different explants like immature zygotic embryo, plumule, and young leaf.

**Highlights:**
Germplasm collection
Collected nipa germplasm from six different sites:

- Brgy. Kigtan, Calauag, Quezon
- Brgy.Duminurog, Calabangga, Camarines Sur
- Vinzons, Camarines Norte
- Brgy. Iba Oeste, Calumpit, Bulacan
- Brgy. San Roque, Paombong, Bulacan
- Brgy. Sta Elena, Hagonoy, Bulacan
- Figure 5 shows collection of nipa from Brgy. Kigtan, Calauag, Quezon on February 13 and April 10, 2012. Inflorescence and fruits were collected to start the experiment on tissue culture of nipa i.e. identification of most suitable explants for clonal propagation and establishment of decontamination procedure of the collected explants.
- Diversity of nipa fruits in terms of shape, size, and color was observed among those collected from Quezon, Camarines Sur, and Camarines Norte (Fig. 7)
- Majority of the seeds directly planted in the soil did not germinate, thus, the seeds were soaked first in water for pre-germination before transplanting in the plastic pots under screenhouse condition (Fig. 8).
- The seeds collected from Calauag, Quezon were planted in the greenhouse and now on their early seedling stage (Fig. 9) while those collected from Bicol Region already died at the seedling stage.

**Figure 5.** Collection of nipa fruit (left) and inflorescence (middle) from Calauag, Quezon.

**Figure 6.** Habit (left) and fruits (right) of Nypha fruticans.

**Figure 7.** Fruit sample collected from Quezon (left), Cam. Sur (middle) and Cam.Norte (right)


**Figure 8.**Seed soaking of nipa fruits collected from Calauag, Quezon, Calabangga, Camarines Sur and Vinzons, Camarines, Norte

**Figure 9.** Planting and maintenance of nipa collection at the greenhouse; A) Seeds ready for planting; B) Planting of seeds in plastic pails with garden soil; C and D) Nipa at seedling stage.

Tissue Culture: Identification of decontamination procedures for the different explants

- Planting material: Mature and immature embryos, plumule, male inflorescence and segments of leaves excised from the fruits and flowers of mature plants of Nypha fruticans were used as explants in the different decontamination experiments. The cultures were incubated under dark condition in the culture room with temperature that ranged from 20 to 22$^{o}$C.

- Decontamination of male inflorescence for anther culture: Decontamination procedure following the method of Verdeil, et.al (1994) for immature inflorescence of coconut was used. Male inflorescences were obtained from the mature plants of Nypha fruticans (Fig. 10, second from left). The outer spathes were removed leaving only about two to three layers of covering. After removing the outer spathes, the basal portion of the inflorescence was also discarded. The inflorescences (Fig. 10, fifth from right) were soaked to different sterilants. After that, they were washed with three changes of sterilized distilled water prior to removing the remaining spathes that cover the anthers. Anthers were excised from the inflorescence with scalpel blades, cutting both the mature and immature anther transversely. The excised anthers were cultured on modified basal media and the contamination of anthers was monitored weekly.

- For the first decontamination experiment, sterilization of anther was optimized using different concentrations of ethyl alcohol, commercial bleach, and combination of these. The explants were sterilized for 10 minutes in different concentration of ethyl alcohol and commercial bleach and for 10 minutes and two minutes for the combination of these sterilants. The sterilized explants were cultured on plain Murashige and Skoog (MS) (Murashige and Skoog, 1962) media. After seven weeks of incubation under dark condition the top four treatments (with red highlights) having minimal contamination (Table 8) were used for the second decontamination experiment, varying the time for the different sterilants.


**Figure 10.** Nipa inflorescence and the explants used –mature and immature anther.

**Table 8.** Result of the first decontamination of anther explants cultured on plain MS medium after 7 weeks dark incubation.

| Sterilants | % decontamination |
|---|---|
| Distilled water | 46.67 |
| 40% ETOH | 40.00 |
| 55% ETOH | 26.67 |
| 70% ETOH | 46.67 |
| 85% ETOH | 86.67 |
| 95% ETOH | 73.33 |
| 1.31% NaClO | 40.00 |
| 2.63% NaClO | 53.33 |
| 3.94% NaClO | 46.67 |
| 1.31% NaClO + 70% ETOH | 60.00 |
| 2.63% NaClO + 70% ETOH | 46.67 |
| 3.94% NaClO + 70% ETOH | 46.67 |

- For the second decontamination experiment, the top four sterilants that have the highest percentage of decontamination were used except for the absolute ethyl alcohol, varying the time to identify which is the more suitable sterilization process for anther.

- The sterilized explants were cultured on modified Euwen's (Y3) (Euwens, 1978); Assy Bah (Assy Bah, 1986) and Murashige and Skoog (MS) (Murashige and Skoog, 1962) media. Euwen's (Y3) and Assy Bah (AB) were the commonly used basal media for the somatic embryogenesis of coconut. This is the reason why these media were tested together with Murashige and Skoog (MS) to identify their suitability in the somatic embryogenesis of Nypha that also belongs to the palm family like the coconut.

- After almost 15 weeks of incubation under dark condition, top two sterilants with highest decontamination percentage (with red highlights) (Table 9) were determined. These sterilization procedures will be employed, for further testing, in determining the suitable callus induction media for anther.

- The medium with the highest number of decontamination of anther was MS (Table 9) but this was not significantly ($P \leq 0.05$) different from the other media tested.

**Table 9.** Percentage decontamination of anther explants sterilized using different sterilants after 15 weeks of incubation.

| sterilants used | % decontamination | | | |
|---|---|---|---|---|
| | AB | MS | Y3 | Average |
| 85% ETOH (3mins) | 28.57 | 42.86 | 42.86 | 38.10 |
| 85% ETOH (5mins) | 80.00 | 80.00 | 100.00 | 86.67 |
| 85% ETOH (10mins) | 60.00 | 60.00 | 40.00 | 53.33 |
| 2.63% NaClO (3mins) | 28.57 | 42.86 | 14.29 | 28.57 |
| 2.63% NaClO (5mins) | 60.00 | 40.00 | 40.00 | 46.67 |
| 2.63% NaClO (10mins) | 40.00 | 100.00 | 60.00 | 66.67 |
| 1.31% NaClO (3mins) + 70% ETOH (3mins) | 57.14 | 42.86 | 28.57 | 42.86 |
| 1.31% NaClO (5mins) + 70% ETOH (5mins) | 60.00 | 20.00 | 40.00 | 40.00 |
| 1.31% NaClO (10mins) + 70% ETOH (2mins) | 60.00 | 80.00 | 100.00 | 80.00 |
| average | 52.70 | 56.51 | 51.75 | 53.65 |

- For another set of experiment, with and without cold pre-treatment were employed to the explants. For cold pre-treatment, the male inflorescences were placed inside the refrigerator for one week prior to decontamination and culture.

- A whitish, gel-like part (with arrows) was observed from the cultured explants with cold pre-treatment after four to six weeks of incubation under dark condition, (Fig. 11). High frequency was observed on the modified Euwen's medium supplemented with activated charcoal. The growth was observed to be like albino plant tissues, however, under the dissecting microscope, the whitish, gel-like parts that grow from the cultured explants seemed to be swollen anthers. This finding will be further verified.

**Figure 11.** Explants cultured on the media without and with activated charcoal (left) and the modified Euwen's media with swollen anther (right).

- Decontamination of embryo: Decontamination of mature embryos was done following the procedure of Luis Sáenz et al (2005) for coconut with few modifications. The fruits were cleaned using liquid detergent prior to removal of embryo. The embryos were removed from the fruit by cutting the fruit transversely using a sharp machete or bush knife that was also cleaned using liquid detergent. The fruit halves containing the endosperm with embryo were soaked to liquid detergent with 3.25% NaClO for five minutes, and washed in running water. The endosperms were removed from the fruit using knife, making sure not to damage the whole endosperm (Fig. 12).

- Under aseptic conditions, the endosperms were cut into cubes without damaging the embryo inside. The endosperms were then sterilized using different sterilants (Table 10).

- Embryos were removed from the endosperm by simply removing the brown part on the endosperm that covers it while making sure not to damage it (Fig. 11C). The excised embryo was then platted on the different culture media (modified Y3, MS and AB) and put under dark condition. Contamination of embryo was monitored weekly.
- Explants treated with 5.25% NaClO + five drops of tween (20 minutes) gave the best performance among the four sterilants employed for mature embryos (Table 10). This treatment is now routinely being used in the decontamination of mature embryos for nipa.

- Cultured embryos germinated after six weeks as evidenced by the emergence of plumule (Fig. 13). The cultures were then transferred under lighted condition to enhance germination.

**Table 10.** Percentage survival of embryo explants sterilized using different sterilants after 10 weeks on incubation.

| sterilants used | % decontamination | | | |
|---|---|---|---|---|
| | AB | MS | Y3 | Average |
| 5.25% NaClO + 5 drops of tween (20mins) | 100.00 | 100.00 | 66.67 | 88.89 |
| 70% ETOH (20mins) + 3.25% NaClO (5mins) | - | 60.00 | 75.00 | 67.50 |
| 70% ETOH (20mins) + 3.25% NaClO (10mins) | 33.33 | 75.00 | 75.00 | 61.11 |
| 70% ETOH (20mins) + 5.25% NaClO + 5 drops of tween (10mins) | 66.67 | 33.33 | 66.67 | 55.56 |
| average | 66.67 | 67.08 | 70.83 | 68.26 |

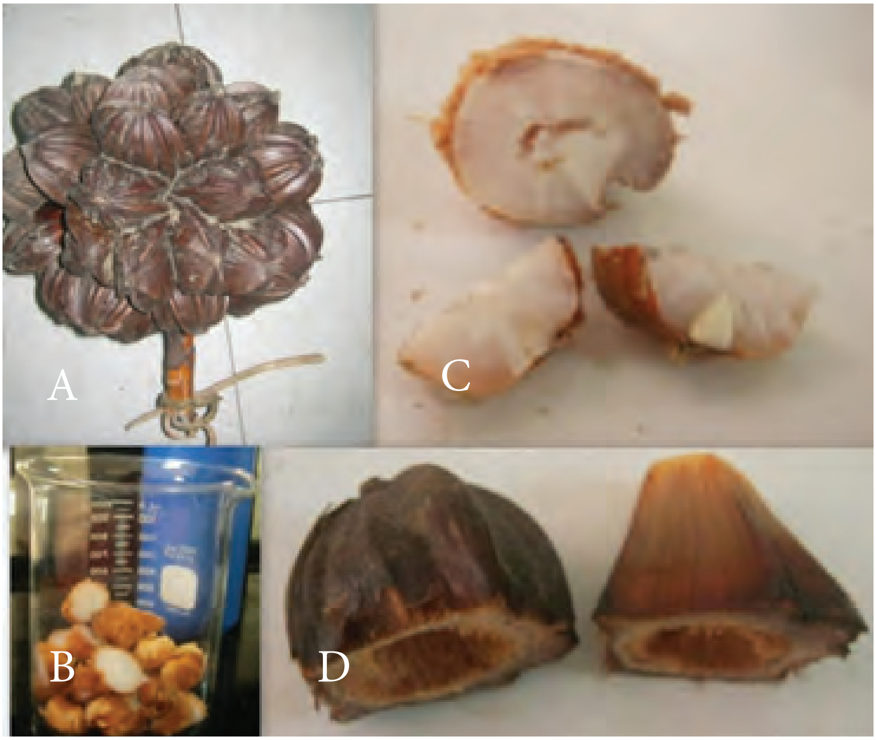


**Figure 12.** Excision of mature embryo from Nipa fruits; A) Mature fruits in bunch; B) Cut endosperms ready for sterilization; C) Excised embryo for culture; D) Husk of nipa fruit after excision of endosperm

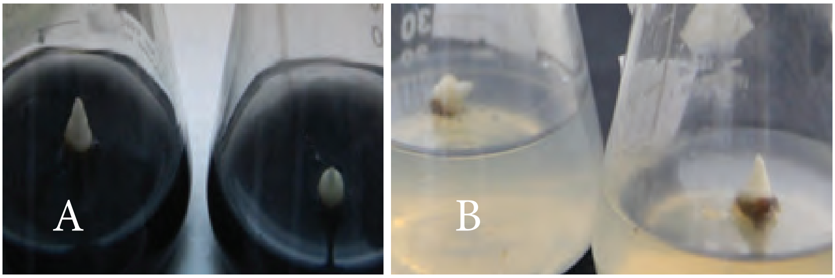


**Figure 13.** Embryos that germinated on modified Euwen's media; A) with activated charcoal; B) without charcoal

- Decontamination of plumule: Decontamination procedure for the plumule was done following the method as described by Luis Sáenz et al (2005) with few modifications.

- Plumule was excised from the mature fruit (Fig. 14) and sterilized using the different sterilants at varying time (Table 11). However, browning was observed immediately after the decontamination procedure since the plumule tissues were directly exposed to the sterilants.

- In order to get viable plumule explants, the embryos were allowed to germinate first in the plain basal medium until plumule emerges (Fig. 12) before utilizing it for testing its suitability as explant for clonal propagation.

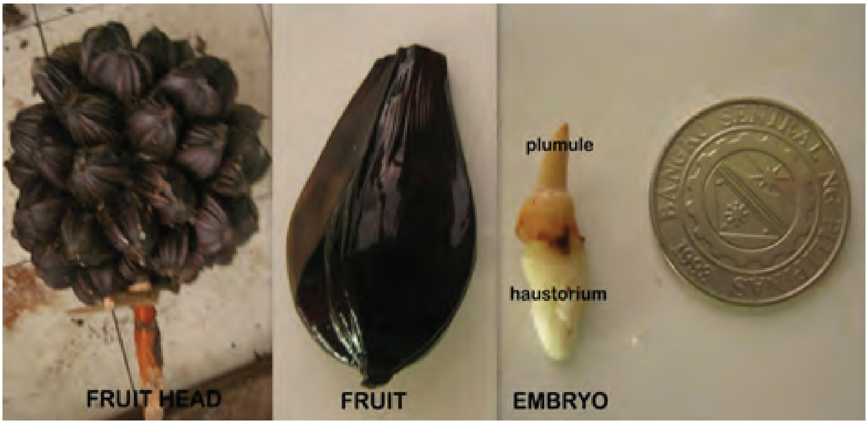


**Figure 14.** Plumule explant excised from mature fruit of nipa.

**Table 11.** Result of the decontamination of plumule explants cultured on plain MS medium after almost 6 weeks dark incubation.

| Sterilants | % decontamination |
|---|---|
| distilled water | 40.00 |
| 70% ETOH (3mins) | 53.33 |
| 70% ETOH (10mins) | 60.00 |
| 1% NaClO (5mins) | 13.33 |
| 3% NaClO (5mins) | 20.00 |
| 5.25% NaClO (5mins) | 33.33 |
| 70% ETOH (3mins) + 1% NaClO (5mins) | 73.33 |
| 70% ETOH (3mins) + 3% NaClO (5mins) | 66.67 |

- Decontamination of young leaf: Decontamination of young leaf was done following the method as described by Karunaratne on his work on the use of coconut leaf for somatic embryogenesis.

- The young leaf was excised from the germinated seed (Fig. 15) and sterilized using ten sterilants (Table 12). Among the treatments, 5.25% NaClO (20 minutes) gave the highest percentage of decontamination. A second round of decontamination experiment will be conducted to establish a procedure for the young leaf.


**Figure 15.** Excision of young leaf for culture; A) Seeds at the right stage of germination; B) Germinated seed; C) Excised young leaf.

**Table 12.** Percentage survival of young leaf explants sterilized using different sterilants after almost 10 weeks of incubation in the dark.

| sterilants used | % decontamination | | | |
|---|---|---|---|---|
| | AB | MS | Y3 | average |
| 2% NaClO (10mins) | 0.00 | 0.00 | 0.00 | 0.00 |
| 2% NaClO (2mins) + 70% ETOH (3mins) | - | 55.56 | 0.00 | 27.78 |
| 70% ETOH (10mins) + 2% NaClO (5mins) | 0.00 | 20.00 | 0.00 | 6.67 |
| 3% NaClO (10mins) | 0.00 | 0.00 | 0.00 | 0.00 |
| 5.25% NaClO (10mins) | 40.00 | 0.00 | 40.00 | 26.67 |
| 70% ETOH (5mins) + 2% NaClO (5mins) | 0.00 | 0.00 | 20.00 | 6.67 |
| 70% ETOH (5mins) + 3% NaClO (5mins) | 0.00 | 0.00 | 0.00 | 0.00 |
| 5.25% NaClO (20mins) | 0.00 | 60.00 | 60.00 | 40.00 |
| 5.25% NaClO (25mins) | 66.67 | 0.00 | 0.00 | 22.22 |
| 5.25% NaClO (30mins) | 33.33 | 0.00 | 50.00 | 27.78 |
| average | 15.56 | 13.56 | 17.00 | 15.78 |

- Among the sterilants evaluated for anther explants, two were selected: A) 85% ETOH for five minutes and B) 1.31% NaClO (10 minutes) + 70% ETOH (two minutes). These sterilants were further evaluated during the callus induction experiment of anther explants and found out that 85% ETOH is the best sterilant for anther explant.

- For the embryo explants, 5.25% NaClO + five drops of tween (20 minutes) was selected as best sterilant and now routinely being used in the lab for decontamination.

- Among the explants tested, embryos had the highest percentage of decontamination while young leaf had the lowest. This is because the embryos were not directly exposed to contaminants as they were inside the fruit and protected by the endosperms while the young leaf was exposed to germs.

- To get a viable plumule explants, mature embryos should be allowed to germinate first on basal media and then excised the plumule. This procedure will minimize the browning of the explants due to direct exposure to the sterilants. To get contaminated free young leaf explants, the leaf from the regenerated plantlets that was utilized for clonal propagation, was used for callus induction experiment.

Tissue Culture: Identification of suitable callus induction media

- A total of 20 culture medium were tested [basal media: N6 and modified Euwens (Y3)] with different concentrations of 2-4D. However, the explants –zygotic embryo, and anther did not yield any callus, however, the zygotic embryo germinated on some of the callus induction media tested (Fig.16).

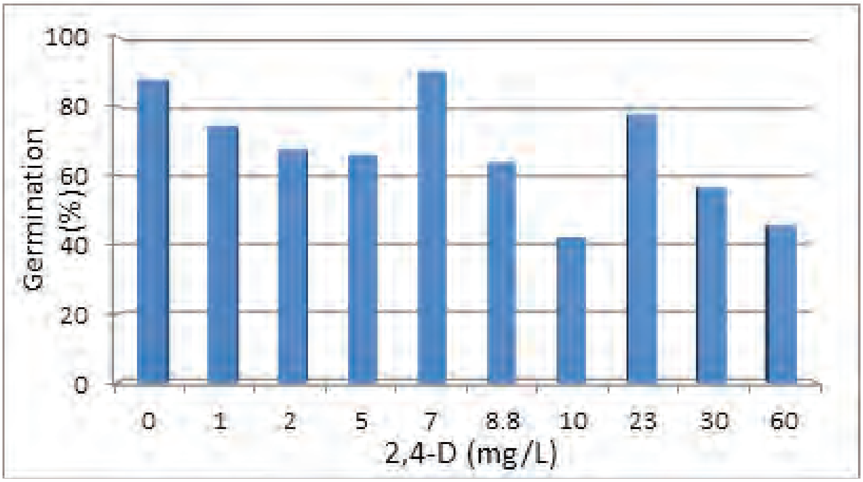


**Figure 16**. Response of zygotic embryos of nipa to different concentrations of 2,4-D

- More than 40% of the zygotic embryo was capable of germinating on the medium with different concentrations of 2-4D however, as the concentration of 2-4D increased, the percentage of plantlet regeneration decreased.

**Table 13.** Effect of different basal media on the callus formation and embryo germination.

| Basal medium | % of embryos that germinate | % of callus formed |
|---|---|---|
| N6 | 62.24 | 0 |
| Modified Y3 | 77.25 | 0 |

- The germination of cultured zygotic embryos was higher in modified Y3 medium which is usually used in clonal propagation of coconut. However, there are no significant differences between N6. Cultured embryos germinated after six weeks as evidenced by the emergence of plumule. The cultures were then transferred under lighted condition to enhance germination and eventually developed into green plantlets (Fig.17). These green plantlets were cut longitudinally into two sections and cultured in regeneration media (modified Euwens media and MS supplemented with different concentration of Auxins and cytokinin) (Fig.18).

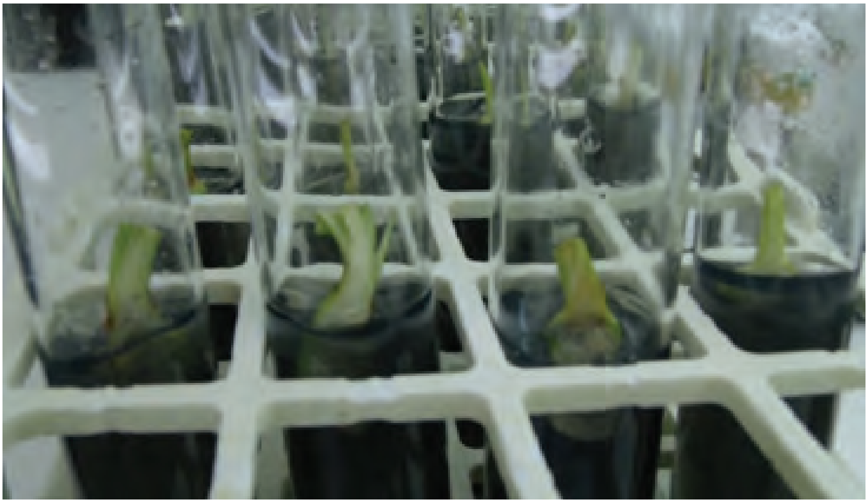

**Figure 17.**Green plantlets cut longitudinally being cultured in different tests regeneration media.

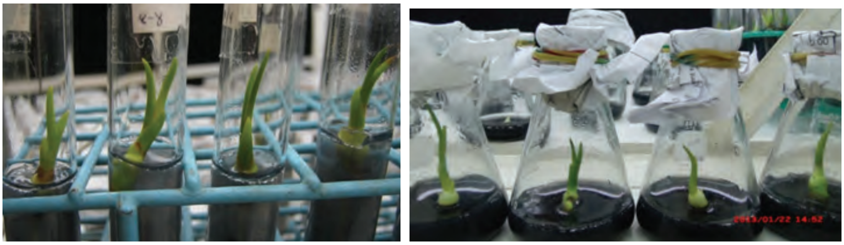

**Figure 18.** Green plantlets derived from embryo culture in different rooting media a) modified Euwens and b) MS basal media supplemented with different concentration of auxin and cytokinin.

**Genetic diversity analysis of nipa palm (Nypa fruticans Wurmb., Arecaceae) germplasm in Camarines Norte**
VC Lapitan, KLC Nicolas

In the Philippines, nipa palm is becoming an important source of industrial and many other derivative products. Recently, research on nipa has focused on its potential use as a biofuel crop because it has several advantages compared with other biofuel-alcohol crops. Having seen this potential, development of cultivars with high sap yield will be an important objective in improving nipa for increased alcohol productivity. Breeding for high sap yield requires selection of parents with wider genetic diversity. Molecular markers have been found to be powerful tools in the assessment of genetic diversity. They are used to provide information on the relatedness of different clones or varieties that are difficult to distinguish morphologically, thus, helping in the management of plant accessions and breeding programs. Microsatellite loci, also known as simple sequence repeats (SSRs), are among the most commonly used molecular markers. Microsatellites are PCR-based markers that are efficient and cost-effective to use.

Large genetic variation is suspected to be present in nipa today because of its outcrossing habit combined with the millions of years of accumulated mutations in the absence of artificial selection. Based on survey in 2009 in Camarines Norte and Surigao Del Norte, there was substantial variation in sap production and yield-related parameters between nipa plants and between locations (Rasco 2011). However, data on the genetic diversity of nipa in the Philippines is still lacking simply because the needed research has not been done, thus this research.

**Highlights:**

- A total of 344 nipa plants have been collected from the following areas in Southern Luzon:

- Kigtan, Calauag, Quezon
- Marilag, Calauag, Quezon
- Calumpit, Bulacan
- Vinzons, Camarines Norte
- Infanta, Quezon

The plants were planted in the plastic pail and maintained inside the screenhouse (Fig.19). From these germplasm collections, 163 were evaluated for genetic diversity using 32 SSR markers isolated from N. fruticans (Table 14) and Phoenix dactylifera (Table 15).

- Genetic diversity and polymorphism information content (PIC) were determined and analyzed using the PowerMarker V3.25.

- A total of 160 alleles were detected by 25 polymorphic SSR markers with an average of 6.4 alleles per locus. Examples of SSR alleles as resolved with the PCR assay for EU746382, mPDC1R015, and RM14380 are illustrated in Fig. 20.

- An average of 0.6 genetic diversity was detected indicating a high level of genetic variation among these germplasm. The PIC value was 0.54 per marker and it ranged from 0.21 (EU746383) to 0.82 (EU746393).

- Cluster analysis of these accessions showed four major groups with additional sub-clusters within each group.

**Table 14.** Characteristics of 17 microsatellite markers (SSR) isolated from N. fruticans

| SSR Locus | Product size (bp) | Primer sequences(5'-3') |
|---|---|---|
| EU746382 | 208 | ACAAACTGCATCCGACAC<br>TTAGCACTGCCAAGAACA |
| EU746383 | 195 | CCCATGTTTCTTCTTCCC<br>CTTCCTTTCCCATCCTCT |
| EU746384 | 183 | GCCTCCTAATCCAGTCTAT<br>CTTGTGGGCAGAAGAACC |
| EU746385 | 212 | CCCGATGGACTACGAAAG<br>GAAGCGGAAGAAGACGAA |
| EU746386 | 142 | TCCTCATTCTCCCAACAA<br>CACTTTAGGCAGATCATTTA |
| EU746387 | 430 | GTCTGTCTCCTTGAACCA<br>CATATCACCATAACATACTTG |
| EU746388 | 316 | ATACAAGTAGAAGGTGGG<br>GAGGAAGAACAGCTAGAC |
| EU746389 | 191 | TCTGCCATAAGGAAAGAA<br>TGATGTGACGGAGTGTTG |
| EU746390 | 223 | CCAAGAATATCTCAATCC<br>TTTGCCAATTCAGTCATC |
| EU746391 | 145 | CTCTACCAAAGCCAAAAG<br>AACAGCACAACTAAAATGAC |
| EU746392 | 122 | TTATGGAACAGGTTGGAC<br>CCCACTTTTGTTATTGCT |
| EU746393 | 214 | AAGAACAAGCATTCAGGA<br>ATAATCTCACCAAAGTCG |
| EU746394 | 305 | TTGACGACGAGGAACCCT<br>CGTGGACGCATCATAGAA |
| EU746395 | 355 | GGCATACACCTAACCAAT<br>CAAGACTTGAAGGGACAA |
| EU746396 | 135 | AAAGAAGTAAATGTAAGCCACC<br>CTCCTCCTCTGTGAGCACTCT |
| EU746397 | 352 | TTTCTCACCCAAATCTTC<br>CAACACCTACTAGGCATTA |
| EU746398 | 199 | TCACGTTGGTTTGCCGAGTC<br>TCCCTCCATCCCTCCCTTC |

**Table 15**. Characteristics of eight microsatellite markers (SSR) isolated from Phoenix dactylifera

| SSR Locus | Repeat motif | Clone size (bp) | Primer sequences(5'-3') |
|---|---|---|---|
| *mPdCIR010* | $(GA)_{22}$ | 180 | F:ACCCCGGACGTGAGGTG<br>R:CGTCGATCTCCTCCTTTGTCTC |
| *mPdCIR015* | $(GA)_{13}$ | 253 | F:AGCTGGCTCCTCCCTTCTTA<br>R:GCTCGGTTGGACTTGTTCT |
| *mPdCIR016* | $(GA)_{14}$ | 209 | F:AGCGGGAAATGAAAAGGTAT<br>R:ATGAAAACGTGCCAAATGTC |
| *mPdCIR025* | $(GA)_{22}$ | 269 | F:GCACGAGAAGGCTTATAGT<br>R:CCCCTCATTAGGATTCTAC |
| *mPdCIR032* | $(GA)_{19}$ | 376 | F:CAAATCTTTGCCGTGAG<br>R:GGTGTGGAGTAATCATGTAGTAG |
| *mPdCIR035* | $(GA)_{13}$ | 341 | F:ACAAACGGCGATGGGATTAC<br>R:CCGCAGCTCACCTCTTCTAT |
| *mPdCIR044* | $(GA)_{19}$ | 340 | F:ATGCGGACTACACTATTCTAC<br>R:GGTGATTGACTTTCTTTGAG |
| *mPdCIR048* | $(GA)_{32}$ | 439 | F:CGAGACCTACCTTCAACAAA<br>R:CCACCAACCAAATCAAACAC |

**Figure 19.** Nipa germplasm collection planted in the plastic pail inside the screenhouse

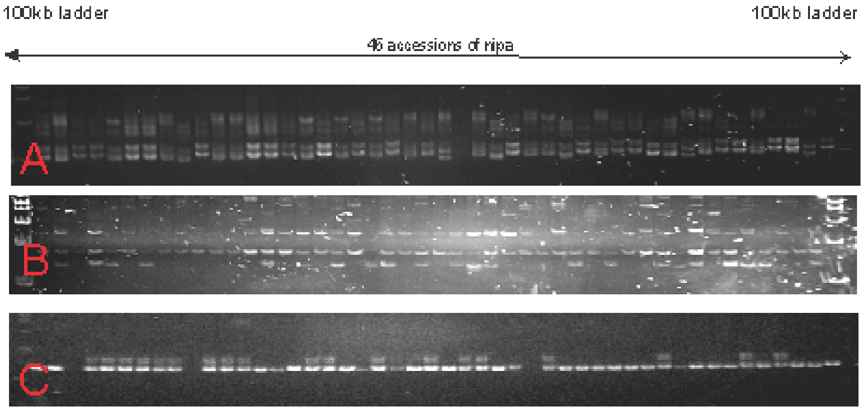


**Figure 20.** Polymorphism observed using EU746382 (A), mPDC1R015 (B), and RM14380 (C) in the 46 nipa accessions.

**X. Village-level bioethanol production as energy source for rice farming**
RB Demafelis

Nipa sap is a potential feedstock for fuel-grade alcohol. A pilot scale demonstration plant is to be established to project the need of a processing facility for converting nipa sap to hydrous bioethanol. As a head start, a distillation column capable of producing 100 liters of hydrous bioethanol per day will be fabricated, installed, and operated in Vinzons, Camarines Norte. A locally produced nipa wine (around 30%) will be distilled to attain a higher bioethanol concentration that can be potentially used as fuel for farm and agricultural machineries in the rice production areas. The different hydrous concentrations will be tested in several engines and be optimized under laboratory and field conditions. This will definitely serve as a pioneering and showcase facility to the public and potential investors for a full-scale pilot plant afterwards.

**Feasibility study of village-level bioethanol production from the sap of Nipa (Nypa fruticans, wurmb) as energy source for rice farming in Vinzons, Camarines Norte**
JJS Cabardo, KCQ Saraos

Nipa is characterized as a species that is intermediate between a marine and terrestrial plant. It can be submerged in water for a long period of time and is considered as the oldest palm species (Rasco, 2011). According to SAKA Laboratory, nipa is classified as a non-threatened and underutilized sugar-yielding palm, which produces rich sap starting from inflorescence stage up to 50 years. It can be found in Southeast Asia, northward to Philippines, Ryukyu Islands and southward Queensland. According to Quimbo (1991), "Nypa fruticans is also an outstanding provider of various products which are essential to everyday living and therefore is said to be the mangrove's counterpart of coconut." Every part of the plant has a use as it can provide food and shelter. The leaves can be used as raincoats, baskets, mats, wrappers of suman, bags, and as a roofing material while the sap is used for making tuba, lambanog, sugar, and vinegar. Currently, lambanog is the main product of Camarines Norte, Quezon, Agusan, and Surigao while vinegar is in Bulacan (Rasco, 2011).

According to the Department of Energy, nipa is one of the potential sources of bioethanol in the country together with sugarcane, corn, and cassava. Bioethanol is made from fermented carbohydrates from starch or sugar unlike ethanol which is made from petroleum. Bioethanol is cheaper and environmentally sound compared to pure gasoline and can also lessen the cost of production of its consumers if they use gasoline with bioethanol.

Nipa as a possible source of bioethanol poses bright prospects for the production of nipa particularly in Vinzons, Camarines Norte, a fourth class municipality, which has been engaged in the production of "barik" (the province's local vodka) for the last 100 years. Nipa palm growth in had been significant in both the river line and coastal areas of the municipality. With the existing nipa alcohol production industry in the town of Vinzons, there is much potential for the establishment of a village-level bioethanol production from nipa. This could significantly contribute as energy source to support the rice farming communities in Vinzons that cover around 2000 hectares of physical rice area. Thus, this study was pursued.

Barangays Calangkawan Norte, Mangcayo, and Cagbalogo in Vinzons were identified as project locations because of their suitability for nipa farming and actively produce products out of nipa, like tuba, lambanog, and shingles. The purpose of the study was to investigate and evaluate the viability of establishing a village-level bioethanol production from nipa. It aimed to devise a decision on its investment potential as energy source for rice farming. Also, it aimed to present a model for a village-level bioethanol production and its planned operations in terms of feedstock, capacity, and location options; determine and assess the technical, marketing, organizational, and financial viability of a village-level bioethanol production from nipa as energy source for rice farming; and recommend specific courses of action based on the findings of the study.

**Highlights:**

Initial findings being presented were obtained from surveys and interviews with 190 nipa farmers, and 68 rice farmers. The initial findings pertain to the market and production aspects of nipa production.

- Market Aspect

The products of the plantation will be lambanog, nipa shingles, and bioethanol, so the market for nipa products is varied and broad. In the establishment of a village-level bioethanol production, rice farmers could serve the primary target market in considering nipa as a possible energy source for rice farming. Moreover, this could be more beneficial particularly for farmers both engaged in nipa and rice farming making both of their farming systems integrated.

A total population of 320 rice farmers belongs to the three barangays of Cagbalogo, Calangkawan Norte, and Mangcayo, where nipa growth of nipa naturally abounds. Sixty-eight farmers served as the sample size for the three barangays. The profile of the rice farmers and their fuel requirements for rice farming are given below.

Rice Farmer Profile in Vinzons Barangay Cagbalogo

There are 17 rice farmer respondents in Brgy. Cagbalogo, three are female and 14 are male. The average age of the farmer is 45 years old with the youngest farmer at age 28 while the oldest at the age of 62. Average number of years in rice farming is 19 years with 2 years as least farming experience and 40 years as the most farming experience. The Cagbalogo rice farmers do not belong to any organization in rice farming.

Total rice area in Brgy. Cagbalogo is 35 hectares with an average farm size of 2.06 ha ranging from 0.50 to 4.00 ha in the said community. Based on the total rice area for production, fuel requirement for gasoline is at 153L and 962.5L for diesel for the whole barangay per season. Fuel costs Php57/L for gasoline and Php46/L for diesel.

Nine out of 17 rice farmers are engaged in nipa farming. However, only one would not consider using biofuel in his rice production because he believes it could destroy his farm machinery/equipment.

Barangay Calnorte

For Brgy. Calangkawan Norte, there are 17 farmer respondents, with four female and 13 male farmers. The average age of the farmers is 54 years old with the youngest farmer at 30 and the oldest at 76. Average number of years in rice farming is 36 years with 15 years as least farming experience and 55 years as the most farming experience. Nine rice farmers are members of the Maluhod Farmers Association while the rest do not belong to any organization related

to rice farming.
Total rice area is 32.4 ha with an average farm size of 1.47 ha ranging from 0.30 to 3.0 ha in the said community. Based on the total rice area for production, fuel requirement for gasoline is at 400L and 137.8L for diesel for the whole of barangay per season. Gasoline requirement is greater in this barangay since most of the machinery/equipment in rice farming are powered by gasoline. Fuel costs Php58/L for gasoline and Php55/L for diesel.

Out of 17 rice farmers, only two farmers are engaged in nipa farming. Three farmers were hesitant to use biofuel in rice production due to the uncertainty of the on bioethanol's potential as energy source.

Barangay Mangcayo

In Brgy. Mangcayo, there are 34 farmer respondents, 16 are female and 18 are male. Average age is 46 years old with the youngest at 26 while the oldest at 68. Average number of years in rice farming is 22 years with four years as least farming experience and 52 years as the most farming experience. Only one farmer belongs to a rice farming organization, the Countryside Multipurpose Cooperative.

Total rice area in Barangay Mangcayo is 57.55 ha with an average farm size of 1.6 ha ranging from 0.20 to 5.0 ha in the said community. This barangay has the largest rice area compared to the other two barangays, which would demand more energy supply for rice farming. Based on the total rice production area, fuel requirement for gasoline is 490L and 2,294L for diesel for the whole barangay per season. Fuel costs Php56/L for gasoline and Php45/L for diesel.

Out of 34 rice farmers, 10 are engaged in nipa farming. Four farmers were hesitant to use biofuel in rice production because of the uncertainty on bioethanol's potential as energy source, especially on machine efficiency.

Inventory of Rice Farm Machinery/Equipment in Cagbalogo, Calnorte and Mangcayo

For the three barangays the machinery/equipment used in rice farming include the handtractor, water pump, and thresher. These are either owned or rented. Table 16 shows the number of units owned or rented by rice farmers and the corresponding fuel requirements per machine for both gasoline and diesel in one cropping season according to barangay.

**Table 16**. Machinery/equipment for rice farming in Barangays Cagbalogo, Calangkawan Norte and Mangcayo

| BARANGAY | Handtractor | | Waterpump | | Thresher | |
|---|---|---|---|---|---|---|
| Cagbalogo | | | | | | |
| *Number of units per form* | | | | | | |
| Owned | 10 | | 10 | | 9 | |
| Rented | 7 | | 7 | | 8 | |
| *Fuel Consumption (L/ha)* | Gasoline | Diesel | Gasoline | Diesel | Gasoline | Diesel |
| Average | 23 | 44 | | 19 | 13 | 9 |
| Min | 8 | 3 | | 3 | 3 | 3 |
| Max | 46 | 60 | | 50 | 24 | 23 |
| Calangkawan Norte | | | | | | |
| *Number of units per form* | | | | | | |
| Owned | 15 | | 3 | | 14 | |
| Rented | 4 | | | | 5 | |
| *Fuel Consumption (L/ha)* | Gasoline | Diesel | Gasoline | Diesel | Gasoline | Diesel |
| Average | 20 | 15.55 | 14 | 3.2 | 9 | 12.8 |
| Min | 10 | 11 | | | 1 | 4.4 |
| Max | 40 | 19 | | | 20 | 17 |
| Mangcayo | | | | | | |
| *Number of units per form* | | | | | | |
| Owned | 11 | | 10 | | 11 | |
| Rented | 23 | | 21 | | 23 | |
| *Fuel Consumption (L/ha)* | Gasoline | Diesel | Gasoline | Diesel | Gasoline | Diesel |
| Average | 26.57 | 29.46 | 21 | 52.7 | 13.7 | 10.44 |
| Min | 13.25 | 7.5 | 4 | 4 | 3 | 1 |
| Max | 57 | 68 | 45 | 409 | 30 | 45 |

- Production Aspect

The municipality of Vinzons has been engaged in the production of "barik" (the province's local vodka) for the last 100 years, making it a part of the town's culture in producing the distinctive "lambanog" taste from nipa sap.

The study aimed to investigate the traditional practices vis-a-vis the recommended production practices in establishing a bioethanol processing plant to achieve certain quality standards required to achieve the requirements for a village-level bioethanol production particularly in the three barangays.

The identified peak season for the three barangays is on the month of January while the lean months may start in March till May. However, the recent climate changes greatly affected their harvest especially towards the end of the cropping season.

Profiles of nipa farmers were recorded to gauge their capacity and capability in meeting the energy source demands of rice farmers.

Nipa Farmer Profile in Vinzons
Barangay Cagbalogo

There are 74 nipa farmer respondents in Brgy. Cagbalogo, six are female and 68 are male. Average age is 42 years old with the youngest farmer at 19 while the oldest at 61. Average years in nipa farming is 23 years with one year as the least farming experience and 50 years as the most farming experience. The range of years dedicated to nipa farming is an indication that the activity has already become a part of the town's tradition. Moreover, nipa farming is still being passed on to younger generations as evidenced by those who have just engaged in its production.

All nipa farmers are farmer-processors. They plant and harvest the nipa sap and process their own "barikulkul". Of the 74 respondents, 65% are owners of their nipa farms. However, no one is a member of any organization related to nipa farming.

Total nipa area in Brgy. Cagbalogo is 137.48 ha with an average farm size of 1.86 ha ranging from 0.50 to 4.5 ha in the said community. Total nipa production of the barangay is 266,850L per season with an average production of 19,415L/ha per season. Its production capacity covers both Calangkawan Norte and Mangcayo.

Barangay Calangkawan Norte

In the case of Brgy. Calangkawan Norte, 23 male nipa farmers are farmer-processors themselves. Average age of the farmers is 49 years old with the youngest farmer at 24 while the oldest at 69. Average number of years in nipa farming is 23 years with one year as the least farming experience and 50 years as the most farming experience. Four of the 23 respondents are owners of their nipa farms. Five farmers are members of Vinzons Bantay Likas Yamang Dagat (VINBALIYAD).

Total nipa area in Brgy. Calangkawan Norte is 48.25 ha with an average farm size of 2.1 ha ranging from 0.75 to 8 ha It has the largest farm size in the community. Total nipa production is 87,195L per season with an average production of 1,805L/ha per season.

Barangay Mangcayo

For Brgy. Mangcayo, there are 39 nipa farmer respondents who are all male and farmer-processors. Average age of the farmer is 45 years old with the youngest farmer at 22 while the oldest at 68.

Average number of years in nipa farming is 23 years with two years as the least farming experience and 50 years as the mos. Forty-nine percent of the respondents are owners of their nipa farms. Sixty-two percent are active members of organizations, where one respondent is a member of VINBALIYAD while 23 are members of Barikulkol Producer of Mangcayo (BAPROMA).

Total nipa area in Brgy. Mangcayo is 66.75 ha with an average farm size of 1.71ha ranging from 0.5  to 13ha in the said community. Total nipa production of the barangay is 115,650L per season with an average production of 1,734L/ha per season.

Details of the production aspect of the study particularly in the establishment of a village-level bioethanol production model are still being refined. Some nipa farmer-processors in our preliminary visits to the project site are concerned with the value addition and switching cost issues once a farmer decides to process his nipa for bioethanol purposes instead of the alcoholic beverage, lambanog. A nipa farmer requires other information to shift from lambanog to bioethanol production investment/capital requirements. They should also be informed on the corresponding profit and payback period data for him to pursue this venture, which will be provided in the financial aspect of the study.

**Design, fabrication and operation of the distillation column for hydrous bioethanol production**
RB Demafelis

Nipa, together with sugarcane, corn, and cassava, is one of the potential sources of bioethanol in the Philippines. Compared to pure gasoline, bioethanol is cheaper and environmentally-sound. The town of Vinzons, Camarines Norte is producing an alcohol from nipa palm, thus, the pursuit to establish a pilot-scale bioethanol plant in the town.

As a head start, preliminary calculations on the design of a Distillation Column were done. The locally produced nipa wine (about 30%) will be used as a feed to the distillation column. The distillation column is capable of producing around 100 liters of hydrous bioethanol per day, with at least 95% distillate. The distillate will then be used as a fuel for the farm and agricultural machineries in the rice production areas.

**Highlights:**

- Design og Distillation Column

A distillation column was designed with perforated trays. Parameters calculated for the design cases are summarized in Table 16.

A 30% mol of ethanol feed is distilled using the distillation facility. The minimum theoretical stage at total reflux was calculated using Fenske Equation:

$$N_m = \frac{\log\left[\left(x_{LK}/x_{HK}\right)_D \left(x_{HK}/x_{LK}\right)_B\right]}{\log\left(\alpha_{LK/HK}\right)_{av}}$$

And the minimum reflux ratio was calculated using the Underwood Equation:

$$R_{\min} + 1 = \left[\frac{\alpha_{LK/HK}(x_{LK})_D}{\alpha_{LK/HK} - \theta}\right] + \left[\frac{\alpha_{HK/HK}(x_{HK})_D}{\alpha_{HK/HK} - \theta}\right]$$

$$where: \theta = \alpha_{LK/HK} + 1 - \left[\alpha_{LK/HK}(x_{LK})_F\right] - (x_{HK})_F$$

The reflux ratio at the top of the distillation column was calculated by multiplying the minimum reflux ratio by 1.25 and the reflux ratio at the bottom of the distillation column was calculated by multiplying the reflux ratio at the top by 1.4.

The number of theoretical stages was calculated using the Gilligand's Equation:

$$\frac{N - N_{\min}}{N + 1} = 0.75\left[1 - \left(\frac{R - R_{\min}}{R + 1}\right)^{0.566}\right]$$

And the location of feed was determined by the equation below:

$$N = N_D + N_B$$

$$\log\left(\frac{N_D}{N_B}\right) = 0.206\log\left[\left(\frac{B}{D}\right)\left(\frac{x_{HK}}{x_{LK}}\right)_F \left(\frac{(x_{LK})_B}{(x_{HK})_D}\right)^2\right]$$

The calculated minimum theoretical stage at total reflux is about seven, minimum reflux ratio is about six, and the number of theoretical stages is 14.

The temperature initially considered at the top and bottom of the distillation column are 78.15°C and 100°C, respectively at atmospheric pressure. The temperatures considered are the boiling point temperature of ethanol and water, respectively.

The maximum vapor rate and maximum liquid rate were calculated by the following equations:

$$Q_V = \frac{V\ MW}{\square}\ ; \quad Q_L = \frac{L\ MW}{\square}$$

The flow parameters calculated using this equation:

$$P_F = \frac{L}{V}\left(\frac{\rho_V}{\rho_L}\right)^{0.5}$$

and the capacity parameters derived are used to compute the area of the column, consequently calculating the diameter of the distillation column.

The condenser duty and reboiler duty were calculated by performing energy balance around the top and bottom of the distillation column, respectively. The calculated column efficiency is about 39.6% and the calculated actual number of stages is 34. Graphical method in determining the number of stages will be done to verify the value different values of stages mentioned above.

1) Perforated Plate

Based on the selected diameters, area of downcomer and active area for bubbling was calculated. Subsequently, percent flooding in the top and bottom of the distillation column was calculated using the equation below:

$$Percent\ Flood = \frac{Q_V}{U_{VN} \square A_A} \square 100$$

The calculated flooding is about 72.4% at the top, the recommended limit is 70-75% for foaming mixtures. Hence, there should be no flooding problem in the designed distillation column.

The fractional entrainment was derived. The total pressure drop across plate equivalent head was estimated using the equation:

wherehw is the weir height, how is the height of the liquid crest over the weir, $h_{ow}$ is the Equivalent surface-tension head loss, $h_0$ is the Equivalent head loss through holes, and *B* is the aeration factor. The calculated value is about 2.5 in.

Weep point is checked for top and bottom of the distillation column by comparing the values for ($h_0$+$h_0$, to the calculated values of ($h_0$ +$h_0$). Since the sum of the hole plus surface tension head terms is greater than the value at the calculated $h_w$+$h_{ow}$ quantities, therefore, all sections will operate well above the weep point.

Liquid backup in the downcomer was calculated using equation

$$H_D = \left[ \Delta H_t + h_w + h_{ow} + \frac{\Delta}{2} + h_d \right] \frac{1}{\varphi_d}$$

Liquid residence time in the downcomer was estimated using the equation below:

$$residence\ time = \frac{A_d H_D}{Q_L'}$$

The results are 6.07 and 43.06 seconds for the residence time at the top and bottom of the distillation column, respectively. The recommended limit is five seconds at the minimum.

Simulation Test Using the Chemical Engineering Distilling Set-up

A validation of the design is based on the test runs done in the distillation facility/set-up in the Department of Chemical Engineering, UPLB. A 30% v/v of ethanol feed is distilled using the distillation facility resulting in about 89% distillate. Table 16 shows the result gathered in the simulation runs.  A run with the following conditions was done (a) Feed Flow Rate=0.4L/min; (b) Feed Concentration=0.3; (c) Reflux Ratio=0.9108.

**Figure 21.** Distillation Set-up at UPLB Chemical Engineering Department

**Table 16.** Summary of Distillate Ethanol Concentration.

| Time | Distillate Ethanol Concentration (%v/v) |
|---|---|
| 0 | 0 |
| 30 | 86.0 |
| 60 | 87.8 |
| 90 | 89.4 |
| 120 | 89.4 |
| 150 | 89.4 |

**Climate change adaptation in Camarines Sur thru appropriate rice-based farming systems**

JRM Vergara , LR Marcelino, GO San Valentin, CP Mamaril,PhilRice LB and DA RFU

Climate change and variability is inevitable. It will continuously affect the sea level rise, and frequency of flooding and drought occurrence. This project entailed research result utilization for climate change vulnerable rice areas, directly involving farmers in the research activities. PhilRice served as a catalyst for support and developed methods of monitoring and analyzing adverse rice environments.

Proper identification and characterization of climate change vulnerable rice areas should be done to understand the dynamics of change and its effects to rice production. The study aimed to generate this information and will identify possible adaptation strategies to increase yield and income.

The study involved three adverse rice ecosystems: drought-prone, flood-prone and saline-prone. Each ecosystem was observed in a representative barangay or municipality in Camarines Sur.

**Highlights:**

- Planning meeting with LGU Nabua (flood prone), LGU Buhi (drought prone), LGU Calabanga (saline prone), and 0DA RFU 5 was conducted to discuss the general plans in research intervention to be executed.

- Sites for the nutrient management and variety trial were identified.

- Farmer cooperators in each ecosystem were identified to monitor and assist in data gathering.

- Training need assessment was also conducted.

- Preliminary observations in saline-prone areas established that variation on salinity depends not only on inherent soil properties but also on the effect of underground and surface intrusion of seawater throughout seasons.

- The position of the farm from the source of salinity, elevation, slope, and presence of fresh water irrigation certainly influences the spatial and temporal variability of salinity of the flood water and soil within the rice field.

- There is a strong relationship between height of tide water and flow of fresh water from gravity sources of irrigation and from precipitation, and salinity level.

- The methodology for site characterization of saline-prone areas that would help delineate areas requiring different levels of management including choice of variety, nutrient management, and water management was identified and proposed.

**XI. Technology development and promotion in Bicol Region**
MM Movillon

This development project was conceptualized to come up with a more comprehensive development endeavour in the Bicol Region that captures diverse environment and stakeholders. The technology promotion activities for Bicol covers the more general populace by promoting location-specific technology (LST) packages to the different municipalities of Bicol (Oas, Albay and Pamplona, Pili, Ocampo, and Nabua, Camarines Sur) with the objective of influencing the local government units (LGUs) to adopt and implement the LST recommendations for increased productivity and income of local farmers. Part of the activities is promoting DA-PhilRice technologies by tapping bus, RORO, and airline corporations to widen the reach of development activities. Thus, a committed and effective partnership among key players/stakeholders in the rice production system would be enhanced.

To date, the project has already endeavored for the adoption of LST recommendations in the municipalities of Nabua and Pamplona, Camarines Sur. It has also engaged the commitment and cooperation of Montenegro Lines; Naga and Legazpi airports thru the Civil Aviation Authority of the Philippines (CAAP); and two bus lines (Alps the Bus, and Bragais Lines) to show PhilRice technology videos during their operating hours.

**Anthropological and socioeconomic characterization of Bicol's Agta Indigenous Peoples (IPS) - Phase 1**

JLM Ocampo, SMM Cuevas,FS Aguilar,MFQ Austerio, IDG Olvida, MM Movillon

The Bicol region is the fourth poorest region in the Philippines with approximately 43% of its population situated below the poverty threshold, many of whom are part of the marginalized sectors such as the indigenous peoples (IPs). This multidisciplinary study combined the perspectives of anthropology, sociology, and economics to characterize four IP communities' needs and constraints on rice production.

The study aimed to introduce intervention activities to stimulate the communities' agricultural potential through the implementation of location-specific farming technologies or techniques to help increase 1) productivity, 2) profitability, and 3) sustainability of rice and rice-based farming systems, such as the Palayamanan approach. Ocampo et al selected and conducted data gathering activities in two selected sites, Barangay San Pedro in Iriga City and Barangay Gatbo in Ocampo as recommended by the National Commission on Indigenous Peoples V.

**Highlights:**

Barangay San Pedro, Iriga City

- Upland rice production within the community has been sporadic. Many of the farmers have resorted to planting abaca, banana, coconut, or root crops. Most of the farmers had problems with pest management and therefore discontinued the planting of rice. Former rice fields not utilized have been left fallow for many years.

- Respondents said that rice and vegetables produced from their farm were set aside for own consumption. Meanwhile, abaca fiber and desiccated coconut are sold in the market.

- Indigenous farming techniques and implements have continuously been utilized by farmers including the practice of "opening new land" or kaingin and giving an offering or apag to the spirits to protect the crops.

- There is a stigma to being called "Agta" which is why the farmers prefer to refer to themselves as "Cimarron" or the more general "IPs".

Barangay Gatbo, Ocampo

- Many of the rice fields have well-developed irrigation with water coming from springs and rivers in proximity while some are rainfed. There are no rice fields in the upland region of the barangay, however some of the farmers have expressed interest in upland rice farming.

- The farmers say that one of their main constraints was the rising cost of inputs such as fertilizers and pesticides. They express eagerness in learning about new technologies that could help them minimize the production cost of rice.

- Income is derived from rice but income-generating activities also include employment in various offices, overseas remittances, selling abaca from the upland, livestock, among others.

**Figure 22.** IP Farmer-Respondent from Iriga during the interview (left) and lowland rice field in Gatbo, Ocampo.

**Table 17.** Number of Rice Respondents by Barangay and by Municipality, Camarines Sur by cropping period

| Site | TOT. NO. OF FARMERS INTERVIEWED | DISTRIBUTION OF FARMERS FOR THE | | | |
|---|---|---|---|---|---|
| | | *DS 2011 and Below* | *WS 2011* | *DS 2012* | *WS 2012* |
| San Pedro, Iriga City | 38 | 25 | 3 | 1 | 9 |
| Gatbo, Ocampo | 36 | | | 34 | |
| **TOTAL** | **74** | **25** | **3** | **35** | **9** |

**Table 18**. Socio-demographic characteristics of IP Farmer-Respondents

| CHARACTERISTICS | IRIGA | OCAMPO |
|---|---|---|
| | **San Pedro** | **Gatbo** |
| **Mean Age** | 48 | 59 |
| Minimum | 30 | 41 |
| Maximum | 70 | 83 |
| **Mean number of Years Schooling** | 6 | 6 |
| **Mean Farming Experience (years)** | 27 | 34 |
| **Mean Household Size** | 7 | 5 |
| **Gender[a]** | | |
| Male | 20 (53) | 26 (72) |
| Female | 18 (47) | 10 (28) |
| **Civil Status[a]** | | |
| Single | 1 (3) | 1 (3) |
| Married | 37 (97) | 32 (86) |
| Widow/Widower | | 3 (8) |
| Separated | | 1 (3) |

[a]Values in parenthesis are percentages.

## Determining the impact of PalayCheck system on the rice yield and income of participating farmers in Bicol Region

JLM Ocampo, FS Aguilar, IDG Olvida, MFQ Austerio, MM Movillon

The Philippine Rice Masterplan of 2009 envisioned a rice self-sufficient economy by 2013 through improved rice productivity and increased income of rice farmers.  Since then, PhilRice has positioned the PalayCheck System as one of the platforms to achieve rice self-sufficiency nationwide. To achieve this, PhilRice has deployed Rice Sufficiency Officers (RSOs) to selected provinces to train farmers with new technologies for rice farming.  In 2009, as part of PhilRice Los Baños' AOR, the PalayCheck System embedded in the Location-Specific Technology Development (LSTD) Project was introduced to selected municipalities in Albay and Camarines Sur. An evaluation of the PalayCheck System's likely effect on the farm level rice yield and income of participating farmers in the selected municipalities in Albay and Camarines Sur is of significance. This goal was attempted through determining the farm yields and relating this to

KeyCheck attainment, identification of factors affecting the attainment of non-attainment of KeyChecks, and formulation of policy recommendations related to and affecting the adoption and impact of the PalayCheck systems in the LSTD sites in Bicol. However, due to PhilRice's prioritization of research areas, this study was terminated. Nonetheless, three out of five LSTD municipalities were covered in the survey, thus, a database of which was made available.

**Highlights:**

- Meetings with the Municipal Agriculturists, briefing of enumerators and checking of surveyed forms in Nabua, Pili, Ocampo and Pamplona in Camarines Sur and Oas in Albay were conducted at the onset of the study. The LSTD sites were Brgys. San Antonio, Bustrac, and Sta. Cruz in Nabua; Brgys. Maporong, Bagumbayan, and Bagsa in Oas; Brgys. Cadlan, Himaao, Pawili and San Agustin in Pili; Brgys San Antonio and New Moriones in Ocampo; and Brgys. Burabod and Salvacion in Pamplona were done.

- A total of 162 out of 231 LSTD beneficiaries were interviewed in November 2012 for the adoption survey of KeyChecks: 57 from Nabua, 57 from Oas; and 48 from Pili. The data collected included information on: 1) Farmers' profile and farm characteristics; 2) Total number of KeyChecks achieved for the next 4 cropping periods after LSTD implementation (DS and WS 2011 and DS and WS 2012) inclusive of data on yield, rice area planted, and net income per season; 3) Reasons for the attainment and non-attainment of KeyChecks; and 4) Problems encountered and farmers' suggestions.

- Adoption of KeyChecks was generally affected by several factors. In Nabua, LSTD beneficiaries were not able to adopt most of the KeyChecks especially in Brgy. Bustrac due to the occurrence of flood. Most of the rice planted was submerged by flood on 2011 DS and WS which damaged the plant at booting stage. On the other hand, LSTD beneficiaries in Pili and Oas were able to follow six to eight KeyChecks per season as these were reported as easy to follow and that farmers would try to strictly apply what they have learned from the PalayCheck System.

- Based on the deliberations of the Project Review on December 2012, the management, project and study leaders agreed to end the study and focus on the recent priority areas for research in PhilRice.

**Evaluation and promotion of LST and general technology promotion for Bicol**

IDG Olvida, KAMP Balingit, LRMarcelino, CNunez, GCastaneda, AComprado

The development of location-specific technology (LST) packages that can overcome yield constraints in an area was the ultimate of goal of the LSTD Program. The Rice Sufficiency Officers (RSOs) assigned in Bicol were able to develop LST packages for the municipalities of Pamplona, Pili, Ocampo, and Nabua, Camarines Sur, and Oas, Albay. Thus, Component I of this study focused on the promotion of LST packages to encourage the local government units (LGUs) to adapt and implement the location-specific technology recommendations. Component II of the study focused on promoting the generated technologies of PhilRice and the DA-RFU V to the more general populace by tapping bus, RORO, and airline corporations to increase awareness and knowledge on available technologies on rice production in particular, and agriculture in general.

**Highlights:**

Component I: LST Package Promotion in Pamplona, Pili, Ocampo, and Nabua, Camarines Sur and Oas, Albay

- Nabua, Camarines Sur — November 21, 2012
- Oas, Albay: — February 20, 2013
- Pamplona, Camarines Sur: — February 21, 2013
- Ocampo, Camarines Sur: — March 6, 2013
- Pili, Camarines Sur: — March 7, 2013

Component 2:Tapping Corporate Social Responsibilty (CSR) in Technology Promotion

- PHILRICE and DA-Region V technology and promotional videos currently being consolidated:

i. PalayCheck System
ii. Technology Videos (Controlled Irrigation, MOET, etc.)
iii. PhilRice advocacy videos (Rice awareness, NYR)
iv. DA-Region V (local technology videos from DA-Information Office)

- Request letters for airlines, shipping lines, and bus lines prepared and ready for distribution.

i. AIRLINES

- PAL / Air Philippines
- Cebu Pacific
- Zest Air

ii. SHIPPING LINES

- Montenegro Shipping Lines, Inc.
- Medallon Transport

iii. BUS LINES

- Superlines
- Raymond
- Alps
- Penafrancia
- Tawtrasco
- St. Jude
- A. Brigais

**XII. GreenFarm - Development and promotion of green technologies in Agricultural Systems**

VT Villiancio

The project is designed to establish a model community-based organic agriculture that can be replicated in other areas of the country. In accordance with the Organic Act, the study promoted the use of organic fertilizers from biodegradable agriculture wastes.

The study showcased the application of environment-friendly (green) technologies in rice based-farming systems. It aimed to develop a mechanism that will formulate, advocate, and implement organic agriculture and livelihood activities that will facilitate the transformation of exploitative and extractive land use system into a more permanent, and sustainable livelihood system. It also targeted to optimize the utilization and value of the irrigated, rainfed, and upland rice areas through organic agriculture that will provide food and livelihood opportunities in the community. With this, the project aimed to: A) develop and promote organic rice-based farming systems in selected rice areas of Camarines Norte;B) showcase the use of organic fertilizers and pesticides in rice-based farming systems;C) assess the technical feasibility, economic viability, and social acceptability of organic rice-based farming systems at the farmers' level; and D)train farmers on organic rice-based farming systems.

**Development and promotion of organic upland and rainfed rice-based farming systems (OUR FS)**
JNM Garcia, RL Limosinero, KAngeles, VT Villancio

The global climate change is now with us. Such was said to have been caused by too much carbon in the atmosphere due to excessive burning of fossil fuel. This resulted in gradual heating up of the earth and in turn leads to vagaries in the weather with serious consequences for our food production.

As the national institution identified for agriculture, it is necessary to examine and suggest ways to solve this global problem. We have to redefine agriculture in terms of inputs that will help eliminate the carbon problem: food production should not be dependent anymore on fossil fuel. This is indeed a challenge considering our shrinking crop production area due to inroad of urbanization and the need to provide food for the populace. Furthermore, there is an expected movement of food production from the lowland to the upland due to sea water intrusion during drought and flooding during intense typhoons.

The passage of the Organic Agriculture Act of 2010 provided a promise for the future of agriculture in the country.

This project was designed to establish a model community-based organic agriculture that can be replicated in other areas of the country. In accordance with the Organic Act, the study initiated the use of organic fertilizers from biodegradable wastes to lessen the problems of farm wasters, industrial wastes. Thus, the twin goals of shifting to organic agricultural inputs and at the same time creating a cleaner environment will be achieved.

**Highlights:**

- Situational Analysis
  The selected site is in Bakiad, Labo, Camarines Norte. Contacts were identified and reconnaissance survey was conducted. Baseline survey questionnaire was designed and sampling frame identified. Farmer partners were also identified.

- Design of organic upland and rainfed rice-based farming systems (RBFS)

  Sets of technologies for organic RBFS were identified. Rainfed rice-based cropping patterns to be established are: rice-rice or rice-upland crops while upland rice-based cropping pattern to be established are: upland rice-upland crops. Technologies identified include:

1. The use of drum seeder in crop establishment
2. The use of vermicompost and biofertilizers (Bio N and Biogroe)

- Establishment of demonstration farms for rainfed and upland RBFS
  Establishment of three demo farm for rice-based farming systems is planned. However, 23 farmers adapted and established demo/trial in their farm. Rainfed RBFS was established and upland rice RBFS was slated for May 2013.

- Promotion and testing of organic rice-based farming systems to farmers
  Among the farmer-partners, 15 farmers used vermicomposts, eight farmers used BioN, and seven farmers used Biogroe in demofarms.

**Adaptation of organic farming technologies in rice-based farming systems (RFS) for irrigated areas**
JNM Garcia, RL Limosinero, KAngeles, VT Villancio

Understanding what makes agricultural systems sustainable is a key concern in agricultural development. For policy makers, understanding the area requirement to support a family in an upland and rainfed rice-based farming system is essential in formulating equitable decisions/programs.

Upland and Rainfed Rice-based Farming Systems model that were showcased integrate various crops, livestocks, and fish with the aim of utilizing all products and by-products of the farm without wasting anything while enjoying a comfortable and wholesome environment.

On the premise that upland rice farmers are basically poor, designing a system whereby the farmer would become self-reliant and self-sufficient is essential in the pursuit of sustainable development. The Palayamanan will challenge and encourage the farmers to combine the art, science, and good agriculture practice in rice-based farming system. Furthermore, producing safe nutritious food and healthy environment will become a dream come true.

Highlights:

- Design of organic rice-based farming systems in irrigated areas.
  Sets of technologies for organic RFS were identified. These include the use of vermicomposts, Bio N, and Biogroe.

- Establishment of demonstration farms for irrigated rice-based farming systems.
  Two demo farms were established at University of the Philippines

Los Banos for the GreenFarm project using different levels of vermicomposts and application of BioN and Biogroe.

## XIII. Development and promotion of upland and rainfed rice-based farming systems through Palayamanan

VT Villancio

Upland and Rainfed Rice-based Farming Systems Model integrates various crops, livestocks, and fish with the aim of utilizing all products and by-products of the farm without wasting anything while enjoying a comfortable and wholesome environment.

On the premise that upland rice farmers are basically poor, designing a system whereby the farmer would become self-reliant and self-sufficient is essential in the pursuit of sustainable development. The Palayamanan will challenge and encourage the farmers to combine the art, science and good agriculture practice in rice-based farming system. Furthermore, producing safe nutritious food and healthy environment will become a dream come true.

**Highlights:**

- Situational Analysis
  Situation analysis was done and the site selected is in Bakiad, Labo, Camarines Norte.

- Design of Upland Rice-based Farming Systems through Palayamanan
  Technologies were integrated with the upland crops in RBFS and vermicomposting. Interdependence of the components of the URBFS was conceptualized to be operationalized.

- Establishment of demonstration farms and Promotion of Upland Rice-based Farming Systems to farmers.
  Two demo farms were established at University of the Los Banos and Labo, Camarines Norte.

  Eighteen farmer cooperators were involved in the trials on corn and vegetables after rice. Seventeen out of 18 farmers are involved in vegetable trials and seven of 18 are also involved in corn.

- Documentation of Farmer-based Upland Rice-based Farming Systems
  Twenty five survey forms were acomplished. The weather data were obtained from PAG-ASA Weather Station at Bagasbas, Daet, Camarines Norte.

## Abbreviations and acronymns

ABA – Abscicic acid
Ac – anther culture
AC – amylose content
AESA – Agro-ecosystems Analysis
AEW – agricultural extension workers
AG – anaerobic germination
AIS – Agricultural Information System
ANOVA – analysis of variance
AON – advance observation nursery
AT – agricultural technologist
AYT – advanced yield trial
BCA – biological control agent
BLB – bacterial leaf blight
BLS – bacterial leaf streak
BPH – brown planthopper
Bo - boron
BR – brown rice
BSWM – Bureau of Soils and Water Management
Ca - Calcium
CARP – Comprehensive Agrarian Reform Program
cav – cavan, usually 50 kg
CBFM – community-based forestry management
CLSU – Central Luzon State University
cm – centimeter
CMS – cystoplasmic male sterile
CP – protein content
CRH – carbonized rice hull
CTRHC – continuous-type rice hull carbonizer
CT – conventional tillage
Cu – copper
DA – Department of Agriculture
DA-RFU – Department of Agriculture-Regional Field Units
DAE – days after emergence
DAS – days after seeding
DAT – days after transplanting
DBMS – database management system
DDTK – disease diagnostic tool kit
DENR – Department of Environment and Natural Resources
DH L– double haploid lines
DRR – drought recovery rate
DS – dry season
DSA - diversity and stress adaptation
DSR – direct seeded rice
DUST – distinctness, uniformity and stability trial
DWSR – direct wet-seeded rice
EGS – early generation screening
EH – early heading
EMBI – effective microorganism-based inoculant
EPI – early panicle initiation
ET – early tillering
FAO – Food and Agriculture Organization
Fe – Iron
FFA – free fatty acid
FFP – farmer's fertilizer practice
FFS – farmers' field school
FGD – focus group discussion
FI – farmer innovator
FSSP – Food Staples Self-sufficiency Plan
g – gram
GAS – golden apple snail
GC – gel consistency
GIS – geographic information system
GHG – greenhouse gas
GLH – green leafhopper
GPS – global positioning system
GQ – grain quality
GUI – graphical user interface
GWS – genomwide selection
GYT – general yield trial
h – hour
ha – hectare
HIP - high inorganic phosphate
HPL – hybrid parental line
I - intermediate
ICIS – International Crop Information System
ICT – information and communication technology
IMO – indigenous microorganism
IF – inorganic fertilizer
INGER - International Network for Genetic Evaluation of Rice
IP – insect pest
IPDTK – insect pest diagnostic tool kit
IPM – Integrated Pest Management
IRRI – International Rice Research Institute
IVC – in vitro culture
IVM – in vitro mutagenesis
IWM – integrated weed management
JICA – Japan International Cooperation Agency
K – potassium
kg – kilogram
KP – knowledge product
KSL – knowledge sharing and learning
LCC – leaf color chart
LDIS – low-cost drip irrigation system
LeD – leaf drying
LeR – leaf rolling
lpa – low phytic acid
LGU – local government unit

LSTD – location specific technology development
m – meter
MAS – marker-assisted selection
MAT – Multi-Adaption Trial
MC – moisture content
MDDST – modified dry direct seeding technique
MET – multi-environment trial
MFE – male fertile environment
MLM – mixed-effects linear model
Mg – magnesium
Mn – Manganese
MDDST – Modified Dry Direct Seeding Technique
MOET – minus one element technique
MR – moderately resistant
MRT – Mobile Rice TeknoKlinik
MSE – male-sterile environment
MT – minimum tillage
mtha$^{-1}$ - metric ton per hectare
MYT – multi-location yield trials
N – nitrogen
NAFC – National Agricultural and Fishery Council
NBS – narrow brown spot
NCT – National Cooperative Testing
NFA – National Food Authority
NGO – non-government organization
NE – natural enemies
NIL – near isogenic line
NM – Nutrient Manager
NOPT – Nutrient Omission Plot Technique
NR – new reagent
NSIC – National Seed Industry Council
NSQCS – National Seed Quality Control Services
OF – organic fertilizer
OFT – on-farm trial
OM – organic matter
ON – observational nursery
OPAg – Office of Provincial Agriculturist
OpAPA – Open Academy for Philippine Agriculture
P – phosphorus
PA – phytic acid
PCR – Polymerase chain reaction
PDW – plant dry weight
PF – participating farmer
PFS – PalayCheck field school
PhilRice – Philippine Rice Research Institute
PhilSCAT – Philippine-Sino Center for Agricultural Technology
PHilMech – Philippine Center for Postharvest Development and Mechanization
PCA – principal component analysis
PI – panicle initiation
PN – pedigree nursery
PRKB – Pinoy Rice Knowledge Bank
PTD – participatory technology development
PYT – preliminary yield trial
QTL – quantitative trait loci
R - resistant
RBB – rice black bug
RCBD – randomized complete block design
RDI – regulated deficit irrigation
RF – rainfed
RP – resource person
RPM – revolution per minute
RQCS – Rice Quality Classification Software
RS4D – Rice Science for Development
RSO – rice sufficiency officer
RFL – Rainfed lowland
RTV – rice tungro virus
RTWG – Rice Technical Working Group
S – sulfur
SACLOB – Sealed Storage Enclosure for Rice Seeds
SALT – Sloping Agricultural Land Technology
SB – sheath blight
SFR – small farm reservoir
SME – small-medium enterprise
SMS – short message service
SN – source nursery
SSNM – site-specific nutrient management
SSR – simple sequence repeat
STK – soil test kit
STR – sequence tandem repeat
SV – seedling vigor
t – ton
TCN – testcross nursery
TCP – technical cooperation project
TGMS – thermo-sensitive genetic male sterile
TN – testcross nursery
TOT – training of trainers
TPR – transplanted rice
TRV – traditional variety
TSS – total soluble solid
UEM – ultra-early maturing
UPLB – University of the Philippines Los Baños
VSU – Visayas State University
WBPH – white-backed planthopper
WEPP – water erosion prediction project
WHC – water holding capacity
WHO – World Health Organization
WS – wet season
WT – weed tolerance
YA – yield advantage
Zn – zinc
ZT – zero tillage

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Department of Agriculture
PHILRICE
PHILIPPINE RICE RESEARCH INSTITUTE

We are a chartered government corporate entity under the Department of Agriculture. We were created through Executive Order 1061 on 5 November 1985 (as amended) to help develop high-yielding, cost-reducing, and environment-friendly technologies so farmers can produce enough rice for all Filipinos.

We accomplish this mission through research and development work in our central and seven branch stations, coordinating with a network that comprises 58 agencies and 70 seed centers strategically located nationwide. To help farmers achieve holistic development, we will pursue the following goals in 2010-2020: attaining and sustaining rice self-sufficiency; reducing poverty and malnutrition; and achieving competitiveness through agricultural science and technology.

We have the following certifications: ISO 9001:2008 (Quality Management), ISO 14001:2004 (Environmental Management), and OHSAS 18001:2007 (Occupational Health and Safety Assessment Series).

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