Towards a Portfolio of Climate Resilient Technological Options:

Community level participatory adaptive research

INTRODUCTION

Farmers in the Philippines are already being challenged by climate change. This is often manifested by climate variability (too much rain, periods of drought, extreme weather, etc.). Household livelihoods, income and nutritional well-being are affected adversely.

The impacts of climate change are often unique to specific locations and tend to differ considerably, even from community to community. Solutions need to be derived locally and in partnership with local communities and local governments. Both livelihood and climate risks need to be addressed (for different socio-cultural contexts and agro-ecologies).

Community-level participatory action help develop adaptive capacities of local communities to address current and future climate risks. Farmers need a range of options that they can choose from.

This publication chronicles lessons from the field from the Municipality of Guinayangan, Quezon. This work has been supported by the Department of Agriculture through the Bureau of Agricultural Research (BAR) and the Systems-Wide Climate Change Office (SWCCO) under the Adaptation and Mitigation Initiative in Agriculture (AMIA) Program and CCAFS Southeast Asia.

Thematic Area of CSA/CRA Intervention **1**:

Watershed Conservation and Development in Forest Ecosystems

Watersheds provide services such as water, food, and raw materials for livelihoods. Unfortunately in the Philippines, many of the watersheds suffer from degradation and deforestation and are often converted to agricultural lands. These significantly reduce the flow of services derived from watersheds (Bennagen, et al., 2006; Arocena-Francisco, 2002). Governments and various institutions and organizations have initiated unsuccessful watershed maintenance strategies due to top-down approach, limited involvement of benefiting communities, and lack of monetary resources (Alpízar & Madrigal, 2008).

Introduction to Guinayangan

Guinayangan, a third class municipality with a population of 45,754 , is a developing town in Quezon Province. Located on the southern tip and eastern coast of Bondoc Peninsula, facing Camarines Sur, it is comprised of 54 barangays covering a total land area of 22,800 hectares. It has a population of 41,669.

In spite of its rich natural resources, the Municipality of Guinayangan remains a typical 3rd class town in Quezon: large number of families are poor and very reliant on agriculture for livelihood. Ranked 371st out of the 609 poorest municipalities in the country, 48% of Guinayangan's 8,334 households live below the monthly per capita poverty threshold of PhP 1,403.00 (approx. USD33).

Six areas in Guinayangan supply most of the water demands of 2,460 households served by the local water district. This includes a public water source located in the town of San Pedro II managed by the Department of Environment and Natural Resources (DENR) in collaboration with People's Organization (PO) and Samahang Pampamayanan Para sa Kaunlaran, Inc. (SPPKI). Two are privately owned water sources located in the towns of Bahukhok and San Pedro I. The one in Bahukhok is classified as an alienable and disposable land. Three other sources originate from watersheds, namely: Maulawin Spring Protected Landscape (MSPL), Tibiang-Dumagundong Watershed Forest Reserve, and Lopez Watershed Forest Reserve. The Tibiang-Dumagundong Watershed Forest Reserve (280 hectares) and the Lopez Watershed Forest Reserve (418 hectares) are both proclaimed watersheds through Presidential Proclamations No. 295 dated July 21, 1938 and No.566 dated June 22, 1940 respectively. These areas are cultivated by individuals with tenurial instruments under the Integrated Social Forestry Program (ISFP).

The Maulawin Spring serves as a critical habitat for tree and shrub bio-diversity

Aside from its water resource, the watershed provides other very valuable ecosystem services. It is a habitat to at least 44 locally known tree species and 15 fauna species including *Madhuca ovolifolia* (Pianga), an endemic plant species highly threatened with extinction. Sixteen of these species fall under the IUCN (International Union for Conservation of Nature) categories as endangered, vulnerable, and critically endangered. The watershed is rich in various palm species such as buri, coconut, and anahaw, which provide local residents with food and construction materials. The biodiversity provided by the watershed allows resident households, as well as those in its adjacent barangays, to sustain supplementary livelihoods

Alpízar, F., & Madrigal, R. (2008). *Constructing payment schemes for ecosystem services at the local level: methodological approach and some lessons learned. Economics and Conservation In The Tropics: A Strategic Dialogue.*

Arocena-Francisco, H. (2002). ***Environmental service "payments": Experiences, constraints and potential in the Philippines. Developing Mechanisms For Rewarding The Upland Poor In Asia For Environmental Services They Provide.*** Puncak, Indonesia: World Agroforestry Centre (ICRAF).

Bennagen, M. E., Indab, A., Amponin, A., Cruz, R., Folledo, R., Van Beukering, P. J. H., De Jong, J. (2006). ***Designing payments for watershed protection services of Philippine upland dwellers.***

Of these six water sources, the Maulawin Spring Protected Landscape (MSPL) was designated as a Protected Area under Republic Act No. 7586 (also known as the NIPAS Act of 1992). It was declared under Proclamation No. 295 on April 23, 2000. It has a total area of 149.01 hectares and covers the towns of Magsaysay, San Pedro I, and Himbubulo Weste. MSPL's four major tributaries (the Hiwasayan and Maulawin Rivers and the Prensa and Sisi (creeks) traverse distinct agro-ecological zones. The estimated 12km Hiwasayan River emanates from the forest ecosystem in MSPL's 92-hectares of strict protection zone. It subsequently traverses through upland areas dominated by coconuts in three barangays covering MSPL and Barangays Dungawan Pantay and Villa Hiwasayan. It then connects to the lowland rice-producing areas in Barangays Ligpit Bantayan, Sintones, and Capuluan, finally flowing down to the coastal ecosystems of Barangay Arbismen, where it exits to Ragay Gulf. The Maulawin River and the Sisi and Prensa Creeks, all located in the northeastern part of MSPL, traverse the densely populated coastal barangays of Calimpak, Sisi, Poblacion, and Manggagawa.

The Maulawin Spring is a critical resource of Guinayangan as it directly supplies water to 2,082 households in the town's center and irrigates lowland farms in at least 8 barangays. The Maulawin Spring also provides other very valuable ecosystem services to at least 13 barangays (from the uplands to the lowland farms and coastal areas of Guinayangan).

Enriching the watershed

A total of 27.5 hectares were planted with 22,689 seedlings of 32 native species in the strictly protected zones. Enrichment planting to previously reforested area was also done. Maintenance was done during the implementation. The latest monitoring visit revealed 80% survival rate of seedlings planted in 2015. Narra, biataog, sampaloc, duhat, lipote, kalumpit, and kakawate dominate in the area. To protect the reforestation site (which was "recovered" from illegal encroachment by local farmers who utilized it for coconut plantation), a fire line measuring 1.5. meter was established to physically separate the reforestation area from adjacent private land. To further protect the reforestation site and the strictly protected zone, kawayan tinik propagation as natural fence and buffer was established doing the 3rd phase of the project.

Migrant populations are organized into peoples' organization like Samahang Tenured Migrants ng Maulawin Protected Area (STMMPA) to help deter further encroachment and obtain their support and involvement in the protection of MSPL. A protected area management board (PAMB) was created to manage the MSPL. In March 2008, the PAMB formulated and approved a community resource management plan yet the protected area is still environmentally degraded by destructive agricultural practices, illegal logging, and unsustainable extraction (e.g. for charcoal production) and use of forest products. A significant portion of MSPL and its buffer zone is also in need of restoration of its forest cover. The state of the forest contributes to the erosion, seasonal flooding, and siltation of lowland areas along barangays traversed by the rivers in MSPL.

Various reforestation projects and initiatives have been implemented in MSPL. These include local and national government projects and initiatives of private organizations. However, these activities are often unsustainable because they are only short-term measures. The government also has limited decision-making powers in the management of water sources drawn from privately owned properties.

Sustaining watershed development at local levels

Sustainablity of activities and regular maintainance is one of the main challenges of watershed management in Guinayangan. The International Institute of Rural Reconstruction (IIRR) utilized

watershed management as a strategy to scale-up its reforestation, food security, and climate smart agriculture interventions into the watershed and biodiversity conservation agenda of the LGU and the DENR. An emphasis on conservation and natural resources management was crucial for preserving natural resources, livelihoods, and health of local people.

IIRR and its partners, together with Forest Foundation Philippines, developed the project titled Enhancing Ecosystem Services of the Maulawin Spring Protected Landscape in Guinyangan, Quezon Province. The project was designed to help sustain the ecosystem services derived from the Maulawin Spring Protected Landscape (MSPL) through watershed conservation, protection, and development activities. This initiative strengthens multi-stakeholder participation and increased environmental awareness in the community.

The local government partnered with IIRR and the DENR in implementing the Payment for Environmental Services (PES) concept. Locally known as the 'Green Fund', PES was approved by the Sanggunian Bayan (Municipal Council) in June 2014 through SB Resolution No. 83, series of 2014. The fund aims to sustainably finance development, protection, and maintenance of the water sources of the municipality.

IIRR and DENR Community Environment and Natural Resources Office (CENRO) - Calauag, conducted an economic valuation study to assess the feasibility plan of the Green Fund and to quantify the economic value of water provided by the MSPL. The study identified people's willingness to pay an additonal levy and explored social acceptability of the PES idea. The study revealed that the most affordable and socially acceptable amount for the PES is twenty pesos (PhP 20.00). The study also indicated that fifty percent (50.5%) of the respondents accepted the idea of PES and were willing to pay the Green Fund. The respondents are aware that PES will enhance the provision of water supply and disaster risk reduction, which are essential to their well-being. A total of 49.5% of the respondents did not support PES, saying they could not afford the additional fees. With regards to the management of the Green Fund, worries about misuse and trust surfaced. From this survey, the Municipal Ecosystem Management Council (MEMC) pegged for a much lower charge of PhP 10.00 for domestic consumers, PhP 20.00 for institutional establishments, and PhP30.00 for industrial establishments.

The initial collection covered consumers of GWD. The Green Fund was incorporated in the monthly water bill. Because it already has an effective collection system in place, the MEMC designated GWD as the Green Fund collector through a memorandum of agreement. In the future, other water users such as resorts and other industrial facilities that directly tap rivers flowing from the MSPL will be charged as well. After collection, GWD turns over the Green Fund to the Municipal Treasurer to be deposited in a trust fund solely devoted for watershed conservation.

The collection of Green Fund contributions commenced in November 2016 after it was launched a month prior. An average of PhP 20,000.00 per month was collected in its first year. The MEMC agreed on the following fund allocation: 50% will go to development of watersheds and 50% towards the procurement of additional land to expand watershed area and support private land owners for a sustainable forest management program through agroforestry.

Payment for ecosystem services (PES)

PES is a voluntary transaction for a well-defined ecological service with at least one buyer, at least one provider, and based on the condition that the buyer(s) only pay if the provider(s) continue to deliver the defined ecosystem service over time (Wunder, 2005).

Sven Wunder, 2005. *Payments for environmental services: Some nuts and bolts.* CIFOR Occasional Paper No. 4.

Multi-purpose agroforestry (in the multiple-use zone) in support of food production and livelihoods of local dwellers

Local authorities and project partners recognized the importance of upland farmers and the need to engage them in resource management. There are 42 households occupying the multiple-use zone of the MSPL. The DENR has recognized their rights by awarding them a tenurial instrument giving them access to the land for 25 years. The instrument is called Protected Areas Community Based Management Agreement (PACBARMA), an approach which stresses the importance of involving the community in managing the forest. The project actively engaged the upland migrants by introducing climate smart agriculture (CSA) farming approaches. The CSA efforts were enhanced and influenced by the participatory action research work also undertaken in the project area, with support from CCAFS and the Department of Agriculture (AMIA) programs .

Many of the upland areas near the watershed are under a mono-crop systems. Diversification and intensification through agroforesty offered prospects of increasing forest cover, income,

and food security. Commercially relevant trees such as cacao, coffee, rambutan, guyabano, banana, and other fruit trees were integrated into what was previously a mono crop coconut based system. The work supported by Forest Foundation Philippines complemented the climate-smart/climate resilient agriculture work of the CCAFS/DA AMIA work of the proponent organization (IIRR) and the Office of the Municipal Agriculturist. CSA technologies for reforestation were introduced such as the use of bigger and deeper pit for tree planting to promote deeper rooting and for in situ water harvesting/storage. Mulching was used to improve/increase survival rates (given the usual threat of long dry season in the uplands). A number of root crop varieties were introduced based on its market relevance, resilience, and nutritional value (e.g. yellow sweet potato). Pineapple was also introduced for its commercial potential. Mother fruit trees were also introduced to ensure future sources of good quality seedlings or vegetative propagation materials. Several of the upland farmers including LGU personnel were trained in various propagation techniques.Diversification through the concept of mini fruit tree orchards were seen as more realistic way of breaking into local markets first (before the specialization that typically characterizes approaches with higher risks).

Small livestock (goat and native swine) production was also introduced in these multi-use zones. Small livestock offers resource poor farmers a source of food, a way of building assets and a source of emergency funds. Small systems, local markets, and with low carbon footprint were prioritized.

A driving force to PES' institutionalization is the LGU officials' recognition of PES as a key element in sustaining conservation efforts in Guinayangan. Active LGU engagement and support encouraged the regulation of PES and involvement of all stakeholders. Learning events helped local government officials make informed and better decisions on how to establish and sustainably implement the Green Fund.

Practices Promoted:

- Landscape based approaches provide opportunities for mitigation, for improving resilience to climate impacts and for increasing food security.
- Ecosystem health and resilience are addressed while conserving ecosystem services such as watershed functions
- Forests, uplands, lowlands, and coastal areas provide a range of diversity of entry points for integrating adaptation and mitigation while enhancing more resilient livelihoods.

Current status:

- 3 barangays initiated by IIRR (Magsaysay, Himbubulo Weste, San Pedro 1) future barangays in coordination with the MEMC (San Roque, San Lorenzo, San Pedro II)
- Restoration and conservation of protected zone
- Introduction of perennial habitat as carbon stock, as reserve/sanctuary for wildlife, flora and fauna
- Introduction of agro forestry based interventions to family farms in the buffer zone, conduct of campaign on conservation. Testing of payment for environmental service concepts

Currently, there are 71 farmers practicing agroforestry in the three barangays that covers the MSPL multi-use zone with an aggregate total of 5 hectares. Sixty percent survival rate for the fruit trees has been observed during monitoring. Pineapple has been harvested and area expanded utilizing the suckers from their first batch. Two nurseries for fruit trees, fodder, and crops have been established. Meanwhile, STMMPA and 4H members were trained in sustainable resource management approaches (e.g. bio-intensive gardening, nursery management, farm integrated planning).

Thematic Area of CSA/CRA Intervention ***2***:

Low External Input Rice Production in Lowland Ecosystems

Low external input rice production (LEIRP) is one way of demonstrating the value of eco-friendly, sustainable intensification of rice-based systems. Important elements of this include: (a) reduction of chemical inputs through green leaf manuring and postcrop systems using legumes; and (b) diversification of farm enterprises through integration of crops, livestock, and fish.

This work is in its early stages and still challenging given the total reliance of rice-centered systems on chemical inputs. While LEIRP is multi-faceted, IIRR/MAO interventions were still limited to the promotion of the most basic and actionable principles of Systems of Rice Intensification (SRI):

- Use of quality and nursery-raised seeds
- Transplanting of young seeds at 10–15 days
- Single seed planting at 20–25 cm intervals

In 2013, a 59-year old farmer named Roger Bucad of Barangay Santa Cruz first heard of the pilot introduction of SRI from the IIRR. He became very interested right away, though doubt was still playing on his mind. He is one of those who pioneered SRI in their community deciding to try the new practice in an area of 200 m2 where only 2 kg of seeds were used. It yielded 88 kg of brown rice on a wet basis compared to the usual practice. In a 200 square meter area he used to plant 6 kg of seeds and harvest only 55 kg in the past. In the same year, he was convinced to expand the land area of his rice farm up to 2,500 m2 where he only consumed 3 kg seeds for his seed bed. Unfortunately, the expansion attempt failed, although he followed correct procedure because of the drought that occurred by that time affecting seedling in the nursery stage.

Instead of being discouraged, Roger attempted again in 2014, planting a similar amount of seeds in the same area. He amazingly harvested 1,100 kg of brown rice on a wet basis, which was far beyond his average yield of 660 kg per 2,500 m2 under his previous practice.

- Minimal use of water (alternate flooding of paddies or alternate wet and drying)
- Minimal and targetted use of commercial inputs (fertilizers and pesticides)

SRI has enabled farmers to increase their net productivity with lesser input through a shift in the management of plants, water, soil, and nutrients toward a more favorable environment for the growth of rice plants. SRI was introduced in 2011 in Barangay Arbismen through an IIRR partnership with the Peace and Equity foundation (PEF). This approach to introducing SRI was chosen because most rice farms in Guinayangan, particularly in Arbismen, are rainfed. SRI has spread significantly since then.

In 2012, before the introduction of SRI, IIRR and MAO introduced seven drought-tolerant rice from SEARICE through an earlier project partnership with PEF. Two of the seven varieties, WADO and Gift 12, proved to be most preferred and have now been spread to more farmers through seed exchange and seed distribution during farmers' days.

Another feature of LEIRP that is currently promoted is the incorporation of small livestock in rice-based farming systems, small water harvesting systems and short-cycle aquaculture utilizing water-harvesting ponds.

LEIRP is recognized by MAO and the SRI farmers as a very viable option, especially in the event of more prolonged dry seasons. Drought has become a major and ongoing constraint to agriculture in Guinayangan, and farmers are well aware of the need to incorporate alternative or additional farming systems such as livestock, rootcrops, corn, legumes, and other short-cycle but drought-tolerant crops.

Climate Smart Alternatives in Rice Production System

Rice farms contribute to the emission of greenhouse gases as result of methane emission from flooded soils. Moreover, the excess and improper use of chemical fertilizers also result not only in loss of expensive fertilizer but contributes to greenhouse gases (e.g. nitrous oxide, ammonia etc.) The continuous burning of rice straws also results in the reduction of organic matter in the soil. Such soils dry up faster under drought conditions. Continuous growing of one rice crop after another also results in depletion of soil micro nutrients, further increasing the reliance on external inputs. The carbon footprint of rice farms that rely heavily on external inputs is big but something can be done about it.

Low external input rice production methods such as the following practices can help: at the outset the burning of rice straw needs to be discouraged so that such residues can be retained in the farm and this results to more carbon in stored in the soil. We also know that the incorporation of rice straw into a field can contribute to at least 500 kilos of additional produce (per hectare). Researchers have long shown that the application of fertilizer in usual recommended high dosages actually result in wastage (as much as half of the fertilizer is lost). Proper application of fertilizer, for example by draining the field can actually not only reduce the in-vestment costs by reduce greenhouse gas emissions. Further the application of kakawate leaves (gliricidia) or other green manure (sesbania) can further reduce or even eliminate the use of chemical fertilizers to a great extent. These methods all ADD organic matter in the soil further improving soil fertility and trapping carbon in the soil (as organic matter). Finally the reduction of fertilisers by as much as half to one third is possible if proper timing is ensured (e.g. at the time of tillering, panicle initiation etc.). Climate smart agriculture provides win-win options for farmers.

SRI or System of rice intensification is also being introduced and is being tested in a number of barangays now but questions of sustainability still need to be further studied and supported. It is also appearing that SRI in the riceland in the Philippines is best targetted to those with less than 1/2 hectare of riceland. However all farmers report that there has been a considerable reduction in seed costs as result of the one /two seedling planting method. Some report a lowering of labor costs with line transplanting method. Also all farmers report no reduction in yields and most report a reasonable 10-30 person increase in production from such systems in the first year. Incremental gains are expected from continued use of SRI.

Combining the planting of hardy rice varieties, with increased organic matter presence and the use of SRI approaches is expected to help farmers cope with rainfall variability.

DA/AMIA and CCAFs are jointly supporting the introduction of stress tolerant rice varieties, SRI and related low external inputs systems and diversification in a fourth of the rice growing barangays. With the reliance on farmer to farmer mechanisms and the use of impact area methods. Accompanying farmer field days with distribution of mini kits of seeds will help spread such technologies and at the farmers own pace.

Stories from the field

Intensifying SRI promotion

SRI practice in Guinyangan started in 2011 in the rainfed paddies of Arbismen. After the very first training in September of that year, of the 21 farmers only 2 tried SRI (notably, these 2 were barangay officials and relatively well off, so they could afford to take risks with the new approach). After a year, a farmers' day was conducted to provide platforms for the 2 early adopters. 15 farmers in the same barangay tried SRI.

In that same year another farmers' day was conducted in December and 55 farmers from 14 barangays attended. 19 signed up from the various barangays. However, only 5 were able to plant because the dry season in 2012 extended (agriculture in most of the barangays was rainfed).

Barangay-based trainings were held in 11 barangays in 2013 to further promote SRI. The IIRRMOA team included a farmer champion from Arbismen. As of 2014, 35 farmers in 6 barangays were practicing SRI. A municipal-wide SRI promotion was led by MOA, and barangays in the southern part of the municipality were invited.

During that same year, 20 farmers from the adjoining municipality – Lopez – attended afarmers' day in Barangay Santa Cruz. One of them established a trial plot as a showcase for farmers' day. Unfortunately, the plot was destroyed by Typhoon Glenda. In 2014, the 1st municipal-wide SRI adopters' reflection workshop was held. Other barangays were again invited as the activity served as an advocacy platform as SRI adopters shared their experiences with their peers. Demand was significant, so in 2015 barangay orientations were conducted in Capuloan Tulon, San Jose, San Luis 1, Triumpo, and Tikay. SRI information materials was distributed and mentoring was done through text messages. This IEC material was developed based on the past 2 years experience of Guinayangan adopters.

Currently there are 60 farmer champions in 6 barangays practicing and promoting SRI. At a reflection session for SRI practitioners, scaling up issues and initial outcomes were discussed. Results revealed that farmers adopted SRI principles mainly because of the significant reduction in seed requirement. This is major consideration for smallholder farmers who have insufficient resources but for whom rice a major staple that ensures their household food security. While the growth of SRI is still somewhat slow, in future better targetting of SRI to smallholders (less than 1/2 hectare) is planned. Marginal holdings are unequally suited to SRI programs.

In the Guinayangan case, these practices are still being advocated for but not all the farmers are using these approaches yet. With time they hopefully will especially when SRI is better targetted to those with limited land area. An entry point meanwhile has been the introduction of water and seed saving methods such as SRI or Systems of Rice intensification. Combined with approaches where farmers compare their varieties with those from other farmers and other regions as well as from research institutions is helping farmers identify varieties that are drought tolerant and productive even under difficult conditions. Participatory varietal selections help farmers make these choices by testing small areas under different crops. Many such new introductions of drought tolerant varieties have spread farmer to farmer across the municipality. This is facilitated by the distribution of mini kits of seeds to farmers so that diversification of varieties takes place.

To further build soil fertility, legumes like mungbean and rice bean are also being reintroduced to the area as post-rice crop. The practice is catching up. Initial work has begun to include legume in the rice based crop-ping system. Diversification to other crops will help ensure that crops can be grown even with limited soil moisture conditions and will help farmers deal with variability.

Stories from the field

A successful season-long participatory action research on stress tolerant saline and drought rice varieties in Barangay Danlagan Central Guinayangan, Quezon

Farmer learning group (FLG) members in Brgy. Danlagan Central identified salinity and prolonged drought condition as two major problems in the rice fields. The group agreed to conduct a participatory action research which aims to determine the best-suited variety in their area. Three participatory varietal selection (PVS) sites were established by selected farmer cooperators. They are Juanito Tique, Reynaldo Nesola and Melencio Nesola. Each farmer cooperator was provided with community innovation fund (CIF) amounting to PhP2,000.00. The CIF covered seed and partial fertilizer inputs. The farmer cooperators shouldered the rest of the expenses including labor and land preparation. All of them submitted a proposal and signed a memorandum of understanding to avail the CIF.

The PAR sites are in a valley and share the same landscape. They followed the same management practices. All of them shared their experiences to other FLG member during their monthly meetings. Basic parameters observed were plant height, number of tillers, resistance to pest, susceptibility to diseases and yield. Saline tolerant varieties tested are NSIC Rc296, NSIC Rc326, NSIC Rc328, NSIC Rc334, NSIC Rc340 and NSIC Rc392. On the other hand, the drought tolerant varieties tested are NSIC Rc192 and NSIC Rc278. The check variety is PSB Rc18. The tallest saline variety is NSIC Rc334 while NSIC Rc278 among the drought tolerant selection. PSB Rc18 is the shortest among all tested rice varieties. NSIC Rc296 has the highest tiller number among tested saline tolerant varieties. It has 16 average number of tillers. The observed tiller number of check variety and NSIC Rc278 is both 12.

A farmers' field day was held in April 3, 2017 to showcase the result of PVS trials. Farmer cooperators shared their 3 months experience in conducting a PVS trial. Based from the average result, NSIC Rc334 has the highest yield among all saline tolerant varieties. It is higher than the observed yield from the check or local variety. Other varieties also out-performed the local variety. Interestingly, PSB Rc18 produced higher yield compared to the tested drought tolerant varieties. According to farmers' observation, this is probably

because drought was not observed during the season. They recommended that another PVS trial should be conducted in the dry season.

Other highlights of the field day are the field tour and sensory evaluation. All the participants from different barangays accomplished an evaluation form. They selected their best-bet variety and explained why they chose that specific variety. Based on the crop stand, the best-bet saline tolerant variety is NSIC Rc326 and NSIC Rc222 for drought tolerant. NSIC Rc222 is drought-tolerant local variety. However, among the different local varieties. PSB Rc18 still tops the sensory evaluation. Out of 32 participants, 15 selected PSB Rc18. They chose it because of it tastes good and soft when cooked.

Selected farmers from the FLG also shared their experiences gained from different CSA such as systems of rice intensification (SRI), use of green leaf manure (GLM), seed storage using hermetic bag called "Saclob" and testing of stress-tolerant rice varieties. Menick Reonesto, one of the farmer cooperators, shared the status of rice farming in Brgy. Danlagan Central. He also shared the group's strategies on how to identify vulnerability and create an action plan to address it. Consolacion Menoza and Juanito Tique shared their knowledge on GLM and SRI, respectively.

The rice farmers actively participated in creating problem trees. They evaluated the CSA practices they saw and learned during the sharing. This activity helped they processed their take-away knowledge. In the end Brgy. Danlagan farmers distributed starter seed kits to their guests. It includes lowland rice, upland rice and mungbean seeds. These materials will helped them conduct their own observation trials in their respective farms.

Participatory Action Research: Testing eight new varieties of drought-tolerant rice for rainfed rice areas

Trial testing of drought-tolerant varieites and crops is one of the identified coping mechanism for prolonged dry seasons. The project facilitated trial planting of 8 new drought tolerant rice varieites through participatory varietal selection (PVS). The purpose of facilitating trial planting of these crops and varieites was to determine adaptability of different varieties to Guinayangan's local conditions.

IIRR acquired drought-tolerant varieties from PhilRice: Realine 3, NSIC Rc348 (Sahod Ulan 12), NSIC Rc192, NSIC Rc346 (Sahod Ulan 11), NSIC Rc274 (Sahod Ulan 3), local check, NSIC Rc286 (Sahod Ulan 9), and NSIC Rc288 (Sahod Ulan 10). These are mostly rainfed rice varieties and thus adaptable to drier conditions.

Three farmers from 3 barangays were selected to test these varieties. Each farmer represented a specific agro-ecosystem. The farmer from Barangay Sintones farms an upland irrigated area, the one from Arbismen a lowland rainfed area, and the Hinabaan farmer in a lowland irrigated area. No upland rainfed farmer participated in the PVS as there was not enough available seeds to accommodate more than three farmers. These farmers volunteered to test the new varieties following the key SRI principles of raising seedlings in a seedbed, transplanting young seedlings (8 to 12 days old), single seedling per hill, straight planting with 25 cm x 25 cm spacing, and alternate wet and drying of irrigated paddies (3 days wet and 7 days dry).

The PVS was conducted following the normal practice of the farmers (thus those selected were already well-versed with SRI principles. Planting was not done simultaneously due to varying water availability during seedbed preparation. The farmer in Sintones was able to start cropping in June 2014, in Arbismen in September 2014, and Hinabaan in December 2014.

The PVS process is typically characterized by the following activities:

- Each farmer provided with ¼ kggram of each variety of rice.
- One square meter seedbed is prepared for each variety.
- Spacing of seeds was sparse (line sowing at 3-4 inches distance) to promote optimum growth of seedlings.
- Labels were put on the the seedbeds to distinguish one variety from another.
- Waterways or small irrigation ditches were constructed to separate the transplanted varieties from one another.
- Farmers were visited by the staff for monitoring from time to time.
- A focus group discussion was conducted as a post-cropping reflection session.
- Field days were organized at each PVS site.

The PVS elicited the following observations from the three participating farmers.*(Note that these are unedited farmer comments)*

- Two varieties, NSIC Rc348 and NSIC Rc192, did not germinate in all sites probably due to the long drought when nurseries were sown. In Arbismen, an additional variety, Realine 3, did not germinate and only 4 varieties were transplanted. The local check variety was unaccounted for during the FGD.
- In Sintones, NSIC Rc346 was observed to grow slower and with inferior performance compared to the others (Rc274, Realine 3, Rc288, local check, and Rc286).
  - NSIC Rc346 was the best performer in Arbismen, as the seedlings of this variety had more tillers than the others.
- Tillering and growth
  - In Sitones, the best performer was Rc288 due to its large number of tillers. Also, it does not grow tall, which lessens the possibility of lodging due to strong winds or heavy rains. Rc286, on the other hand, grows quite tall, up to 1.5 meters.
  - In terms of growth, Rc346 was the best performer in Arbismen, although the farmer observed that it did not do well later in terms of tillering and flowering. The other varieties also did poorly in terms of tillering.

- Growth of all varieties in Hinabaan was abnormally slow despite the farmer's application of organic fertilizers. This was attributed to the days of flooding experienced by the seedlings when they were still in the seedbed. Tillering was also poor for all varieties. The farmer observed that average number of tillers for all varieties was only 3 to 4. Again, this is attributed to the flooding of the seedbed.

• Flowering
  - In Sintones, Rc286 flowered first mainly because it was taller than the others.
  - No comparative records on flowering was reported by the farmer in Arbismen.
  - The plot in Hinabaan did not reach flowering stage due to rat infestation.
• Performance against pests and diseases
  - In Sintones, all the varieties were affected by bacterial leaf blight in August, when the crop was in its 3rd month in its reproductive stage. According to the farmer, this made the rice ripen faster. No comparative records on this aspect was done by the farmer in Arbismen.
  - In Hinabaan, the plot was attacked by rats in January 2015, around 1.5 months after transplanting. All varieties were affected and thus the farmer gave up on continuing the cropping. He instead focused on rat management (using rat poison) to avoid infestation in other paddies. The farmer observed that the varieties had better aroma, the reason why it was continuously attacked by rats for 3 nights.
• In terms of overall suitability of the varieities to the area and preference for further cropping, the PVS farmers shared the following:
  - The farmer in Sintones (upland irrigated) preferred Rc288 due to its vigor and better performance in terms of growth and tillering compared to the other varieties.
  - The farmer in Arbismen (lowland rainfed) preferred Rc346 due to its good growth performance and higher tillering. However, he stated that his preference for seed propagation and future cropping is still Wado and Gifts 12 (see note) as these varieties are already proven hardy in dry conditions, with good harvest and also have good aroma when milled.
  - The farmer in Hinabaan (lowland irrigated) generalized that none of the varieties were suitable in their area and thus is not interested in further trials of these varieties.

Practices Promoted:

- Action research on stress tolerant rice varieties
- Rice-based systems are a major contributors of green house gases(methane, nitrous oxides etc..) Non burning of rice straw and reduced and targetted use of chemical fertilizers is advocated
- Increasing crop intensity of rice systems (through multiple cropping cycles of rice or other crops)
- Transplanting 1 seedling per hill at 25x25 cm distance and use of young seedling (8-12 days seedlings) to increase tillering and raise productivity
- Increasing crop residues, inclusion of green manuring and inclusion of post rice legumes, Efficient fertilizer use & bio-fertilizers to enhance organic matter. (Use of Kakawate)
- Agricultural enterprises based on quality seed production for rice and legumes
- Diversification of income sources from rice based systems (ducks, fish, vegetable, trees)

Current Status:

- 56 farmer cooperators in 12 Barangays (Sta. Cruz, San Roque, Ermita, Balinarin, Hinabaan ,Arbesmin, Sintones, Dancalan Central, Ligpit Bantayan, Tikay, San Luis II, San Pedro 1)

Thematic Area of CSA/CRA Intervention ***3***:

Agroforestry in Upland Ecosystems

Agroforestry

Agroforestry offers some of the best opportunities for introducing climate smart agriculture that help communities achieve both mitigation and adaptation objectives. Guinayangan already has a rich coconut tree coverage and these are already serving as effective carbon sinks. However the lives of farmers that rely on the mono cropping of coconuts has not changed much. It is well-known that further diversification and intensification of coconut based systems can help farmers improve their livelihoods and lives but what is less well known is that it can also help enhance the ecosystem functions (including increased mitigation of carbon).

Diversification through the use of the understory to raise fruit trees, grow livestock and plant root and tuber crops can help farmers cope with future climate by diversifying their sources of income through less risky enterprises.

- Pineapple is one such introduction in Guinayangan. Pineapple is a very drought tolerant crop and can in fact absorb moisture from the air. Its plant structure helps trap moisture and so pineapple crops cope well with rainfall variability. Pineapple is grown in parts of the coconut plantation where there is adequate levels of sunlight. Climate smart approaches for managing the crop is emphasized such as the application of chemical fertilizer in micro doses using spot placement of fertililser (to save on the losses). Cover crops of rice bean are grown in between the rows of the pineapple to lower the soil temperatures and enriches the soil and add organic matter (i.e. trap carbon)

- Mini fruit tree orchards can also be used to diversify the coconut based farms. Pits are dug deep to en-sure that the fruit trees develop a deep root structure and can cope with drought. Farmers are now increasingly trying out a range of fruit trees in contiguous areas so that they can do joint marketing when the production levels rise five years from now. As many as five different crop species are currently

Diversification of coconut-based livelihood by introducing fruit trees and cash crops: an opportunity for tenants

Most farmers depend on coconut as their main source of livelihood. Coconuts, however, are vulnerable to calamities and take longer periods of time before they can recover. With this, farmers were introduced to fruit trees and cash crops in 2014 to provide them an additional source of income. Some of the fruit trees and cash crops introduced were cacao, banana, coffee, and paminta. These are intercropped with the coconut following a proper spacing. It is mainly practiced in barangays San Pedro 1, Magsaysay, HimbubuloWeste, Ermita, Sta. Cruz, and San Roque. There are about 130 farmers who have adopted this technique, most of which are tenants living in upland areas.
Fruit trees usually need about five years before they can yield fruits, which is why farmers have yet to observe the benefits of practicing this technique. However, these can definitely be sources of additional income and emergency funds if the harvests are of good quality and marketable. These can also be used for personal consumption of the family. As of now, since most farmers are tenants, it is a challenge to practice this technique because they still need to ask permission from the land owners. They also believe that it should be done in an area large enough to accommodate the coconut trees and the fruit trees or cash crops to be intercropped with them. Farmers should also make sure that there are no loose livestock or other animals near the fields since there is a possibility that they will destroy or eat the crops.

grow. With time, these areas will also start to explore the potential for establishment of local nurseries of fruit trees to capitalize on the increasing interest in trees. Mother tree nurseries will provide diverse sources of planting materials to support decentralized fruit tree nursery production systems

- Further diversification of coconut based systems using banana based agro forestry systems are envisaged. Two of the country's best varieties are being targeted (Lakatan and Latundan) for cultivation under the coconut tree canopy with a further lower understory crop of ginger. These systems will also include root and tuber crops, including sweet potato, purple yam and other related yams. The effective vertical use of space is expected to further enhance the use of space. Farmers who diversify can be able to better prepare themselves to address the challenges of climate variability. With most intensive and effective use of uplands the ecosystems functions of the uplands can be enhanced. The inclusion of livestock production systems in previous tree based systems allows for more nutrient recycling, better water conservation, etc.

- The potential for replacing or reducing chemical use in tree-based systems is considerable and will receive attention especially small timber, fodder and fuel-species, and fruit tree production. Trees are deep rooted and will extract nutrients and moisture from lower profiles of the soil. The leaf litter helps conserve soil and lower soil temperatures.

- Diversified coffee and cacao systems are preferred over monocropping plantation crops given the expected rises in temperature. Multistoried systems are more climate smart! Guinayangan coffee producing areas will also receive special attention especially to introduce green manure trees which will help coffee trees cope better to drying environment of the future. The potential for converting the coffee areas to organic systems will be tested through farmer participatory research with support from DA AMIA. Cacao and black pepper seedlings

were distributed to coffee growing areas. Mass distribution of Jackfruit or Langka seedlings raised in the community nursery was also distributed. The farmer business school approach in coffee will help farmers get better market for ecologically produced coffee

Practices Promoted:

- Agroforestry provides opportunities for enhancing multiple benefits from CSA interventions (mitigation, income, adaptation)
- Opportunities to increase carbon sequestration whilst reducing ambient temperatures as well as soil temperatures
- Diversification of income sources through multi storied cropping (multiple canopies) and inclusion of livestock
- Risk reduction from diversified farming involving perennials, short term perennials and annual crops grown together
- Introduction of drought tolerant crop species (peanut, corn) with associated quality seed production enterprises

Current Status:

- 112 - Pineapple Farmer Cooperators
- 22 - Coffee Farmer Cooperators
- 9 - Cacao Farmer Cooperators
- 105 - Rambutan Farmer Cooperators
- 48 - Mango Farmer Cooperators (Guimaras and Carabao Variety)
- 29 - Calamansi Farmer Cooperators
- 27 - Guyabano Farmer Cooperators
- 6 Agro-forestry Barangays (Barangay Sta Cruz, Magsaysay, Ermita, San Roque, San Pedro I, and Himbubulo Weste)

Increasing fruit trees resiliency through deep pit method of planting

Planting in deep and wide pits is mainly practiced in barangays Himbubulo Weste, Sta. Cruz, San Pedro 1, Himbubulo Weste, Magsaysay, and Ermita. All of the practitioners are from upland areas and most of them are tenants. Currently, there are more than one hundred farmers from the different baranagys applying this method. It was first introduced in 2014 to strengthen the foundation of fruit bearing trees and other varieties of trees. They are always greatly affected during typhoons since they either fall over or their roots become uprooted.

Farmers were taught to put decomposing leaves first to neutralize the acidity of the soil. Theyinitially planted the mother trees following a measure of 1 x 1 x 1 m^3, but they had a hard time doing this. They were then instructed to plant the normal fruit trees using a 30 cm^3 measurement instead. This depth is followed to ensure that the roots of tree can penetrate deeply (for moisture extraction) while serving as anchors against winds (typhoon tolerant). The width, on the other hand, serves as a catch basin for the rain. This is of great help during the dry season since the seedlings still have their supply of moisture.

Benefits and Limitations of the CSA Practice

As of now, farmers who have adopted this technique are still in the process of experimentation. This is referred to as technology development. They continue to practice this to increase their yields, but have not yet benefitted from it financially as the trees are still young. However, they have observed that the leaves of the plants are greener and the first few fruits have increased in size. Nanay Efrenia Untalan from San Pedro I is a known practitioner of this technique. Before, she just puts the seeds in the ground and digs holes which have the same size as a polybag. She noticed that the seedlings were not rigid enough and easily uprooted from the soil. Some of the seedlings even die. With this, she adopted the technique and observed that her plants were greener and the fruits were plumper. She now uses this technique when she plants fruit trees. However, this practice is quite laborious for the farmers especially when they have a variety of fruit trees planted in their field. They have to dig the soil regularly so that water can be continuously collected in the pit when it rains.

Thematic Area of CSA/CRA Intervention ***4***:

Root and Tuber Crops in Upland Ecosystem

Production of climate change resistant crop such as different root and tuber crops

In the past, large tracts of land in the six barangays of Cadig area were left untilled since most of the people worked in coconut farms. They are also involved with banana plantation, coal production, and vegetable farming. However, these kinds of livelihood are greatly affected when drought hits the province of Guinayangan. They are not able to earn enough money since harvests from coconuts and bananas decrease during a prolonged dry season.

Because of this, the Office of the Municipal Agriculture in partnership with the International Institute for Rural Reconstruction thought of ways to help the farmers earn a living even when drought strikes. They were able to consider planting root and tuber crops which can withstand this drought. In 2014, they started distributing cuttings of the Lakan 2 variety of cassava. They were able to give the seeds to a total of 14 farmers from different barangays. Later on, they distributed the Formosa variety of pineapple to eight barangays. They were able to use the harvests for personal consumption or sell them in the market for additional income. Some of the barangays also shared their pineapple suckers with nearby barangays so that they can adopt and start the practice on their own. There are some farmers who have completely neglected their fields, but others continue to plant pineapple. Ube production is also practiced by five farmers in San Luis I and five farmers in San Luis II as well.

The planting of cassava, ginger, kamote, and ube is widely practiced in the Cadig area. Pineapples, on the other hand, are mostly grown in barangays Himbubulo Weste, Magsaysay, Ermita, Sta.Cruz, San Pedro 1, San Roque, Mabini, San Luis 1, and San Luis 2. Farmers use their own criteria in deciding what crops or varieties they will continue to grow. Offering them a portfolio of options is therefore important.

Guinayangan, Quezon. Two (2) Farmers' Field Days on Sweet Potato, Cassava and Native Pigs as climate resilient agriculture crops and livelihood were held last March 2017 in Barangay San Luis 2 and Arbismen. For Sweet Potato and Cassava, a total of 62 participants (27 females, 35 males) from different 9 villages attended while for native pigs 57 participants (30 females, 27 males) coming from 7 villages. The Farmers Field Day is an opportunity for farmers to farmer learning extension. Farmers shared their knowledge and learning on field experiments, observations, livetsock management strategies and innovations. Likewise, it also promoted the adoption of different climate resilient technologies by different farmers.

Sweet potato and cassava: participatory selection

Selection (PVS) on sweet potato and cassava was undertaken. These are crops that are resilient to drought and typhoon. Mr. Vicente Macabuhay, a farmer from Barangay San Luis 2 tested four (4) varieties of cassava namely, Rajah 1, Lakan1, Lakan 2, Lakan 3, and Lakan 4 acquired from UPLB/IPB cassava program. Based on his field observations and studies, Lakan 2 is the most drought resistant and with highest yield; Lakan 3 is the most typhoon resilient to typhoon; Rajah 1 is the most susceptible to pest; and Lakan 4 is not drought-tolerant.

Ariel Flores, who experimented 11 varieties of sweet potato (VSP 1, VSP2, VSP 3, VSP 4, VSP 5, VSP 7, NSIC 25, NCSIC 30, Tinangkong 1, and Imelda), shared that VSP 2 has the highest production followed by VSP 4, VSP 5, Tinangkong 1, and Trescolores. These varieties were acquired from Philippine Root Crops. Apart from the PVS, the activity also included sensory and taste testing, harvesting of sample crop varieties and participatory selection of varieties according to farmer's choice.

Cassava trials offer both challenges and opportunities

Cassava production is already part of the farming traditions in some parts of Guinayangan. However, most farmers plant it only for household consumption, with very few farmers producing for local markets. Large-scale production is very limited due to the limited absorptive capacity of local markets.

Considering the longer dry seasons, cassava production was identified as a viable alternative crop. In the mid 2000s, cassava cultivation was widely promoted by another NGO as an alternative livelihood, especially among coastal residents. This approach was generally unsuccessful as no additional market was identified or created which to absorb the additional production. This resulted in a generally negative perception of farmers against big-scale cassava production. As part of the new approach, the focus was shifted to small scale-production aimed at both household needs as well as for local markets. Both human and livestock were considered as users.

This prompted IIRR and MAO to facilitate a trial planting of a new variety of Cassava (Lakan2 white variety) but with strong link-up with a pre-identified market/buyer. Linkage was established with a food processing company (Global Foods Solutions, Inc.) based in the neighboring province of Laguna through the Philippine Rootcrops. Meetings were conducted with the company and agreements were made for the possibility of a contract-growing scheme with farmers from Guinayangan wherein Global Foods pay for the cost of planting materials and the farmers selling their harvest to the company. Aside from its profitability, cassava is also touted as a drought-tolerant crop that would easily adapt to increasing temperatures due to climate change. It is also a low-maintenance crop and perceived as good option for farmers in Guinayangan whose main source of income is copra-making, a labor-intensive livelihood. In the case of farmers in Cadig, the main source of income of most farmers is charcoal making and the idea was to get them engaged into cassava a relatively easy to manage crop.

Despite being outside the project area, the IIRR and MAO selected the Cadig Area, a cluster of barangays composed of San Luis I, San Lusi II, Del Rosario, San Jose, and Bagong Silang, for the trial planting of Lakan 2 variety, the preferred variety of Global Foods. IIRR and the LGU secured a truckload of planting materials from Pangasinan. The decision to conduct the trial planting of the area was also based on the local government's initiative to reach out and provide services to the area, which has not experienced any government-initiated assistance for almost a decade due to insurgency problems.These are the farthest barangays of the municipality and also the most underdeveloped, thus desperately in need of livelihood interventions. The IIRR-MAO promotion of Lakan2 has therefore provided the opening wedge for revitalizing government's role in agricultural productivity in the Cadig area and the introduction of CSA as a viable strategy for sustaining productivity considering climate variabilities.

Meetings were conducted among farmers in the area and while a total of around 50 farmers were oriented on the proposed intervention, only 22 farmers did actual trial planting of the Lakan2 variety, mostly on a quarter hectare of their farms. Most farmers took a wait-and-see perspective and said they would try it out as a trial production. They waited also to see if the linkage with the food manufacturing company succeeded. One farmer agreed to utilize 1.5 ha as a Lakan2 crop propagation center, the purpose of which was to propagate clean planting materials for widescale distribution in the next cropping period. The initial planting materials, which were distributed to 22 farmers, were sourced from a commercial cassava nursery in the province of Pampanga, north of Metro Manila. Linkage was established through the assistance of PhilRootcrops. Sourcing from an accredited nursery was done to ensure that the planting materials distributed to farmers were disease-free and of good quality. Upon pick-up of the planting material, the farmer in charge of the propagation center was also provided basic training on the establishement and maintenance of cassava nurseries and production of clean planting materials.

The cassava trial started only in August 2014 as the town was struck by Typhoon Rammasun in early July and most farmers had to prioritize rebuilding damaged houses and could not start working on their farms immediately. The 22 farmers met occasionally to discuss relevant issues such as the need for capacity building on new cassava production practices, viable cassava intercrops, and soil and water conservation practices. In these meetings, the farmers also floated ideas farmers about helping each other out in selling their harvests, especially to Global Foods. Training was conducted by IIRR and PhilRootcrops on soil and water conservation and intercropping practices. The farmers were provided training on soil and water conservation since most of the cassava trial plots were planted on sloping farms and soil erosion was prevalent, especially during the first 3 months of planting (August to October). Legumes were also distributed: various varieties of rice bean, pigeonpeas, lima beans, and mungbean. However, only a few farmers tried intercropping these legumes as most still preferred the traditional cassava corn system.

Since May 2015, the farmers have started harvesting their cassava and most were happy with how Lakan 2 has performed (better than the other varieties they are used to planting) in terms of quantity of harvest and resilience to typhoons and heavy rains. The variety was shorten duration. They observed that the tubers of the variety compare favorably with their best varieties both in terms of size and in quantity of tubers per plant. Also, the tubers grow laterally so extraction/harvest is easier as the tubers do not root deeper than the other varieties. The disadvantage, however, of shallower tubers is that it is more prone to lodging due to heavy rains and strong winds. However, farmers also observed that while Lakan2 lodges, it also recovers quicker than their local varieties (provided the tubers did not rot from waterlogging). This was observed after the typhoon Amang in January, wherein most of the cassava fell but still recovered after a few weeks. But the typhoon also resulted to unusual yellowing of some of the tubers, which resulted in some of the harvest being rejected by the food manufacturing company. This also led them to realize that only around half (those that would pass quality requirement) of their total harvest could be sold to Global Foods and they would have to contend with local markets.

Moreover, maintenance of quality of the produce (considering the average 6 hours of delivery time from their area to Global Foods) was another main challenge as Lakan2 loses its white color faster than their other white varieties once uprooted. Luckily, only the farmer with the 1.5 crop propagation center delivered a portion of his harvest to the company. Most sold their produce locally, showing the capacity of the local market to absorb increased cassava production. The farmers emphasized that in order for them to gain higher profits, they prefer to harvest and sell to local markets in small quantities. Linkage with larger markets such as Global Foods has to be maintained if the area of cassava is further expanded and production levels are greatly increased. This also has implications for post-harvest challenges. The negative experience of the farmer who sold to Global Foods discouraged around 40% of the original 22 farmers. However, those who remained increased their area cultivated with cassava. Overall, the total number of farmers who are planting Lakan2 variety for the second cropping increased to 28 as the planting materials produced from the crop propag ation center were also distributed to new farmers in at least 5 more barangays in the municipality. However, farmers currently rely only on local markets. From this group of farmers, MOA has formed a farmers' field school on vegetable gardening. It is ongoing. The group was also able to source assistance from the DA national office for the provision of a communal tractor and a cassava chipper.

Benefits and Limitations of the Cassava Based CSA Practice

The production of climate change resistant crops such as root and tuber crops has helped farmers earn additional income, especially at times coconut harvests are low. These plants can also be processed into other products which they can sell for a higher price. It promotes value addition which motivates the farmers to plant more of the crop and the producers to increase their production. Farmers use their harvest for personal consumption or as feeds for their livestock.

However, now that the cassava has spread to other villages in the municipality, additional support will be provided to process cassava for food and feeds through local level processing facilities.

Practices Promoted:

- Root and tuber crops are resilient to drought and extreme weather events (restoring them to the backyards and farms)
- Growing below the ground they are less susceptible to extreme winds
- Broad agro ecological adaptation (grow in diverse environments)
- RTC have a role in nutrition for both humans and livestock (including Vit A and as anti oxidant
- Provide income through direct sale and from value addition through processing
- IIRR promotes yellow, orange, red and violet sweet potato for nutrition and Cassava for processing
- Establishment of decentralized /satellite plant propagation centers

Current Status:

- 19 Farmer Cooperators at 6 Barangays (Sta. Cruz, Magsaysay, San Luis I, San Luis II, Del Rosario, Bagong Silang)
- Training on Cassava Marketing and Value Chain,Food Processing of Cassava and uses as alternative feed for livestock (Coordinated with Philippine Root Crops)

Thematic Area of CSA/CRA Intervention *5*:

Low External Input on Small-Livestock System

Livestock Production Systems

Livestock production systems, (especially the large scale commercial systems) rely on antibiotics, preservatives and micronutrients. Feed is transported hundreds of miles to feed retailers and then to the producers. Many of these systems, aside from relying heavily on external inputs, are also increasingly serving the richer corporate style farmers. Without the benefit of financing mechanisms the poor, especially the women cannot take advantage of these opportunities. Further marginalization of the poor will continue to take place. The challenge is to change this trend via approaches especially suited to small holder. Small holder systems can lower the cost of production and modify their production systems using native housing and low-cost feeds with only a limited reliance on commercial feeds.

Climate and Livestock

Livestock production is also expected to come under considerable pressure in the future from rising temperatures. This is expected to affect growth and reproductive rates of pigs and other livestock. There are also ways to reduce the carbon footprint of livestock production systems by emphasizing small scale, backyard systems that rely more on locally grown alternative feed sources such as roots and tuber crops, leafy crops and by products like copra and rice bran. Using native housing for animals can further lower the temperatures that the animals are subjected to.

Such alternative systems will prioritize both social and economic objectives. It will also consider such factors and the cost of credit (e.g. when farmers rely on money lender).

- Local markets are tapped for sale of pigs. The focus on temperature tolerant native pigs or mixed breeds will further reduce the current total reliance on external feeds for small holder pig production.
- With a shift to organic meat production a new market in expected to be developed at the municipal levels. Increasingly the health value of livestock that don't have an antibiotic load will be valued.
- More than anything else when the poor that never had a chance to raise livestock now feel that they do have an option to do this in a climate smart and environmental friendly way, everyone will be a winner.
- Such production systems help create new production mechanisms that the poor, especially women can take advantage of. The National Swine and Poultry Research Station in Tiaong, Quezon is an exemplary institution supporting such systems.

These systems are climate smart because they rely on natural resources, most of which are produced locally and are rarely transported long distances.

- Alternative livestock production systems can bring in a new sector of growers: women and the very poor. Local innovation and experimentation in feeding systems (formulations) is encouraged and shared woman to woman.

CSA Practices Promoted:

- Small livestock can be a risk aversion strategy (compared to more weather susceptible crop based farming)
- Livestock production systems increasingly rely on external inputs and are emerging with big carbon foot prints
- Meat and Milk demands are rising in Asia and new opportunities are available to small farmers
- Small scale livestock are pathways for economic empowerment especially or women (asset building)
- Production systems relying on farm grown feed, recycling of waste, and use of native/mixed breeds are promising new CSA options
- Inter species and intra species diversity (pigs, ducks, goats chicken) reduce disease risks.
- Native breeds, native housing: to reduce susceptibility to rising temperatures which affect breeding and health.

Pig Production System

Current Status:

- Pig Farmer Cooperator at 6 Barangays (Barangay Capuluan Tolon, Arbismen, Dungawan Central, Magsaysay, Sta. Cruz and Ermita)
- Establishment of Central IFG Propagation Nursery for Pig Production System (37 farm level sites)
- PIG IFG Crop Composition of Tricantera, Cassava, and Camote (Sweet Potato)
- These crops are common and available, easy to grow, has the nutrients content same as commercial/processed feeds for Pigs

- Trainings feature already known local formulations that bring the best of practical science to the farmer, e.g. feed composition that ensures a balance of protein, energy sources and micronutrient sources.
- Aside from pigs, goats are emerging as an animal that can cope with rising temperatures. If combined with practices that include the cultivation of grasses in intensive feeding systems, assured feed/forage even during dry seasons can be achieved. Intensive feed gardens have been designed for pigs and goat production systems.
- In the future, a focus on ethno veterinary practices will be encouraged.
- The best farmers are used as trainers in promoting the experiences from the impact areas to other villages.

Livelihood Diversification through Small Livestock Management

Goats, native pigs, and poultry are popular small livestock diversification choice for farmers in Guinayangan. Prospective farmers are required to build a housing for the livestock to contain them in one area only. Farmers also needed to maintain

Intensive Feed Garden as a Main Source of Forage for Small Livestock

Before farmers can grow pigs or goats in their own backyard. Each cooperator is required to build a small housing and maintain a garden which will serve as a source of food for their livestock. The intensive feed garden is where a variety of crops, especially those that are drought-tolerant, are planted. These are mostly observed in barangays Himbubulo Weste, San Pedro 1, San Roque, Capuluan Central, Dancalan Central, Arbismen, Magsaysay, Sta.Cruz, Ermita, Capuluan Tulon, Dancalan Caimawan, Sintones, Ligpit Bantayan, and Dungawan Pantay where goats and pigs are grown.

Farmers who maintain an intensive feed garden have experienced its benefits through time. They have observed that they spend a lot less when it comes to the food of their livestock. Their savings can be used for other necessities needed by the pigs or goats they are growing. They have a sure source of food even if they do not have the budget for commercial feeds and can forage the garden as long as there are yields. Nanay Julie Belmin, for instance, grows native pigs at her backyard. Before, she spent about 1,500 for a sack of commercial feeds. Now, she just goes to her garden and collects crops such as *balinghoy* and *katawan ng saging* to feed her pigs.

However, there are times when the farmers are not able to manage their intensive feed gardens properly because of other responsibilities. This makes the practice unsustainable for them. It is also limited to those who have the needed area to plant the variety of crops for the livestock.

Farmers who are interested to grow native pigs are required to provide a counterpart to build a house of local materials and maintain a garden which will serve as a food source for the pigs. They need to meet these requirements to ensure that the pigs are properly taken care of. The housing is made of materials which can be collected from the surroundings. Rice hulls are used as flooring. The walls, on the other hand, are made of bamboo grass. A material called *buri* is used as the roof. It should be cleaned (ask how often) so that the environment of the pigs

an intensive feed garden so that they can have a source of food for the livestock they are growing. Native pigs, for example, are provided a housing with rice hulls or other similar material as bedding and fed with a variety of crops such as trigo, tricantera, and San Fernando (gabi).

Benefits and Limitations of the CSA Practice

Small livestock management is a good opportunity for the farmers to earn additional income. Farmers can sell native pigs at 120 pesos/kilo (liveweight) or about 180 pesos/kilo if they have been butchered. They can also provide emergency funds for the family. Small livestock can also be a household's source of food. The family need not buy meat from the market if they grow chickens. They can also cook the meat for special occasions such as weddings and fiestas. Such use, even for home use, helps conserve (save) valuable cash resources. Food consumed at home need to be valued and quantified.

Current Status:

- Pig Production System
- Goat Production System
- Intensive Feed Garden (Fodder Crops for Livestock)

Other Livestock Initiatives:

- Duck dispersal in two Barangays (Sta. Cruz and Balinarin)
- Free range chicken dispersal in two Barangays (Himbubulo Weste, and Sta. Cruz)
- Pig production community support propagation systems

Confinement and use of light materials housing of goats

The practice of using light materials as housing for small livestock is mainly observed in barangays Capuluan Central, Capuluan Tulon, Arbismen, Himbubulo Weste, Magsaysay, San Pedro I, Sisi San Roque, Sta. Cruz, Ermita, and Danlagan Central. Small farmers who are usually tenants and women are more involved with this practice. It started in 2013 when goat beneficiaries were required to build a housing before they can start with the livestock project.

Bamboo and *anahaw* are the main materials necessary to build a house for the goats. About 100 to 200 sambakod are needed for one to two goats. Bamboo, anahaw, coconut husks, soil, and rice hulls are the materials needed to start a house for the pigs.

Bamboo poles are used as the walls; the anahaw is used as the roof of the house; and the rice hulls, soil, and coconut husks are used as flooring. The floor area should be at least 100-200 square meters.

Benefits and Limitations of the CSA Practice

This practice allows farmers to decrease their expenses for the housing of their livestock. Their materials are secured locally which they can gather at any time convenient for them. The use of rice hulls, for example, it absorbs the livestock's urine and feces thus reducing labor costs. With the housing, farmers are also able to contain their livestock in one area. This allows them to manage the livestock easily preventing them from getting wounds. They also collect their manure which can be used in creating organic fertilizer.

However, farmers have observed that confined goats are relatively thinner requiring better feeding management: not just grasses but concentrates (such as pigeon pea, cowpea, etc.). Farmers must also have the knowledge on confined goat management to still ensure the proper growth and development of the livestock.

Stories from the field

Native pig growers experience various benefits from the practice. Native pigs can grow as heavy as fifty kilos and can be sold for 120 pesos per kilo, if they are still alive. Some practitioners butcher the pigs and sell them for at least 180 pesos per kilo, depending on the agreed price. Value addition is evident when it comes to the market of native pig meat. The pig can also ensure a household's food supply for its meat can be consumed by the family.

Nanay Juliana Belmin from Arbismen grows native pigs despite her poor leg condition. She started in January 2014 after IIRR gave her and her son one young suckling pig each. According to her, caring for native pigs helped them reduce their expenses for feeds and other materials. It also helped her with her regular medication and personal expenses such as food and supplies. The meat of the native pigs also serve as food for the home. There was a time she butchered one of the pigs and used its meat as food for the workers building her family's house.

The use of light materials gave **Nanay Cresencia Untalan** the opportunity to build the housing of her livestock by herself. Before, she just tied her goats in the field which allowed them to destroy or eat her crops. With the housing, she is able to contain her goats in one area and collect their manure which she uses as fertilizer.

Tatay Fred Rosales from Capuluan Tulon, on the other hand, also takes care of native pigs. He is currently the president of the group of native pig growers in Brgy. Capuluan Tulon. According to him, pigs are helpful in times of emergency. They can just sell the native pigs they have to earn the money they need. He was able to buy materials for an improved house when he sold one of his native pigs.

The practice of taking care of native pigs has its limitations as well. One is that it is laborious. Just like a parent taking care of an infant, the practitioner must ensure that the house of the pigs are properly maintained to ensure that the environment is conducive for their development. They should have a garden where plants which can act as food sources may thrive. It somehow requires physical strength to be able to accomplish the responsibilities of a native pig grower.

Thematic Area of CSA/CRA Intervention ***6***:

Coastal Ecosystem Intervention

Coastal vulnerabilities to climate change

Climate change poses the threat of sea level rise and increasing sea surface temperature in the Philippines. These are projected to result to major disruptions in natural systems such as shifts in oceanic currents that affect seasonality of fish abundance; imbalance of saline and fresh water in mangrove ecosystems that may affect spawning and reproductive habits of marine species and growth of its juveniles; shifts in the abundance and distribution of planktons, and other marine species in seagrass and coral communities; and the increasing occurrence of destructive typhoons. These on top of the long-occuring problems of overfishing and mismanagement of coastal resources.

Coastal residents are thus among the highly vulnerable sectors in Guinayangan, owing to their exposure to risks of coastal flooding and storm surges not to mention the high poverty rate among fishing families. The number of informal settles in coastal areas is also on the rise, thus slowly increasing the number of vulnerable people over the years and at the same time putting more pressure on coastal and marine resources. There is a need to diversify livelihoods of coastal dwellers and coastal agriculture is considered one option. Guinayangan has 15 coastal barangays with support from CCAFs. Mangrove replanting (one cycle) was undertaken in half of those villages. With DA AMIA support, coastal agriculture efforts were introduced into one pilot village: Dancalan. These activities targetted mostly women (wives of fishers).

Adaptation and mitigation in coastal communities

Adapting to the vulnerabilities in coastal areas and mitigating its impacts entail serious addressing of longstanding issues and concerns of coastal resource management. Among the initially identified areas of work and its anticipated benefits are:

Restoring degraded coastal mangrove areas through community reforestation activities

- Provide protection from storm surges through its intricate rooting systems, which significantly breakdown wave action.
- Revives spawning areas of fish species, crustaceans and other commercially important

There are times when Guinayangan, Quezon is hit by typhoons which destroy the livelihood of farmers and fisherfolks. This is why livelihood diversification is essential for them so they can have alternative sources of income in times of calamities. In 2016, farmers and fisherfolks of Barangay Dancalan Caimawan were introduced to different crops which they can grow in their fields. Some of these include varieties of ube, banana, peanut, kamote, cassava, and other vegetables. These were given to them so they can experiment and find out which crop grows best when planted in coastal areas.

- Performs as buffer that prevent intrusion of saline water into inland estuaries, river systems as well as ground water systems used mainly for domestic and agricultural purposes. On the other hand, mangroves perform as natural sieve that decreases siltation of eroded soil from the inland towards coastal ecosystems.
- Initial work on coastal reforestation has been initiated (will be expanded when more resources are available).

Facilitating diversification of livelihoods of coastal fishing families

Much of the woes of coastal communities result from livelihood issues associated with degradation of landscapes and resources. Illegal fishing and unsustainable resource utilization usually result from coastal fishers putting environmental and community concerns below family welfare. Diversification of livelihoods seeks to identify and develop livelihood activities that would decrease the reliance of fishers on capture fishing and thus relieve coastal resources from the pressure.

Disaster preparedness and facilitating dialogues to address settlement issues

Awareness raising on coastal vulnerabilities will ultimately be geared towards facilitating disaster preparedness. Since vulnerabilities in the coasts are mainly tied with the presence of informal settlers, dialogues to address settlement issues will be an integral part of advocacies.

Establishment of Coastal Bio-Shields:

- Pilot testing of coastal initiatives on mangrove bio shield establishment to protect coastal areas, livelihoods and related assets (step one towards integrated coastal management)

Tatay Gemenciano Ricafrente is a fisherman who now plants varieties of crops such as cassava, kamoteng bagging, ube, peanut, and corn. He is still at the experimental stage wherein he is trying to find out which crop is most suitable to grow in his land of about half a hectare. However, he is already able to harvest a few crops which he uses for his family's own consumption, specifically for merienda. According to him, this has helped them reduce their food expenses so they are able to use the savings on other things such as the school needs of his children.

He is currently finding that banana, cassava, sweet potato, eggplant, papaya, and peanuts are performing well and has expanded his area. Nine other farmers has now started small coastal farms in their backyards.

He also uses his harvests as seeds for the next planting season. He does this so that he will not become dependent on IIRR and ask the institution for more supply of seeds. He shares seeds and other commodities given to him with other members of their group so that they can start their own alternative livelihood as well.

Undetered by salinity, these fisher families take advantage of heavy rains (due to lower salinity levels) to grow crops.

- Community centered /managed restoration of mangroves using local species targeted to different niches (front line)
- Designation of mangrove sanctuaries in each of fifteen coastal villages
- Exploration of coastal-agriculture and asset diversification options (root and tuber crops, small livestock production, saline tolerant vegetables etc)
- Community based education on the role of bio shields and coastal shelter belts
- Aside from some planting of mangroves in the villages and the testing of coastal agriculture, further fundraising has to be done to support the coastal restoration.

Coastal agriculture - Pilot testing of CSA options

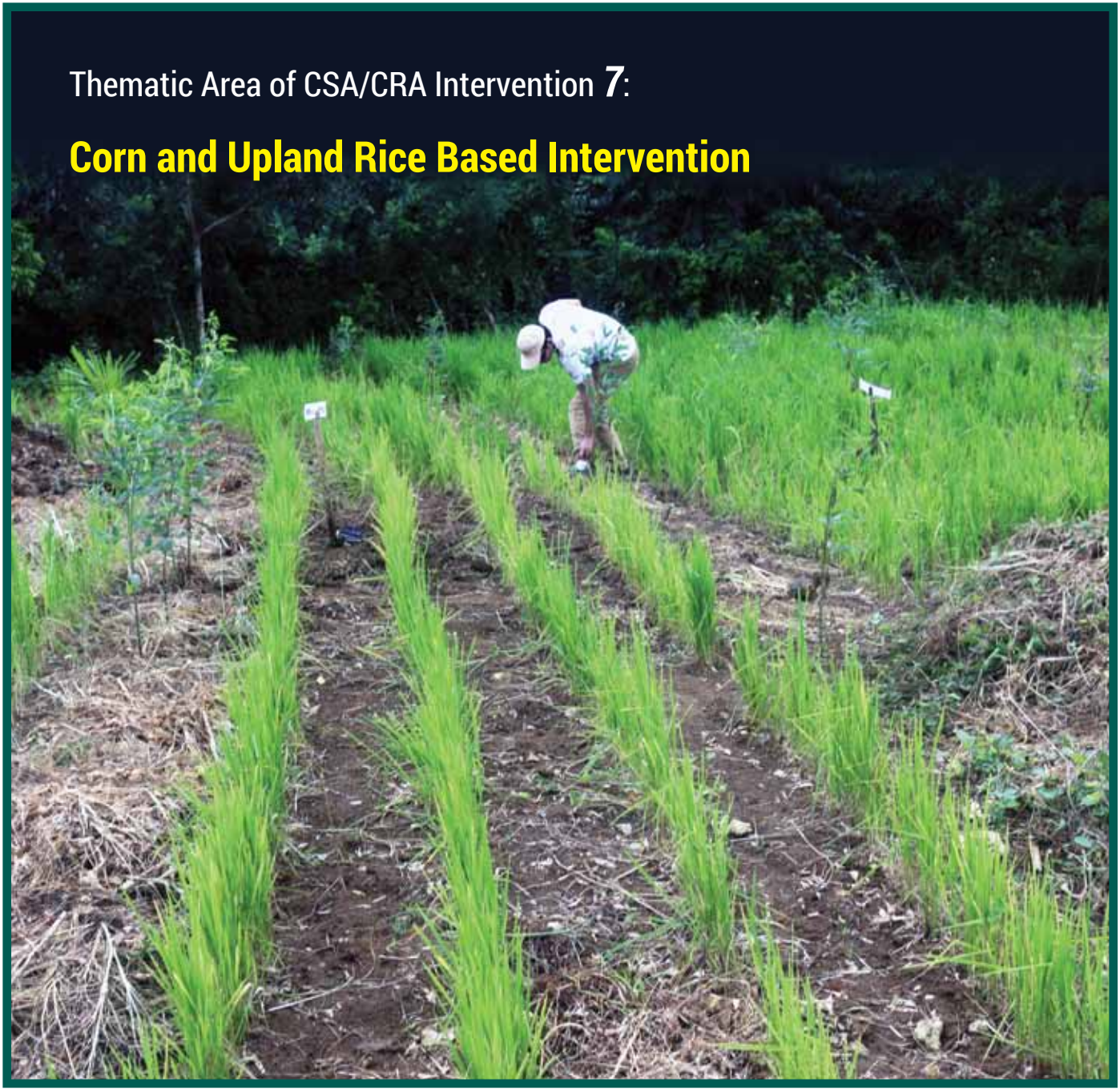
Coastal areas are expected to be particularly vulnerable to climate change - too little or too much rain, winds, and higher salinity levels (especially in summer). The heavy rains Guinayangan has experienced might have favored the first ten pilot farmer (as salinity levels drop with heavy rains due to leaching). A nine to ten month period (say June to end of February) is considered favorable for planting crops. Farmer-managed observation trials, mostly managed by women, farmers have been promising. The following crops have done remarkably well: cassave, sweet potato, banana, peanut, pigeon pea, onions, eggplant (known to be tolerant to certain levels of salinity), and arrowroot. Varietal trials are also being done for cassava and peanuts. Planting older seedling of vegetable also helps plants cope with salinity. Colored-flesh sweet potatoes have been introduced and are being tested. By virtue of the fact that men are engaged in fishing, women are leading the small-scale homestead centered family farms. More is needed to introduce planting materials from analogous sites in other coastal areas. Increased use of green manure from kakawate is expected to reduce salinity impacts on crops.

Current Status:

- 8 Coastal Barangays as Beneficiaries (Barangay Sisi, Calimpak, Manlayo, Himbubulo Este, Dancalan Central, Dancalan Caimawan, Arbismen, Capuluan Tulon)
- Coastal Agriculture Pilot in Dancalan with mangrove reforestation

Thematic Area of CSA/CRA Intervention **7**:

Corn and Upland Rice Based Intervention



Sloping upland areas can benefit greatly from the excessive rain the Philippines often experiences, thanks to adequate moisture and good drainage. Crops can be grown for 8 to 10 months relying on water stored in soils. Corn, upland rice, peanuts, and grain legume are promising new crops that farmers in Guinayangan have adopted in over a dozen barangays supported by CCAFs and DA AMIA.

Introduction of Glutinous Corn Varieties

Guinayangan's farmers grew corn before the municipality was converted to coconut plantations. In recent years, an effort was made to reintroduce corn. The Office of the Municipal Agriculture in partnership with the International Institute for Rural Reconstruction re-introduced the technology in 2015 to promote climate-smart agricultural practices among farmers. Cabong Norte was the first barangay to implement the practice which inspired other barangays to do the same. Currently, the planting of open pollinated glutinous corn varieties is mainly done in barangays Cabong Norte, Ermita, San Pedro, Himbubulo Weste, Sta. Cruz, and San Isidro. Forty-six farmers from different farmer associations have already adopted the technology.

The planting of glutinous corn starts with land preparation in which a carabao or a tractor is used to till the land to disintegrate the soil and remove the grass that has grown on the land. The seeds are then planted directly in the soil following a spacing of 25 x 75 centimeters. Farmers wait for 15 days to about a month before they do *pagsusungal* or the process of guiding a caraboao through the intervals of the rows of corn so it can till the land again allowing 'new' soil to cover the lower portion of the stalks. This is also the stage where farmers perform weeding, microdosing, and intercropping with legumes and RTC. It takes a maximum of three months before farmers can finally harvest their glutinous corn.

The planting of open pollinated glutinous corn varieties offer benefits to the farmers. For one, it offers an alternative food source for the household. Nanay Jessean, for example, boils the corn so that her children can have their baon for school. There are also times when she mills a part of her harvest into a rice substitute. Glutinous corn can also be a source of income for the family since it can be sold to the market as it is or processed into other goods such as *binatog* which can increase the value of the product. In the case of Nanay Jessean, peddlers visit her at times to get their supply of glutinous corn. She also peddles her harvest or delivers them to her *suki* sometimes. She earns about PhP2,000 when she has good deals during a market visit.

There are some limitations which include the low demand for glutinous corn. Sellers are more inclined to buy yellow corn because it has a wider, larger market. Nanay Jessean earns much greater when she is able to sell her harvest of yellow corn. So its yellow corn for the market and white corn for home use.

Intercropping of Corn, Peanut, and Upland Rice

In the past, farmers planted corn or cassava in large areas without planting other crops in between. However, in 2016, an orientation which introduced the concept of intercropping corn with cowpea or paayap was conducted. Four farmers from Cabong Norte and three from San Isidro were the first ones to

learn the technique and so they experimented with it. Harvest season was in July 2016 and they found out that intercropping corn with cowpea was not effective since the cowpea 'crawls over' the corn which prevents it from growing.

Farmers from Cabong Norte tried intercropping in October 2016, using peanut and monggo. This technique yielded better results which is why they resumed efforts of disseminating information about intercropping corn with cassava or leguminous plants.

Farmers in Cabong Norte still practice intercropping. Different farmer associations in other barangays such as Ermita, Mabini, Triumpo, San Isidro, and Cadig area have also adopted the practice due to the continuous effort of the Office of the Municipal Agriculture in partnership with the International Institute for Rural Reconstruction. This is usually done in the months of May to July which is the season when farmers plant corn.

Benefits and Limitations of the CSA Practice

Intercropping of corn with cassava or leguminous crops offers a number of benefits to the farmers. For one, it allows farmers to maximize the land they have. Instead of letting grass grow on it, they can plant other crops together with corn. It can be a source of additional income since the farmer has two crops which s/he can harvest and sell. Nanay Jessean, for example, plants glutinous corn and intercrops it with peanut. She can harvest and sell the glutinous corn after three months and do the same with the peanut a month after. The crops can be processed into various food products or other goods which can promote value addition.

Diverse cropping provide sources of food, especially in times of need. Nanay Jessean also intercrops her corn with cassava or balinghoy. The children of Nanay Jessean sometimes have glutinous corn as their *baon* to school. She uses the *balinghoy* to create food products which she sells in the elementary school of their barangay.

The practice of intercropping, however, is sometimes laborious for the farmer since s/he is dealing with two crops. Proper knowledge and skills in managing cassava and leguminous crops are also needed to ensure good harvests. If well managed, legumes can in fact reduce labor cost for cassava.

Stories from the Field:

Sustainable Soil and Nutrient Management through the Planting of Leguminous Crops

Farmers have long been planting peanut and other leguminous crops in their fields. However, they are not knowledgeable about the benefits these crops. With this, the Office of the Municipal Agriculture and the International Institute for Rural Reconstruction conducted seminars for the farmers and taught them how leguminous crops can help enrich the soil and recycle its nutrients. This practice is mainly done in barangays Himbubulo Weste, San Pedro 1, and Magsaysay. A range of peanut varieties were provided.

Planting leguminous crops can offer a lot of benefits to the farmers. The harvests can be an alternative livelihood and additional source of income for the family. Peanut and cowpea, for example, can also be used for household consumption. In the case of Nanay Emma Alfiler, she is able to gain additional income and support the needs of her family because of the leguminous crops she plants on her field. It also prevents the land from being idle leading to the loss of its nutrients and moisture. Legumes can be used as concentrate for goats and native pigs.

However, since most of the practitioners are tenants, they cannot easily plant the crops when they want to. They have to ask permission from the land owners first. There are also times when the weather conditions greatly affect the crops. Pest such as rats are a problem for the farmers as well. Legumes (except for peanuts) are not currently a major crop but they provide opportunities for diversifying food sources while rebuilding soil fertility.

This document presents work in progress in the Municipality of Guinayangan, Quezon. Participatory action undertaken at the local levels involves farmers and their communities in discovering solutions to current and future climate risks while provide more secure livelihoods. Succesful community-based adaptaton work invariably relies on a portfolio of locally relevant options that can deliver on both livelihood and climate change adaptation objectives.

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