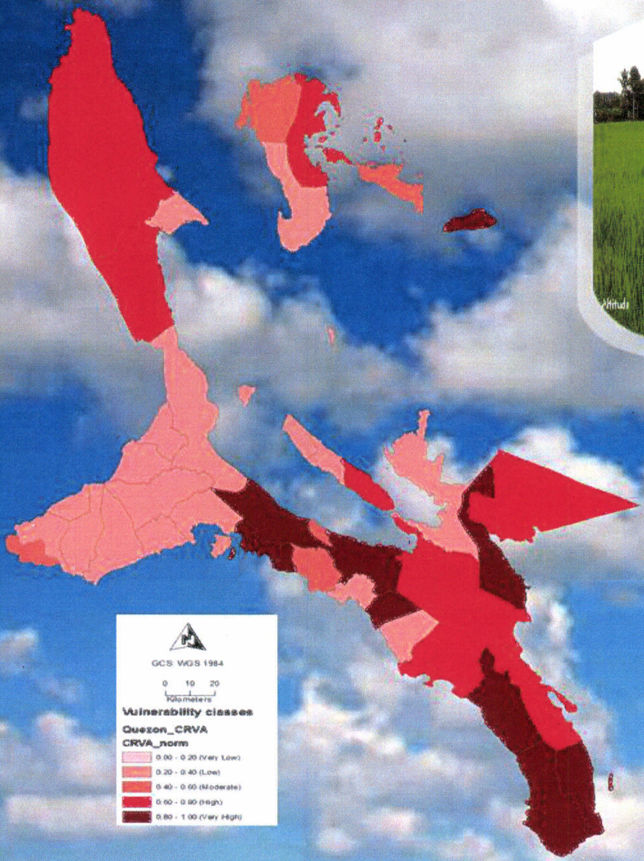

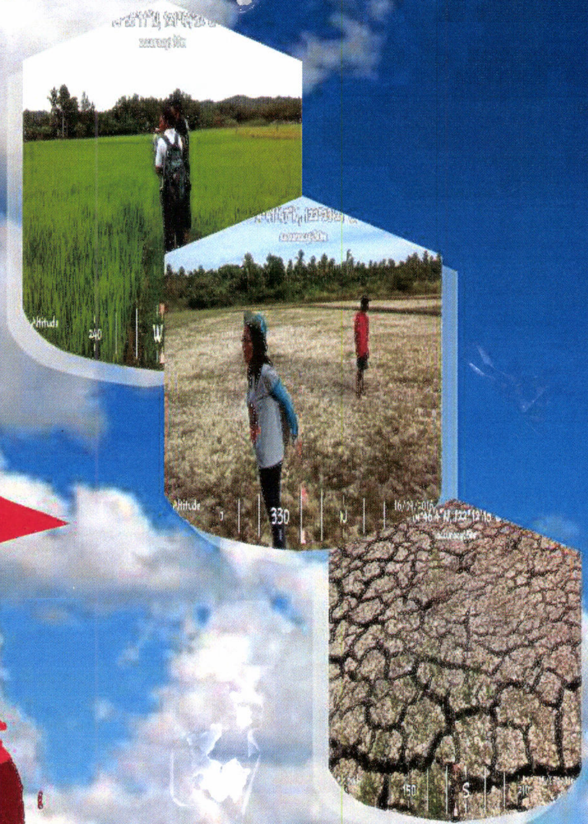

Regional Climate Resilient Agri-fisheries (CRA) Assessment, Targeting and Prioritization for Adaptation Mitigation Initiative (AMIA) Phase 2 CALABARZON

Prepared by: Southern Luzon State University

Regional Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 (CALABARZON Region)

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ABSTRACT

Project Title: ***Regional Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 (CALABARZON Region)***

Project Proponents: **For. FELINO J. GUTIERREZ, Jr. / Jesusita O. Coladilla, Ph.D**

Addressing the challenges of climate change and economic growth is a mandate of every government. The Philippine government through the Department of Agriculture planned and implement strategies to support local farm communities in managing climate-risks and food security by establishing the Adaptation & Mitigation Initiatives in Agriculture (AMIA) Program through its research and extension functions. In support to this, the Southern Luzon State University conducted the vulnerability assessment of selected crops in Quezon Province.

The study aims to assess the climate risks vulnerability of the selected crops using geospatial & climate modelling tools, particularly on rice, corn, eggplant, squash, cacao and tilapia in different municipalities in Quezon; to determines the various CRA practices in the province and to recommend the most feasible CRA practice that can assist farmers in coping with the negative effects of climate risks and hazards in the province and in sustaining food production.

Climate-risks Vulnerability Assessment (CRVA) is measured thru three important components; (1) exposure of crop to hazards (2) crop sensitivity to climate risks, and (3) adaptive capacity on climate change impacts. Specifically, the study determines which municipality in the province is vulnerable to climate-risks and hazards. MaxEnt Model and ArcGIS/QGIS Softwares were used for suitability and vulnerability assessment of the sic (6) identified crops. MaxEnt is based on Representative Concentration Pathways (RCPs) 8.5 with 33 Global Climate Models (GCMs) ensemble into one to predict scenarios from present condition and year 2050 posed by climate change. On the other hand, cost-benefit analysis was used in the identification and prioritization of CRA practices in the province.

Results found out that areas in 3rd district of Quezon are highly vulnerable to climate-risks, particularly San Francisco, Quezon. CRVA result indicates that high sensitivity of crops will lead to low suitability and can greatly influence the level of vulnerability. Further, municipalities in Quezon are highly exposed to climate-related hazards, such as typhoons, landslides, and drought and pest infestation, which have impacts to its climate-risks vulnerability. The main factor that influences the vulnerability of the area is the adaptive capacity of a particular area, where most of the municipalities in 3rd district of Quezon have low adaptive capacity.

Moreover, twenty-three (23) CRA practices were identified in a focus group discussion and workshops composed of farmers, agricultural technicians, municipal agriculturists, and researchers. Through community immersion and participatory approach, the study found out that Quezon farming communities are aware of climate change impacts at the farm level.

Using the cost-benefit analysis (CBA) tool, two (2) identified CRA practices were analyzed. Results show that utilization of Rainwater Harvesting Methods and Coconut-Based Integrated Farming Systems are privately and socially profitable to invest, in ensuring food security and in addressing the effects of climate-risks and hazards.

Through these processes, policy and decision-makers can prioritize options and strategies that are beneficial to the greater number of farmers despite climate change occurrence.

Keywords: *Vulnerability Assessment, Climate Change, Hazard, Sensitivity, Exposure, Adaptive Capacity, Cost-benefit analysis*

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A. BASIC INFORMATION

1. Project Title

   Regional Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting & Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2 (CALABARZON Region)

2. Proponent (s)

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   3.2. Collaborating Agency

   a. Department of Agriculture - RFO IVA
   b. Department of Agriculture- Southern Tagalog Integrated Agriculture Research Center (DA-STIARC)
   c. Provincial Government of Quezon

d. Local Government Units in Quezon Province

4. Project Duration
    a. Approved Duration (Y/M): (1 June 2016 – 31 July 2017)
    b. Start Date of Implementation: August 2016

5. Project Location

    Region IV-A Southern Luzon (Quezon Province in particular)

6. Beneficiaries of the project/Partner Farmer Organization

    The project directly benefit the Agricultural Offices in the Province and municipalities in the province of Quezon since the project results will provide planning inputs for their respective agricultural development programs and projects. Indirectly, the results will benefit the farmers and fisher folks associations in the province of Quezon where the project served as the pilot area in Region IVA for Climate Resilient practices in Agriculture (CRA). Specifically, the project outputs will be used by DA- Southern Tagalog Integrated Agriculture Research Centre as part of their implementation of their mandate to implement a community-based climate smart agriculture practices.

7. Project Funding
    6.1. Total Approved Budget **P 1,000,000**
    6.2. Total Amount Released **P 1,000,000**
    6.3. Actual Expenses **P 861,811.25.00**

B. TECHNICAL DESCRIPTION

1. Introduction

Climate change is threatening food production systems and therefore the livelihoods and food security of billions of people who depend on agriculture. Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather and because people involved in agriculture tend to be poorer compared with urban residents. Through this kind of situation, the CALABARZON region as an agricultural base region is highly affected by the changing climate.

CALABARZON region is the 12th largest region in the Philippines, and it comprises 5 provinces but has the largest population as of 2010 surpassing the National Capital Region. It is consisted of coastal areas and highlands with a large agricultural base. In terms of labour, the agriculture sector absorbed the 12.80% of the total employment of the region according to Philippine Statistics Authority Report last 2015. Apart from rapid urbanization and industrialization, NEDA-CALABARZON considered climate change as the biggest threat to agriculture in the region. In 2014, the region was severely hit by Typhoon Glenda, which caused billions in damages in agri- and aquaculture. The year also saw the onset of El Nino (Aquino, 2016). With this kind of situation the national government provided different studies and approaches in order to address the rapidly-growing problem on Climate Change. The Department of Agriculture through the Bureau of Agricultural Research and DA-SWACCO provided a study where it seeks to plan and implement strategies to support local communities in managing climate-risks from extreme weather events to long-term climatic shifts which were called as the Adaptation and Mitigation Initiative in Agriculture (AMIA).

With AMIA Phase 1 and Phase 2, the country is able to found out the crops and areas which are vulnerable to those climatic changes. As part of this approach a vulnerability assessment was done by the region led by the SUC. The assessment was done considering the different indicators in identifying the vulnerability of such area.

2. RDE Agenda Addressed

Addressing Climate change for fisheries and agriculture is far more challenging and complicated since these sectors produce food and provide livelihood to the people. Changes in weather pattern create environmental stresses such as flood, drought, soil erosion and increase pests and other pathogenic organisms that cause the low production of agricultural commodities and could eventually lead to poverty increase. The project was proposed and being implemented to address one of the following RDE Agenda of the Bureau of Agricultural Research, which was the climate change Research, Development and Extension (RDE) Agenda Program for fisheries and agriculture. This RDEAP focused on short and long- term adaptation strategies and mitigation options that could target climate change issues.

Specific areas addressed by this project includes: 1) Development of crop modelling tools (crop stress monitoring, crop yield forecasting) for predictive use especially for high value crops; 2)Identification and development of nutrient management technologies and techniques considering climate change vulnerability assessment; 3) Development of unified Vulnerability Suitability Assessment (VSA) for all areas; 4) Economic analysis of the strategies/interventions to crop production; and 5) Crafting of enabling policies and support mechanisms on development and promotion of technologies to other areas (out-scaling).

With this program, DA-BAR gives a priority on the adaptation strategies studies including technology generation, forecasting tools, climate risk assessment, and biodiversity, watershed, and water resources studies.

In connection to this, DA-BAR through the CIAT-AMIA 2 collaborates with key research and development institutions within the region led by a local state university/college (SUC). In Region IV-A, the Southern Luzon State University created a research study entitled "Regional Climate-Resilient Agri-fisheries (CRA) Assessment, Targeting and Prioritization for the Adaptation and Mitigation Initiative (AMIA) Phase 2". This study enabled the Region 4A particularly Quezon Province to identify the area and crops who are vulnerable to climatic issues.

3. Description of Technology/Information Developed/Generated

This research project utilized a number of methods and technologies to generate information that can be used by agricultural planners and practitioners. These technologies include the use of participatory methods like focus group discussion (FGD), and Key Informant Interview (KII) in data gathering; use of Geographic Information Systems (GIS) and spatial modelling for the identification of exposed area to climate change hazards; crop sensitivity modelling using MAXENT model for crop sensitivity to climate change hazards; and use of cost benefit analysis (CBA) for determination of economic feasibility of the adaptation options.

This project also able to generate four (4) major information that can be used by policy makers, policy implementers and farmers/fisher folks in the identification and formulation of climate change adaptation and mitigation strategies to minimize the negative effects of climate change. These information are as follows: a) areas in Quezon province that are projected to be exposed to climate related hazard in the next 50 years, b) crops that would be sensitive to these climate related hazards, c) crops that would be suitable to the changing climatic conditions, and d) economically feasible adaptation strategies to changing climatic condition.

3.1. Agriculture Crop Sensitivity

According to IPCC 2007 as cited by Fellman, Thomas, agriculture crop sensitivity can be reflected through different changes whether it is direct or indirect. As discussed by Fellman, it can reflect the responsiveness of a system to climatic influences. Thus, sensitive system is highly responsive to climate and can be significantly affected by small climatic changes (Fellman, n.d.). In identification of agriculture crop sensitivity will enable the farmers' decision making. It may also help on the production aspect of such crop and eventually could help on the economic living of the farmer.

3.2. Climate-risks Vulnerability Assessment

Climate Risks Vulnerability Assessment determines the what, where, when and why of such vulnerability. This could be identified through the assessment of its exposure to vulnerability, sensitivity to vulnerability and its adaptive capacity. With this kind of assessment farmers and fisher folks would be able to have ideas to what they should do in times of calamities. They are able to adjust their cropping season when there is a sudden change in the climate. It can help them to provide alternatives that will not damage their cost of living.

3.3. Cost-Benefit Analysis of selected Climate Resilient Agriculture (CRA) practice

In Quezon Province, there are several CRA practices and technology that were identified but only two of those practices were selected to determine the economic feasibility of such practice. Those practices selected were processed through the Cost-Benefit Analysis that was spearheaded by International Centre for Tropical Agriculture. The said tool will determine the effectiveness of the technology or practice being promoted.

C. Potential Impact

The project outputs are expected to provide inputs to climate change adaptation initiatives of the Region IV-A particularly in Quezon Province towards climate change resiliency of the agricultural sector and also an input to other sectors who are working on climate risks management The identification of areas and crops vulnerable to climate change impact will enable the responsible government agency to deliver a more targeted services and targeted adaptation and mitigation program and project. It will enable the sectorial agency (ie. Department of Agriculture) to plan and implement strategies to support local communities in managing climate risks – extreme weather events to long- term climatic shifts as Climate- Resilient agri-fisheries (CRA) that directly involves, and impact on the livelihoods of farming supported by an integrated package of climate services and institutions, within a broader food system/ value chain setting.

In terms of the farmers point of view the CRA-AMIA2 project will enable them to construct or create an idea or alternative activity and practices that could help them to have a productive and sustainable outputs in terms of their living.

D. Objectives:

1. Outcome or General Objective/Purpose

The purpose of the study is to assess, target, and prioritize climate-resilient agri-fisheries (CRA) in Quezon Province.

2. Expected Output or Specific Objectives

1. To strengthen the capacities of research and development organizations in the region for CRA methodologies;
2. To assess climate risks in the region's agri-fisheries sector using geospatial & climate modelling tools;
3. To determine local stakeholders' perceptions, knowledge & strategies for adapting to climate risks;
4. To document and analyse local CRA practices to support AMIA2 knowledge-sharing and investment planning.

E. Review of Related Literature

Agricultural Sector in Region IVA and Quezon Province

The Province of Quezon is heavily based on agriculture where mostly of the community rely on. In the Region IV- A, Quezon has the highest agricultural farm area with a 112.2 thousand farms, covering 341.4 thousand hectares of agricultural land based on the Philippine Statistics Authority 2012. CALABARZON contributes a lot on the rice production of the Philippines because "palay" is the temporary major crops of the said region. There are also other crops that the region is rich for, like sugarcane, corn, coconut and fruit bearing plants. The region also engaged into livestock and poultry raising activity. Mostly, of the male population are engaged into those agricultural activities cited above (Republic of the Philippines Philippine Statistics Authority, 2012). In year 2014, the region contributed also a great volume of fishes in the country. Quezon having 221 hectares of coastline provided 8.2M volume in their fisheries sector. In maintaining the good harvest the province provided programs that will help the fisher folks. One of those programs is the Fishery Livelihood and Productivity Enhancement Program which aims to increase the income of small and marginal fisher folk, fishing gears/paraphernalia are distributed to fishing communities. Production inputs were also given to fish cage and backyard fishpond operators such as fingerlings of the bangus, tilapia, and *pangasius* variety, large prawns, crab legs, and bags of feeds (Quezon Province, n.d.).

Climate Change on Agricultural and Fisheries Sector

Climate change threatens agriculture production's stability and productivity. A long term changes in the patterns of temperature and precipitation, that are part of climate change, are expected to shift production seasons, pest and disease patterns, and modify the set of feasible crops affecting production, prices, incomes and ultimately livelihoods and lives (Rudinas, Godilano, & Ilaga, 2013).

Food security is compromised by the impacts of climate in view of the changes in weather patterns, pest and disease incidence, production areas are threatened by floods, landslides, droughts, sea level rise, soil erosion, etc. Results of the preliminary spatial analysis of the three predicted consequences (landslides, drought and flooding) of climate change showed approximately 67% (20 M hectares) of the country total areas will be severely affected by climate change. For agriculture alone, 86% will be affected by the various impact of climate change (GIS analysis, E.C. Godilano, 2009, 2010), i.e. production areas, farm to market roads, warehouses, post-harvest facilities, irrigation infrastructure, industries, mariculture parks, and fish ports. This also entails collateral damage to farm equipment and fishing gears if not the loss of lives of our farmers and fisherfolk.

The precise and localized impacts of climate change on fisheries are, however, still poorly understood (FAO, 2008a; WorldFishCenter, 2007a; Stern, 2007). This is because the inherent impulsiveness of climate change and the links that entangle fishery and aquaculture livelihoods with other livelihood strategies and economic sectors make disentanglement the exact mechanisms of climate impacts hugely complex. (WorldFishCenter, 2007b).

Small-scale fisheries and aquaculture have contributed little to the causes of climate change but will be amongst the first sectors to feel its impacts. Some anticipated consequences include falling productivity, species migration and localized extinctions, as well as conflict over use of scarce resources and increased risks associated with more extreme climatic events such as hurricanes. These result from direct impacts on fish themselves as well as from impacts on the ecosystems on which they depend, such as coral reefs. In general the consequences of climate change will be negative for fishers at low latitudes. In contrast, fish-farmers may benefit from expansion of the areas where aquaculture is viable due to increased temperatures and rising sea levels. However, these benefits may be tempered by reduced water quality and availability, increased disease incidence and damage to freshwater aquaculture by salinization of groundwater.

Climate Change Risks on Different Agricultural Crops

Climate change has begun to impact the agricultural landscape. The next big challenge in agricultural sector is to find ways to maintain and improve the productivity of the yields (*Spaldon S., et.al, 2015*). The increasing temperature, irregular precipitation, droughts, floods, typhoon are the most important issues associated with climate change; these are the major threats for crops specially in high value (*Moretti, C.L., 2009 and Tirado et al., 2010*). The adverse impact of climate change should be mitigated and developed in way of adaptation strategies on crops such as management practices like integrated farming system, organic farming, irrigation practices (STW, SWIP,DRIP etc.), intercropping, mulching with crop residues, plastic mulches help in conserving soil moisture.

The Quezon, Province has different strategies which will also be covered through agricultural mechanization that is expected to reduce the negative impacts on climate change. Now that climate change and its manifestations happen, there is a need to reshape the agricultural sector in Quezon into a 'climate-resilient' one. Policies and programs initiated by Province of Quezon such as Farmer's Productivity Enhancement Program, Coconut Integrated Pest Management Program, Organic Agriculture and Agri-eskwela are also expected to absorbed stresses and maintain functions to have a positive impact on these mitigating efforts (Quezon Province, n.d.).

Rice

Rice is the major temporary crops and most important staple food in CALABARZON (*www.psa.gov.ph*). Rice yield and rice production depend on many factors such as technology, soil quality, planting practices and climate variables. Due to unpredictability of climate variables (increasing temperature, droughts, declining rainfall, water scarcity and flooding) have put pressure on rice value chains (*www.IRRI.org.ph*). The impact of climate change has adverse effect not only on agricultural crops but also on the livelihoods of the farmers and economic value related to its production, processing, distribution, and consumption are widely considered a key for economic development, food security, and poverty reduction. (*Terdoo, et.al., 2016*). It was discussed in the IPCC 4th Assessment Report that in Southeast Asia rice is vulnerable to the effect of Climate Change since the region are highly dependent on agriculture same as the agriculture is the main source of the economic production (Redfern, n.d.). According to DA Secretary Manny Pinol, "We should hit rice self-sufficient within the next two years... It's a must not a choice" (Times, 2016). As part of this objective the Department of Agriculture provided several research development and extension programs to address the current trend or issue of the rice sufficiency in the country. In response, the DA formulated El Niño mitigation and adaptation plan has been implemented interventions to support crop production. Strategies include provision of shallow tube wells (STW), farm machineries, seeds and fertilizers, and establishment of production facilities.

The International Rice Research Institute reported that, when temperature rises, rice production will be to slow or decreases its yield. In addition, the higher day-time temperature increases yield on rice, on the other hand higher night-time temperature can affect the future yield loss because temperature are rising faster at night (Welch,2010). Furthermore, the Philippine Rice Research Institute (PhilRice), recommended low-cost drip irrigation system (STW) that can resist the impact to drought to adapt on climate change.

Maize

Maize is another major agricultural product of the province. Quezon also ranked first in the region in terms of maize production. As of 2015, the province produced 35,452 metric tons out of 66,249 metric tons production of the regions. Major producers of maize are the Municipalities of Mulanay, Catanauan, San Andres, San Francisco and Buenavista. There was a 12.8 percent decline in the region's total maize production in 2015. White maize production decreased by 17.9 percent while yellow maize production decreased by 9.2 percent. The decline in production may be attributed to inadequate rainfall, shifting from corn to sugarcane and lack of capital resulting from losses in previous cropping. Lesser application of fertilizer due to dry weather resulted in stunted growth of the crops and smaller cobs developed particularly in Batangas. In addition, area harvested for maize was reduced by 15.5 percent from 34,519 hectares to 29,185 hectares due to insufficient water supply and hot weather condition during planting time. Because of the reduced output and area harvested, both white and yellow maize productions are below the target yield for 2015. White maize production was short by 20.5 percent and yellow maize short by 33.2 percent from their target (Jolongbayan & Nelson J. Aman, 2015).

According to the latest National Climate Assessment, climate change means that farmers can expect a higher incidence and intensity of floods, droughts and extreme heat, which can reduce maize's ability to pollinate. In addition, maize at high risk from the higher temperatures, changing rainfall patterns, and water shortages caused by climate change would be also a factor of its productivity (*Goldenberg, 2014*). Moreover, sloping areas is highly sensitive to prolonged rains and surface run off but rising temperature could possibly a limiting factor (Thornton et al. 2009). Precipitation variability is expected to intensify the flood and drought events that are harmful in particular to rainfed agriculture areas (Pachauri and Reisinger 2007). The study of (Banua, 2016), stated that if you had a good weather conditions it may contributed to increased production of rice and corn.

Eggplant

Eggplant (*Solanum melongena L.*) was the second profitable product not only in Quezon province but also in the Philippines sharing 13.45% of the total production in 2010. The incidence of extreme weather events like floods and droughts are the emerging major problems. The farmers would be engaged intensive use of pesticides to grow quickly bearing some implication on environment and human health. However, the Provincial Government of Quezon has developing strategies for the better improvement of eggplant production; it is alternative pest control strategies such as integrated pest management (IPM) technology and intercropping (*www.calabarzon.da.gov.ph*).According to Food and Agriculture Organization, suggested the basic management practices in order to adapt successfully to climate change are controlling weeds and mulching plants, protect from frost and maintained soil moisture. According to Kembel J.K. and Sanders D.C. 2000, the study revealed that squash & eggplant requires adequate amount water because of shallow root system. In addition, squash is most sensitive to drought stresses that affect the flowering, fruits and seed development (www.fao.org). In response to climate change, Provincial Government of Quezon has establishing strategies within the community (e.g., integrated pest management and intercropping) and needs the better improvement for the appropriate strategies depending upon on the impact of climate or changing in weather patterns.

Squash

Quezon province has the biggest area harvested of squash accounting for 60.04% of the total area harvested of the crop in CALABARZON. Squash requires a relatively plot elevation and it can be cultivated both in wet and dry season; requires 1 inch of water from rainfall. Also, it adapts well on organic-rich and well-drained soil. The peak months for squash are July, August, September, November and December while lean months are February, March and November (*www.calabarzon.da.gov.ph*). The study of Kembel J.K. and Sanders D.C., 2000, that squash & eggplant with irrigation can increase the survival rate and high quality of production. Furthermore, Food and Agriculture Organization suggested the basic management practices in order to adapt in changing of climatic condition are maintained soil moisture and controlling weeds.

Cacao

In the year 2015 the Regional Development Council together with NEDA Region IV-A reported in the Regional Development Plan that cacao production decreased by 32 percent from its 2014 record. However, there was a 1.5 percent expansion in the areas planted with cacao. Nonetheless, there was a 33.3 percent decline in the average yield from 0.06 metric tons/hectares to 0.04 metric tons/hectares. The resulting yield is short by 93.5 percent of the target 0.62 metric tons/hectares for 2015 (Jolongbayan & Nelson J. Aman, 2015).

Climate change has large implications for the future of cacao production and community livelihoods. The important factor as responses to climatic conditions in weather parameter such as rainfall, temperature and relative humidity can control sustainability of cacao production and predicting yield. The decreasing productivity rates due to the quality farm inputs such as seeds and fertilizer might affect the income of the farmers. Furthermore, reduced rainfall and increased temperatures, which lead to prolonged periods of drought, are causing a reduction in soil moisture during the dry seasons and decreased soil fertility (*Parry, M. L. 1990*). However, the study of M. Wessel., 2015, suggested that extreme temperature leads to drought and should have adaptation strategies (e.g., shaded trees and integrated farming will be necessary in the farm). According to Nwachukwu, I. N. et.al., (2012), it was suggested that cacao farmers should adopt new measures to cope with the emerging negative effect of climate change and also cacao farmers are highly dependent on the health of the environment for their livelihoods.

Coffee

According to the 2015 CALABARZON Regional Development Council coffee production declined by 51.6 percent resulting in a yield of 0.17 metric tons/hectares that is 51.4 percent below its 2014 level and 80.5 percent short of its target for 2015. The decline in output was due to the strong winds of Typhoon Glenda during the flowering stage. Some coffee areas, particularly in the province of Cavite, were shifted to pineapple because of higher profitability (Jolongbayan & Nelson J. Aman, 2015).
Climate change is threatening coffee crops in virtually every major coffee production. The warming temperatures, long droughts, punctuated by intense rainfall, more resilient pests and plant diseases—all of which are associated with climate change that could affect coffee production and threatening the livelihood of coffee growers. Hence, protect and conserve environment with proper management practices of coffee can increased the crop yields and enhance the knowledge and quality of life for farmers and society as a whole (*JergunPohlan, Hermann A.* and *Marc J. J. Janssens*). In addition, the study of Adhikari, Umesh et.al (2015), reported that high precipitation rate will contribute to the increase of coffee yield and may threaten its productivity.

Government Initiatives in Controlling the Effects of Climate Change

The Department of Agriculture provides an initiative on Climate Smart Agriculture. It gives attention to landscape approaches, for example integrated planning of land, agriculture, forests and fisheries and water to ensure synergies are captured. Climate Smart Agriculture encourages the use of all available and applicable climate change solutions in a sensible and impact-focused manner (Stapleton, 2011). The Department has a banner component which was called as the Agri-Pinoy Program that integrates government initiatives and interventions for the agricultural sectors; namely food security and self-sufficiency, sustainable resource management, support services from farm to table, and broad-based local partnerships (*www.da.gov.ph*). Recent empirical studies indicate that farmers in the Philippines are already practicing CSA adapted to the existing climates that they face by choosing crops, livestock or some mix of them to match their climate.

There are also legislative efforts that the national government provided towards the climate resiliency. One of those laws is the Climate Change Act of 2009, which institutionalizes the government's climate response mechanism. It is also complemented by a number of key environmental laws, that when implemented effectively will drastically decrease the effect of climate change to different sectors particularly in the fishing sector which is the number one affected by it (Office, 2010).

As response to the programs of the national government, the local government of Quezon provides programs for their community. When it comes to agricultural sector the government implemented different programs such as Farmer's Productivity Enhancement Program, Coconut Integrated Pest Management Program, Organic Agriculture and Agri-eskwela. These programs aim to achieve sustainable agriculture. For the fisheries sector the provincial government provided activities and programs such as Adopt-a-Reef Project, Cultivation of Edible Seaweed and Fish Hatchery. With all this programs, projects and activities, the government makes sure that it will help the layman through income generation and when there will be calamity to happen (Quezon Province, n.d.).

Cost-Benefit Analysis for Climate Resilient Agriculture

Understanding Cost-Benefit Analysis is quite complex. It is an economic analysis to aid social decision-making and is used to evaluate the desirability of a given intervention or interventions. It is a formal discipline used to help appraisal or assess projects and informal approach to making decisions of any kind to establish weather a proposed public or private investment is worthwhile. The method compares all cost and benefits that can be expressed in monetary terms. To indicate the most efficient method, net present values, cost benefit ratios or internal rates of returns for the adaptation strategies are compared (Shongwe, 2013).This tool estimates and totals up the equivalent money value of the benefits and costs to the community of projects to establish whether they are worthwhile (University, n.d.). It is not limited to monetary considerations only. It often includes those environmental and social costs and benefits that can be reasonably quantified (Dictionary, n.d.).

Cost-Benefit Analysis in Climate Resilient Agriculture can be a tool to have different options to consider. It may help us in comparative analysis of different Climate resilient options. Through CBA, stakeholders or anyone concerned can decide whether their project or activity will be beneficial for them and whether they will still go or not to such project. Decision-makers, planners, funders, and other agriculture and development stakeholders need tools and methods that clearly outline the impact of practices and services within specific agricultural systems in order to assess CSA related trade-offs (Sven, Loibl, Greiving, Gruehn, & Meyer, 2010). CBAs are commonly used tools for decision-makers to evaluate investment options, especially in relation to government planning (Birol, Koundouri, & Kontouris, 2010).

F. METHODOLOGY

Component 1 - Capacity strengthening for CRA research & development

The regional project team participated in series of trainings, workshops and learning events organized by CIAT being the national program lead coordinator for the assessment, targeting and identification of climate resilient agri-fisheries practices. To strengthen the capacities of the project team, CIAT organized training-workshops and learning events regarding the adopted CRVA Framework and the prioritization of Climate Resilient Agriculture. Knowledge gained by the research team from CIAT and other

SUCs during the workshops were rolled-down to the municipal agriculturist and agricultural extension workers during the participatory data gathering as part of the project introduction.

Component 2 - Geospatial assessment of climate risks

The regional project team collected and organized geo-referenced data on vulnerability to climate risks of the region's agri-fisheries sector. These datasets, from both primary and secondary sources, based on the methodological guidelines provided by the AMIA2 CRVA project – Climate-risks Vulnerability Assessment (CRVA) has three (3) components; (1) climate-risk exposure,(2) sensitivity, and (3) adaptive capacity.

Each component processed in GIS software and climate modelling tools (Maximum Entropy Model) were used for sensitivity analysis. This was undertaken at the provincial level. The project team participated in a national-team level joint analysis of cross-regional data.

1. Climate-risk exposure

Climate-risk exposure processed the data from secondary information/historical records as reference in predicting climate-related hazard to be a good representation for future climate scenarios. These are the climate-related hazards such as tropical cyclones, flooding, landslide, drought, erosion, salt water intrusion, sea level rise and storm surge. The source and unit of measurement, spatial and temporal resolution are listed in Table 1.

Experts from Province of Quezon (representatives from Office of Provincial Agriculturist, Municipal Agriculturists, Agricultural Technicians and farmers) were invited to the workshops and rate each hazard using the standard form (See attachment A) based on their experience. Normalization of each hazard was done, from zero (Low) to one (High). This can be provided a multi-hazard index by adding all the hazards and repeat normalization process from zero (0) to one (1). Then, five equal breaks was arbitrarily used with 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High), and 0.80-1.00 (Very High).

Table 1. The parameter of climate-related hazard, source and unit of measurement, spatial and temporal resolution.

Parameter	Source	Unit of measurement, spatial and temporal resolution
Typhoon	UNEP / UNISDR, 2013 (http://preview.grid.unep.ch/index.php?preview=data&events=cyclones&evcat=2&lang=eng)	1 kilometer pixel resolution. Estimate of tropical cyclone frequency based on Saffir-Simposon category 5 and higher from year 1970 to 2009.
Flooding	AMIA multi-hazard map / baseline data from Mines and Geosciences Bureau, Department of Environment and Natural Resources (MGB, DENR)	1:10,000 scale. Susceptibility of flood risk for Philippines from the past 10 years
Drought	AMIA multi-hazard map / baseline data from National Water Resources Board	Groundwater potential for the Philippines
Erosion	AMIA multi-hazard map / baseline data from Bureau of Soils and Water Management (BSWM)	1:10,000 scale. Soil erosion classified from low to high susceptibility
Landslide	AMIA multi-hazard maps / baseline data from MGB, DENR	1:10,000 scale. Landslide classified from low to high susceptibility
Storm Surge	AMIA multi-hazard maps / baseline data from Disaster Risk and Exposure Assessment for Mitigation, Department of Science and Technology (DREAM, DOST)	
Sea level rise	AMIA multi-hazard map /	
Saltwater Intrusion	AMIA multi-hazard map / baseline data from the NWRB	Groundwater potential for the Philippines

2. Sensitivity Analysis

2.1 Data Preparation

The regional project team conducted several workshops and collected crop occurrences data that were prioritized by Department of Agriculture Regional Office IVA. The following crops are the priority crops in the region, namely rice, maize, eggplant, squash, cacao, coffee and tilapia. Experts from different municipalities (representatives from OPA, MA's, AT's and farmers) in Quezon participated in the said training-workshop. Maps with basic reference such as river, roads, barangay and admin boundary and fishnet method of 1km cell size were used to pin-point the crop occurrence. Furthermore, all points were referenced and converted to excel format and save as comma delimited (*.csv) file. Under these heading has name of crop, exact locations point (easting & northings) in order to run in Maximum Entropy Modelling (MaxEnt Model).

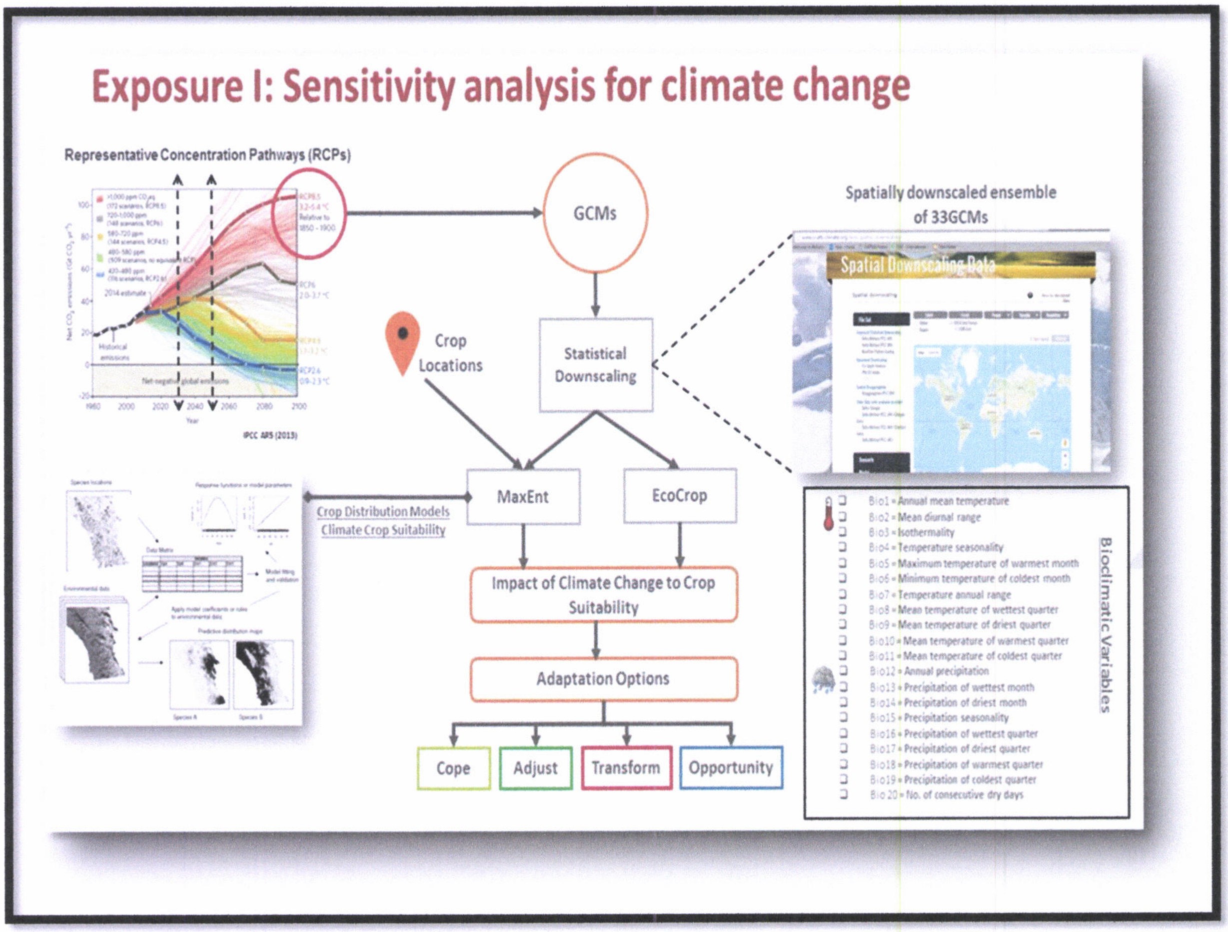

Figure 1. *Sensitivity Framework*

Figure 1 shows on how sensitivity analysis was processed based on crop occurrences data. This method used Representative Concentration Pathways (RCPs) 8.5 with 33 Global Climate Models (GCMs) (See attachment B) ensemble into one. This can be provided as input on climate data because it is most recent and policy relevant. Also, GCMs were used for the improvement of sensitivity results based on climate model to predict scenarios posed by climate change. However, GCMs have still errors/limitations in predicting future climate scenarios, while they can provide a reasonable accuracy about large-scale features and other variations due to climate forcing. This can be done through statistically downscaled into 1km resolution from CCAFS-Climate Data Portal. The twenty (20) bioclimatic variables (See attachment C) climate data were used to derive the annual (e.g., mean annual temperature and annual precipitation) and seasonal projections (e.g., annual range in temperature and precipitation from present condition and year 2050. The outputs were used to determine the impact of climate change to crop suitability.

3. Adaptive Capacity

Step 1
- Dataset used to determine the adaptive capacity index came from: 1) National Competitive Council of the Philippines (NCCP), 2) Philippine Statistics Authority (PSA), 3) International Water Management Institute (IWMI), 4)National Mapping and Resource Information Authority (NAMRIA), 5) Provincial Development and Physical Framework Plan CY 2015-2020, and 6) Data from different Municipalities.

Step 2
- Relevant variables were pre-selected from the database of NCCP, 2015

Step 3
- Principal Component Analysis (PCA) and Random Forest was used to explore the geographic variances, correlation, and feature importance of data across provinces and indicators. The shortlisted indicators were cross checked and some more variables were included to complete the representation of the other AC capitals.

Step 4 & 5
- Experts from Province of Quezon (Office of the Provincial Agriculturist), Municipal Agriculturists, Agricultural Technicians and farmers were invited to the workshop. They were grouped with their respective municipality and ask to rank each of the indicators according to importance. Each group should discuss and decide for a common value/rate for each indicator. They were provided with 1-5 score/rates, where 5 is the highest/most important. Some of the variables were lumped into a single variable and was given a high score as suggested by experts. Overall weights for "Sensitivity (15%)", "Hazards (15%)", and "Adaptive Capacity (70%)" were also identified by the experts during the workshop.

Step 6
- The values of the 32 indicators were integrated in the shapefile municipal boundaries. Each of the indicators was normalized and was treated with equal weights. The sum of the 32 indicators provided the adaptive capacity index.

Step 7
- Five equal breaks was arbitrarily used with 0-0.20 (Very Low), 0.20-0.40 (Low), 0.40-0.60 (Moderate), 0.60-0.80 (High), and 0.80-1.00 (Very High).

Figure 2. *Steps on collecting Adaptive Capacity Capitals.*

Figure 2 shows the step on how adaptive capacity index was processed. Sixteen (16) out of Thirty-two (32) indicators were derived from national & provincial information and data from different municipalities in Quezon Province. These indicators are as follows:

Table 2. Attribute capital and indicators.

Attribute Capital	Indicator
Economic Capital	• Potable water • Sanitary toilet • Households have electricity • Access to credit • Agricultural insurance • Employment in agriculture
Natural Capital	• Soil Organic Matter • Supporting Ecosystems and their Health • Groundwater availability • Reliable water for irrigation
Social Capital	• Existence of farmer's groups or unions • Participation/ Activity of farmer's groups or unions • Equity of women and men in decision making
Physical Capital	• Farm Size/ HA • Access to irrigation infrastructure • Access to post-harvest infrastructure • Access to quality seeds • Access fertiliser and pesticides • Reliable Infrastructure
Institutional Capital	• Effective Gov't and CSO programs for Climate Change • Adequate Gov't Response to previous shocks • Farmer's visited by or consulted with agricultural officer
Human Capital	• Literacy rate • Quality of education in local schools/ Teacher-Students Ratio • Health centers/ Public health Facilities • Health workers/ Public Doctors • Public Health Facilities • Number of Public Doctors
Anticipatory Capital	• Farmer/Fisher Awareness of climate change and local impacts • Disaster Preparedness Committee • Existing Early Warning System • Access to early warning information • Access to communication technology

4. Vulnerability

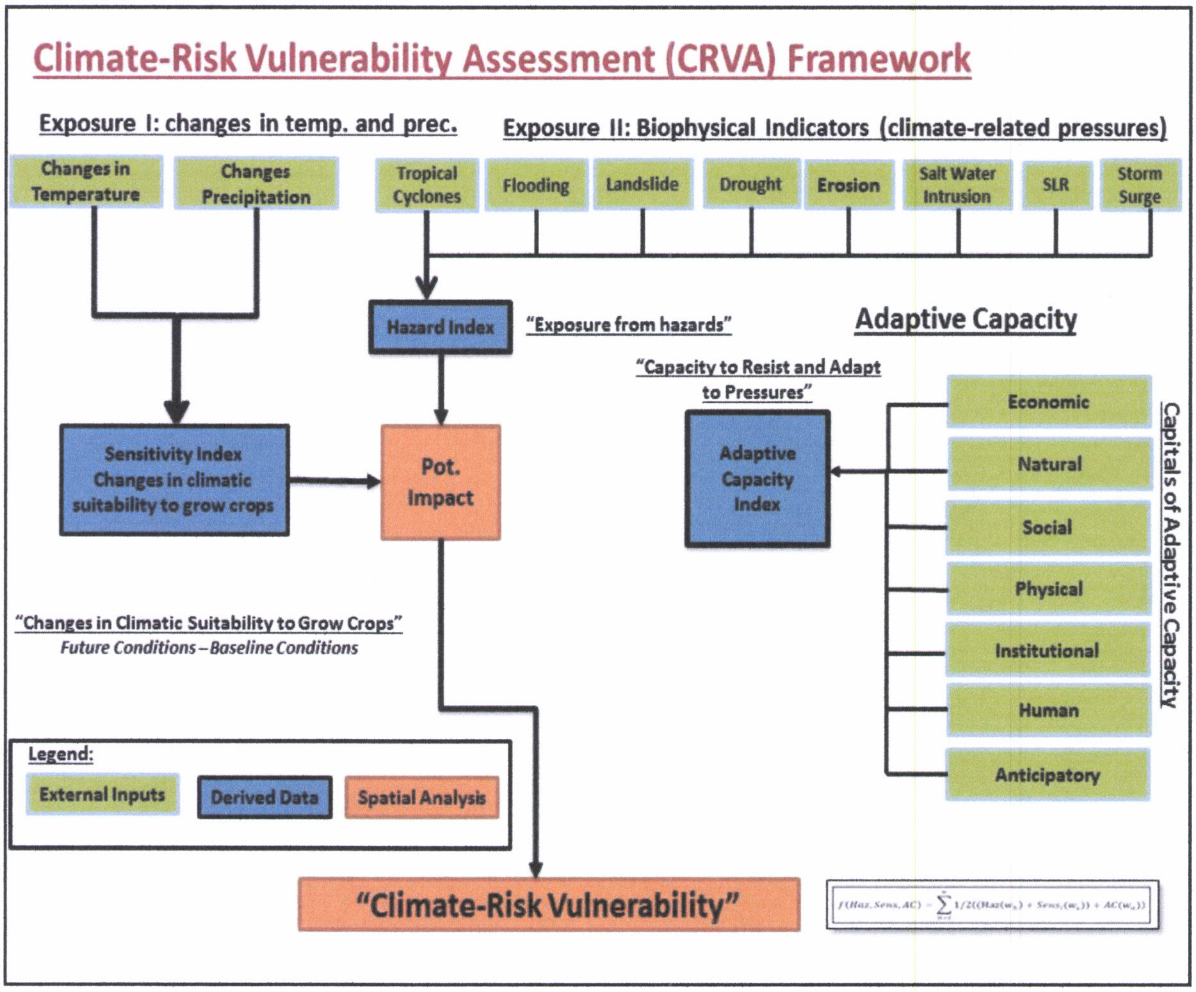

Figure 3. *Framework used on Climate-Risk Vulnerability Assessment*

Overall, Climate-risks Vulnerability Assessment (CRVA) is composed of these three (3) important components; (1) Exposure of crop to hazards (2) Sensitivity that determines the changes in climatic suitability to grow crops, and (3) its Adaptive Capacity to cope, to adjust, and to adapt on climate change impacts. This can be processed using ArcGIS/QGIS and derived from the revised formula of CIAT:

$$f(Haz, Sens, AC) = \sum_{n=i}^{n} 1/2((\mathrm{Haz}(w_h) + Sens_i(w_s)) + AC(w_a))$$

Where: Haz = hazard index, Sens = sensitivity index, and AC = adaptive capacity index. Wh = weight given for hazard, Ws = weight given for sensitivity, and Wa = weight given for adaptive capacity.

The summation of three components was normalized from zero (0) to one (1) and can provide the vulnerability index. Five equal breaks were arbitrarily used. These were a) Very Low, b) Low, c) Moderate, d) High, and e) Very High with the value of 0-0.20, 0.20-0.40, 0.40-0.60, 0.60-0.80, and 0.80-1.00, respectively.

5. Validation Process

CIAT Team provided the validation protocol to establish the validity & accuracy of the CRVA results. The regional project team followed the process of each component as shown in figure 4 below.

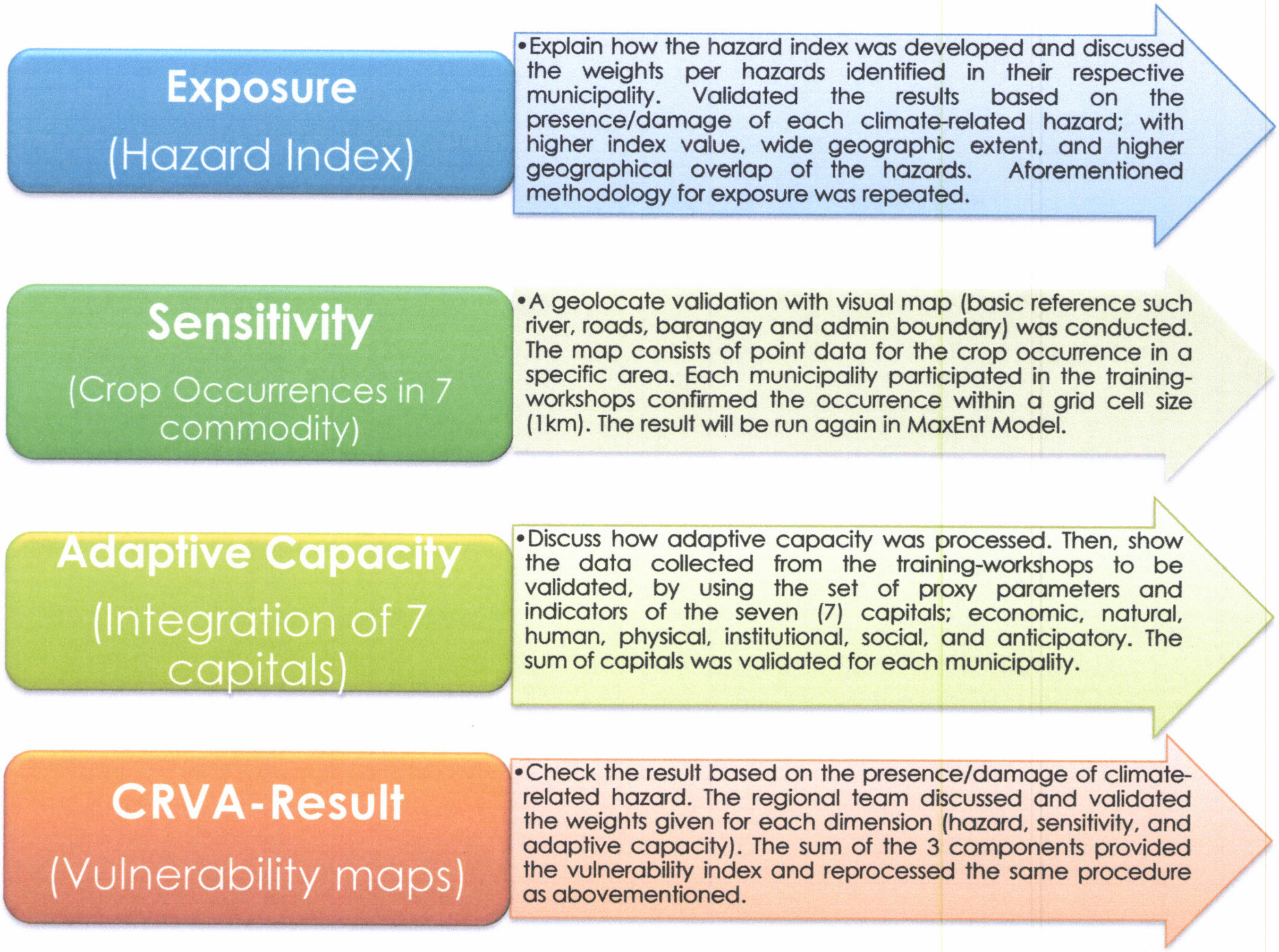

Figure 4. *Validation process on Climate-Risk Vulnerability Assessment (CRVA)*

Component 3 - Stakeholders' participation in climate adaptation planning.

The Regional Project Team conducted data collection, stake holders meeting, workshops and trainings in order to know how the stakeholder does participated in adaptation planning. In figure 5 are the 1st 4 steps conducted by the team using Key Informant interview, meetings and workshops in adaptation planning and maps production. Upon producing maps, the team collected different climate resilient practices from different municipalities and the selected practices were processed for Cost-Benefit Analysis to see if that practice would be feasible to everyone (see figure 6).

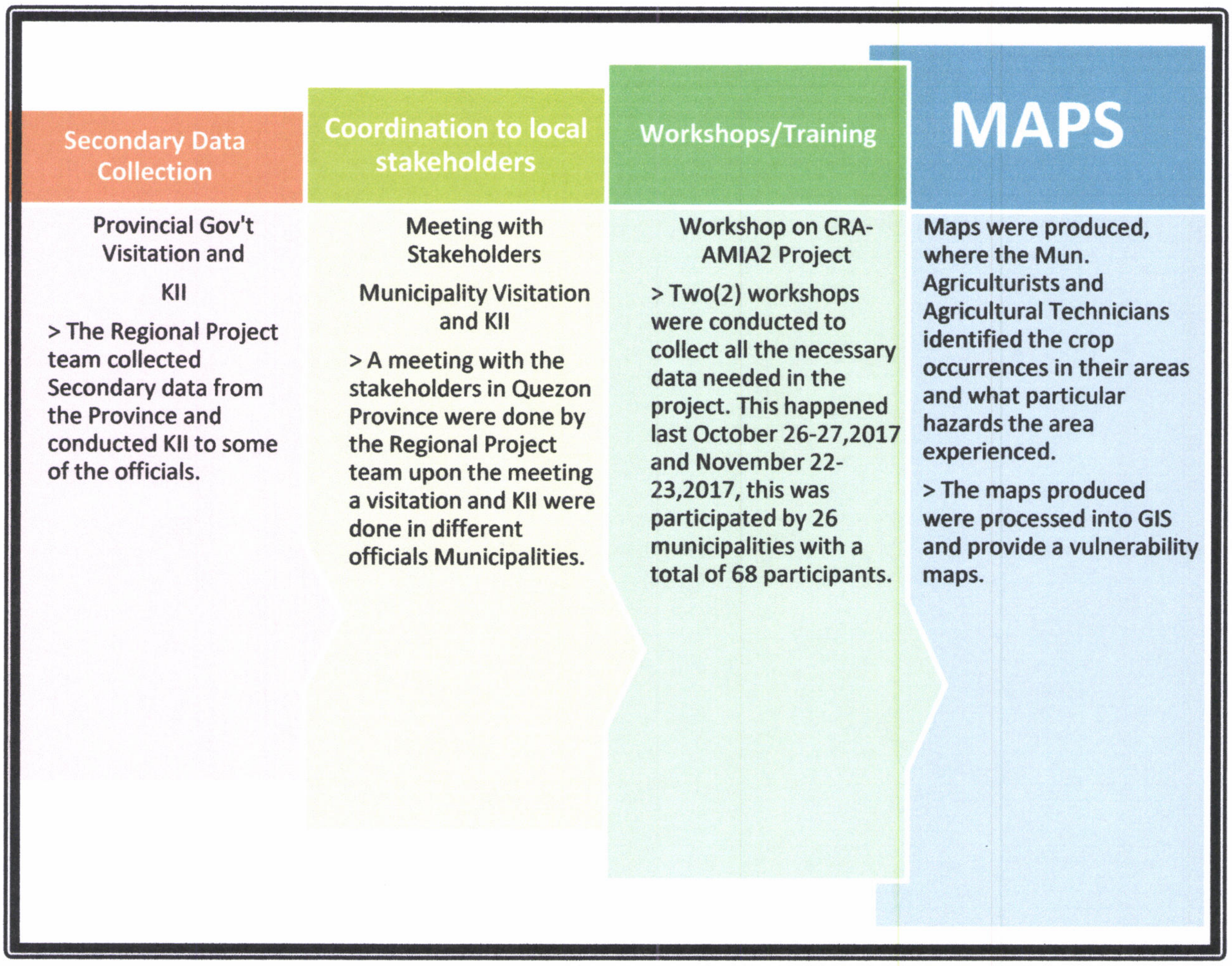

Figure 5. *Steps for stakeholders' participation.*

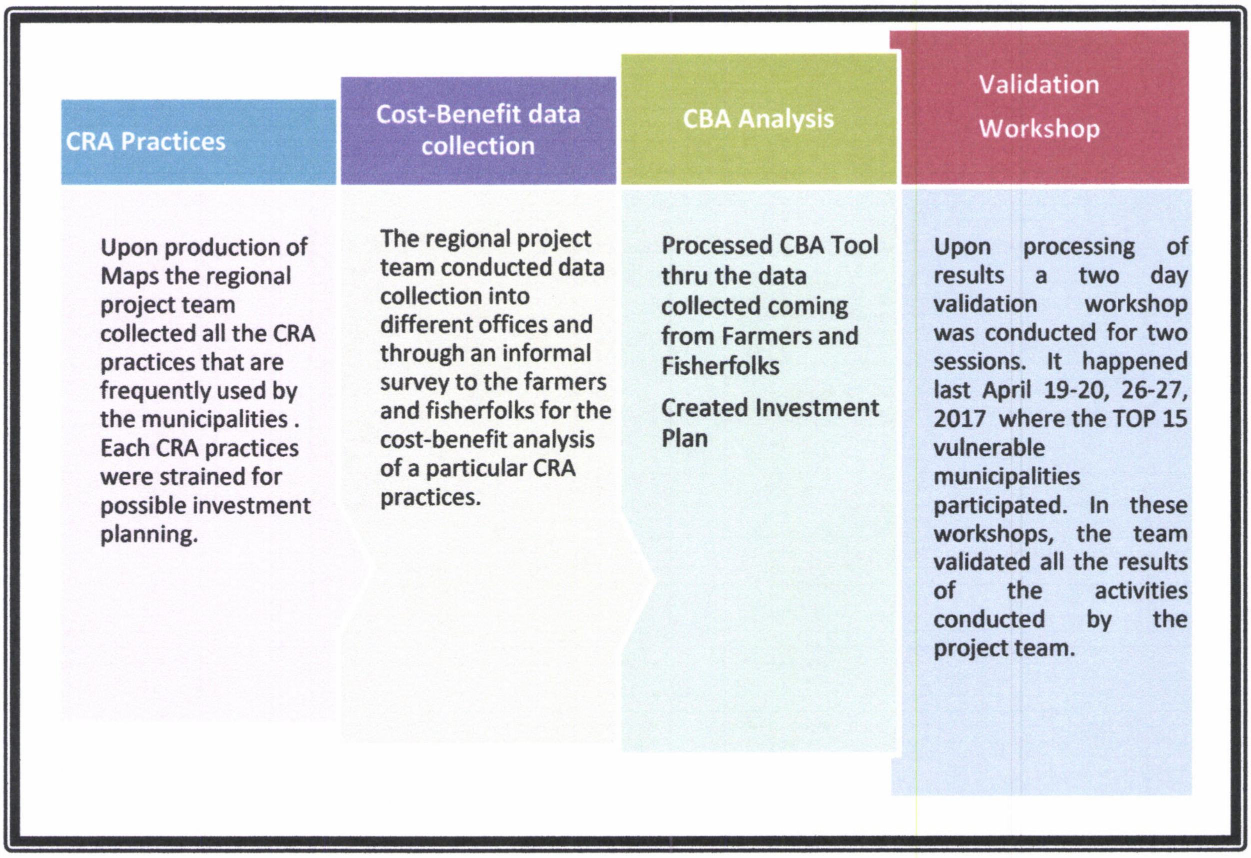

Figure 6. *Steps for stakeholders' participation.*

Component 4 – Documentation and Analysis of CRA practice

The regional project team conducted a key informant interview in different municipalities in Quezon province to document identified different CRA practices. These CRA practices identified were analyzed and selected the top most frequent CRA practice used in the whole province. The most frequent CRA practice utilized by farmers were processed using cost-benefit and trade-off analysis tools prepared by CIAT as an input to CRA-AMIA2 prioritization and investment planning. The outputs from this analysis served as input in the development of knowledge management systems which will be uploaded in a searchable online portal which will be managed by the Department of Agriculture as part of the whole AMIA program.

G. RESULTS AND DISCUSSION PER OBJECTIVE

1. To strengthen capacities for CRA methodologies of research and development organizations in the region.

SLSU-CRA Project Team participated in all of the trainings, workshops and seminars organized and coordinated by CIAT for the purpose of this study. These include action planning for the implementation of the AMIA 2 Program Framework, GIS Mapping (CRVA Methodology), CRA Decision Support and Cost-Benefit Analysis (See Table 3).

Table 3. Seminars, training-workshops and learning events participated by the project team

Event	Purpose	Venue	Date	Remarks/Person Involved
1. Planning Workshop on AMIA2-CIAT Projects	CIAT and DA-SWCCO presented and discussed the over-all framework and target outputs and work plan of the AMIA 2 Program.	CEC, UP Los Baños, College, Laguna	May 19-20, 2016	UPLB-FI DA-RFO's STIARC AMIA-CIAT Team Project Leader: For. Felino J. Gutierrez Jr.
2. Training on Climate Risk Vulnerability Assessment	Capacitated the regional team in the conduct of CRVA based on the methodology formulated by CIAT team, being the national program leader	Torre Venezia Suite, Quezon City	June 6-8, 2016	DA-BAR Representatives DA-RFO's CIAT Team SLSU Team (For, Ronald C. Garcia and Dr. Jesusita O. Coladilla)
3. Training on Cost-Benefit Analysis for Climate Resilient Agriculture	Strengthened the capacities of project team in Cost-Benefit Analysis methodology and guidelines.	Torre Venezia Suite, Quezon City	August 4-6, 2016	DA-BAR Representatives DA-RFO's CIAT Team SLSU Team (For. Felino J. Gutierrez, Jr., Dr. Jesusita O.

	Discussed and confirmed the corresponding tasks in Decision-Support platform for CRA of different regional project team Provided update on the progress of the project and conducted general planning for CRVA and Decision-support platform for CRA.			Coladilla and Ms. Phoebe Ann Hadaza C. Villasanta)
4. Workshop for Regional Climate Resilient Agri-fisheries Assessment, Targeting and Prioritization for AMIA 2 CALABARZ ON	Provided orientation to different municipalities in Quezon Province about the AMIA Program Framework Determined and mapped out the crop occurrence in different municipalities in Quezon Province Determined the sensitivity of different identified agricultural crops to Climate Change and; identified	Southern Luzon State University	October 25, 2016 November 21, 2016	CIAT-AMIA Team SLSU-AMIA Team OPA- Quezon Municipal Agriculturists of LGUs in Quezon Province Agricultural Technicians of different LGUs

	various existing farmer's strategies in climate change adaptation and mitigation Identified the current climate change adaptation strategies in different municipalities in the province			
5. Project Team Meeting	Planned and strategized on data collection process, workshop process and activities; monitored the project implementation based on plans and logical framework	SLSU Ayuti Campus	January 17 January 18 March 7 March 14 April 3 February 23 May 17	SLSU Team: Project Leader: For. Felino J. Gutierrez, Jr. Socio-economists: Dr. Jesusita O. Coladilla GIS Specialists: For. Ronald Garcia Research Assistants: Phoebe Ann Hadaza C. Villasanta Ma. Chariz A. Montero
6.Data Collection and Geospatial Assessment	Data Collection Geospatial Assessment		September 2016 October 2016	Eleven (11) municipalities were involved; Patnanungan, Panukulan, Jomalig, Polillo, Burdeos, Unisan, Padre Burgos, Guinayangan, Real, Infanta, Agdangan Representatives: Mayor MA's AT's Farmer MAO's Staff Regional Office: Philippine Coconut

			October, 2016 - November ,2016	Authority R4-A DA-Regional Field Office 4-A Provincial Office: Office of the Provincial Agriculturists Provincial Planning and Development Office Provincial Environment and Natural Resources Office
6.	Data collection and validation for the municipalities	Collected data in 41 municipalities and cities and validate the data with the Office of the Provincial Agriculturists and the DA-RFO IVAs data and information.		September 2016 – March 2017	All municipalities' in Quezon were involved in Ground working and showed cooperation through provision of necessary data and information.
7.	Workshop on CRVA Pre Final Output	Provided update on the status of data collection for crop occurrences and adaptive capacity Demonstrated the operation of Maxent model to generate climate and climate change crop suitability for each province Assessed and revisited weighting for exposure 2 - climate related	SEARCA, UP Los Baños	January 10-12, 2017	CIAT-ASIA Representatives SUC's Project Team SLSU Project Team (For. Felino J. Gutierrez, Jr, Phoebe Ann Hadaza Villasanta, Ma. Chariz Montero)

	environmental hazards			
8. AMIA-CIAT Project: Results Sharing and Validation Workshop on CRVA & CRA Decision Support	shared and validated the results of AMIA 2 (Phase 1) Identified variables for the improvement of the upcoming CRVA AMIA 2++ (Phase 2) Discussed evidence-based strategic plan for climate-resilient agri-fisheries communities CRVA Stakeholder Validation Workshop	Cebu City	February 6-7,2017	Team AMIA 1 BSWM CIAT-AMIA Team DA-RFO's SUC's SLSU-AMIA Team
9. AMIA-CIAT Project: Workshop on Finalizing Results on CRA Prioritization, CRVA, and extended CBA	Provided update on the status of CBA activities and present pre-final results of different SUCs project team Revisited the CBA methodology and explored additional assessment indicator for social and environmental dimensions Prepared investment briefs of proposed CRA practice feasible to Quezon Province	Quezon City	March 1-3, 2017	CIAT-ASIA Team SUC's SLSU-AMIA Team

10. DA-BAR Monitoring and Evaluation	Provided updates on project implementation to DA-BAR PMED team Discussed issues and concerns experienced in the implementation of RCRA-AMIA2 Project		March 20, 2017	DA-BAR M&E Team SLSU-AMIA Team
11. National Review and Planning Workshop for DA-BAR funded Climate Change Related Projects	Presented the Pre-final Result of the project team to panel of evaluators	Brentwood Suites, Quezon City	April 4-6, 4017	DA-BAR Climate Change Focal Persons SUCs Regional Team SLSU Project Team
12. Results Sharing and Validation on CRVA and CRA Decision Support	Presented the Pre-final results on CRVA in Quezon Province to different stakeholders. Validated the results on CRVA and CRA Decision Support with the different stakeholders	BRC 4th Floor, SLSU Hotel	April 19-20, 2017	DA-RFO's OPA SLSU-AMIA Team Municipal Agriculturists Agricultural Technicians Farmers Office of Extension Services Staff
13. Results Sharing and Validation on CRVA and CRA Decision Support	Presented Pre-final results on CRVA in Quezon Province. Validated the results on CRVA and CRA Decision Support	BRC 4th Floor, SLSU Hotel	April 26-27, 2017	DA-RFO's OPA SLSU-AMIA Team Municipal Agriculturists Agricultural Technicians Farmers Extension Services Staff

14. MAO's Meeting and Validation Workshop on CRVA and CRA Decision Support	Validated the Results with the Municipal Agriculturists ad Agricultural Technicians of Quezon Province Roll-out the Pre-Final Result	OPA, Pagbilao, Quezon	May 12, 2017	DA-RFO's OPA Municipal Agriculturists Agricultural Technicians SLSU Project Team
15. Roll-out Training to Communities	Roll-out of the project and presented the CRVA Results to members of the communities in Quezon Province	Gumaca, Quezon Tayabas, Quezon Lucban, Quezon Gen. Nakar, Quezon	February 16, 2017 (Invitation from IIRR) April 25, 2017 & June 30, 207 (Invitation from Tanggol Kalikasan, Inc.)-talked about climate change April 28, 2017 (Invitation by Mam Kath for GIS Class) May 23, 2017 (AGEXTN Class) May 29, 2017 and Aug 23, 2017 (ATI	SLSU Project Team SLSU Students (BS Agriculture, BS Environmental Science and BS Forestry) Farmers/Fisherfolks Municipal Agriculturist and Agricultural Technicians Barangay Officials and Indigenous People

			Invitation in Gen. Nakar)	
		Agdangan, Quezon (BRACE Activity)	May 18,2017	
		Padre Burgos, Quezon (BRACE Activity)	June 15,2017	
16. Completion Review of BAR Funded Climate Change Project (CRVA-AMIA2)	To standardize the CRVA Results To standardize the format for final report	Partido State University, Goa, Camarines Sur	May 31-June 2, 2017	CIAT Team SUC's Regional Team SLSU Project Team

The above mentioned trainings, workshops, and meetings capacitated the project team to accomplish the project. The team were equipped with new concepts, tools, methods and strategies in conducting CRVA. Knowledge about the tools and methods used in this study were acquired mostly from the trainings provided by CIAT, namely: GIS applied in vulnerability assessment, CBA applied in assessing the economic aspect of the climate resilient agricultural practices, and modelling using MAXENT applied in crop sensitivity analysis. The project provided an increased capacity of the regional project team from 40% to 90% in terms of climate risk vulnerability assessment. Before the project was launched, only one (1) personnel had the capacity to do the vulnerability assessment but the remaining members of the team knew the methods used for CRVA such as the use of geographic information system (GIS) and other data gathering methods. Through component 1 of the project, the regional project team was able to fully understand the concepts and technicalities of CRVA and the climate science. This project gave opportunities for the team in terms of access and operationalization of modelling tool in projecting the impacts of climate change using the MAXent Model and data gathering procedure for hazard exposure and adaptive capacity indicators. These were introduced by CIAT, the program leader for the CRVA of the whole Philippines.

The knowledge gained from different training workshops was not only utilized for this study but also spread for wider dissemination of knowledge and building of community practicing this knowledge and skills of vulnerability assessment. Application of tools and methods were discussed in classes, seminars, workshops and even in small group discussion within and outside the university. Particularly, the project team had able to rolled-out the learnings in different municipalities in the Province thru various extension modalities of the university and upon invitation of the DA-Agricultural Training Institute Training Center IVA.

2. To assess climate risks in the region's agri-fisheries sector (particularly Quezon Province) through geospatial & climate modelling tools.

Figure 7 shows the hazard exposure map index of municipalities in Quezon Province while Table 4 shows the list of municipalities and its corresponding hazard index. Results show that most of the municipalities in Quezon province will be less exposed to hazard or have low exposure index comes climate change. Out of the 42 municipalities, only 2 municipalities (Jomalig and Patnanungan) were assessed to be moderately exposed to climate related hazards comes year 2050, the rest were projected to have low hazard exposure index. Jomalig, an island municipality, have 0.44 hazard exposure index, followed by Patnanungan with 0.448 hazard exposure index. Among the hazards that frequently observed in these areas are typhoon followed by drought.

The factors which affect the area most, is flooding especially in low lying areas due to increasing rainfall intensity. In addition, the geographic location of these municipalities contributed to its exposure. Jomalig is facing the Pacific Ocean where typhoon usually started to form. PPDO (2015) reported that, this island is experiencing type II climate which characterized by no pronounced rainy season but rainfall is distributed throughout the year.

Most of the muncipalities have low to moderate exposure index to hazard, but considering that crops are highly sensitive to changes in temperature and in extreme rainfall, then a minor change in weather and climate could have major implications on production which may threathen the livelhood of farmers. This requires farmers in the rural areas to become more vigilant in monitoring of weather and climate to enable them to adjust their planting season or change their crops as part of their adaptation to the changing climatic condition.

Table 4. Hazard Index in Quezon Province.

Municipality/ City	Hazard (15%)	Vulnerability Category	Municipality/ City	Hazard (15%)	Vulnerability Category
Agdangan	0.318	Low	Padre Burgos	0.325	Low
Alabat	0.311	Low	Pagbilao	0.317	Low
Atimonan	0.278	Low	Panukulan	0.372	Low
Buenavista	0.302	Low	**Patnanungan**	**0.448**	**Moderate**
Burdeos	0.391	Low	Perez	0.311	Low
Calauag	0.317	Low	Pitogo	0.326	Low
Candelaria	0.278	Low	Plaridel	0.295	Low
Catanauan	0.306	Low	Polillo	0.339	Low
Dolores	0.264	Low	Quezon	0.304	Low
General Luna	0.329	Low	Real	0.281	Low
General Nakar	0.243	Low	Sampaloc	0.270	Low
Guinayangan	0.304	Low	San Andres	0.275	Low
Gumaca	0.309	Low	San Antonio	0.259	Low
Infanta	0.309	Low	San Francisco	0.269	Low
Jomalig	**0.457**	**Moderate**	San Narciso	0.298	Low
Lopez	0.310	Low	Sariaya	0.300	Low
Lucban	0.295	Low	Tagkawayan	0.335	Low
Lucena City	0.317	Low	Tayabas	0.300	Low
Macalelon	0.327	Low	Tiaong	0.274	Low
Mauban	0.281	Low	Unisan	0.324	Low
Mulanay	0.293	Low			

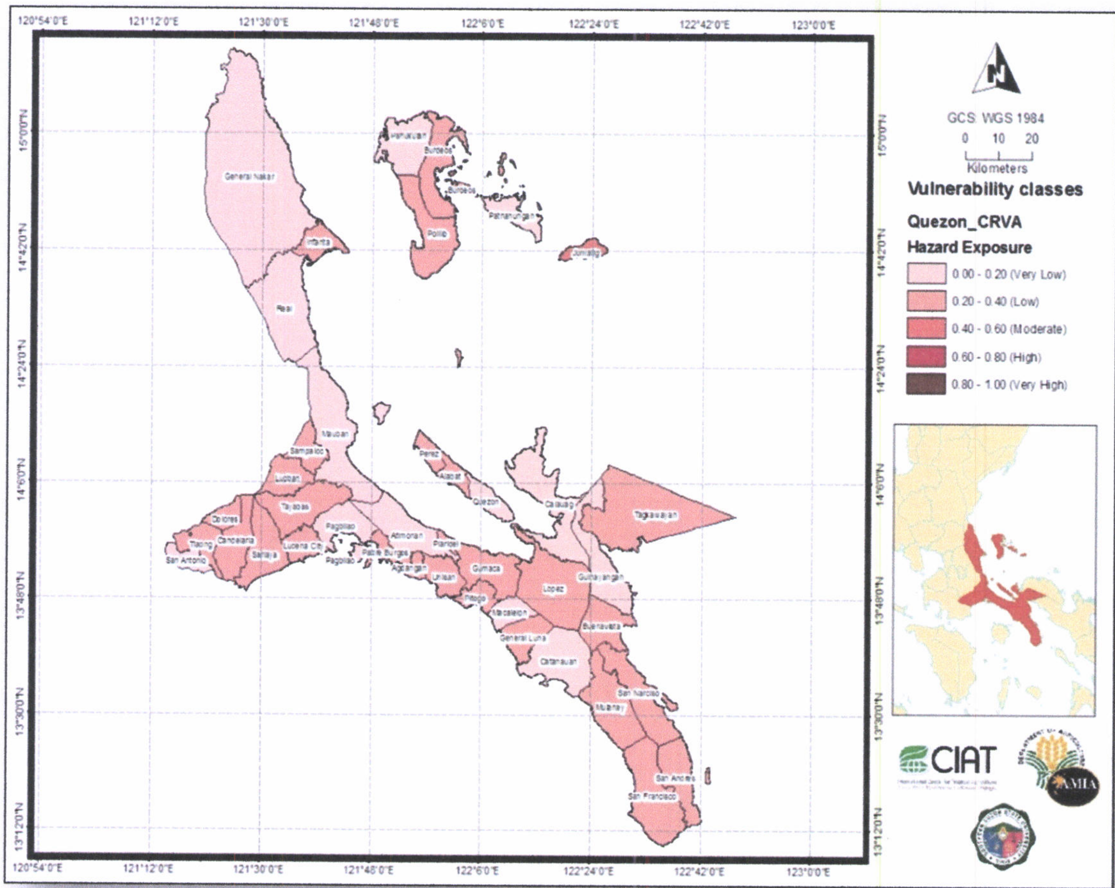

Figure 7*. Hazard Exposure Index of Municipalities in Quezon Province.*

Climate-Risk Vulnerability Assessment (CRVA) of the agricultural sector in Quezon aims to determine the exposure of the municipality to climate-related hazards, determine the sensitivity of agricultural crops and determine the capacity of the farmers to adapt with the changing climatic conditions.

Assessment results presented in Figure 8 and Table 5 shows that the town of San Francisco has the highest vulnerability index with a normalized value of 1.101 followed by Guinyangan with 1.00 vulnerability index. This municipality has low exposure to hazard index, but this municipality was found to have several crops that are sensitive to changes in climate and have low adaptive capacity index leading to its high vulnerability index.

High vulnerability implies that crops found or grown in the area have high sensitivity, therefore not suitable in the area if the projected climate changes will take place.

Results also shows that in the case of Quezon produce, factor that influences the vulnerability of the area is the low adaptive capacity of most municipality. San Francisco town was found to have very low adaptive capacity due to the poor economic condition, poor human and social capital. This indicates that if vulnerability will be reduced, the best strategy is to increase the social and human capital of the area.

This vulnerability assessment results can serve as basis for decision makers to come up with a plan and strategies that will enable them to resist the impacts and adapt to the changes.

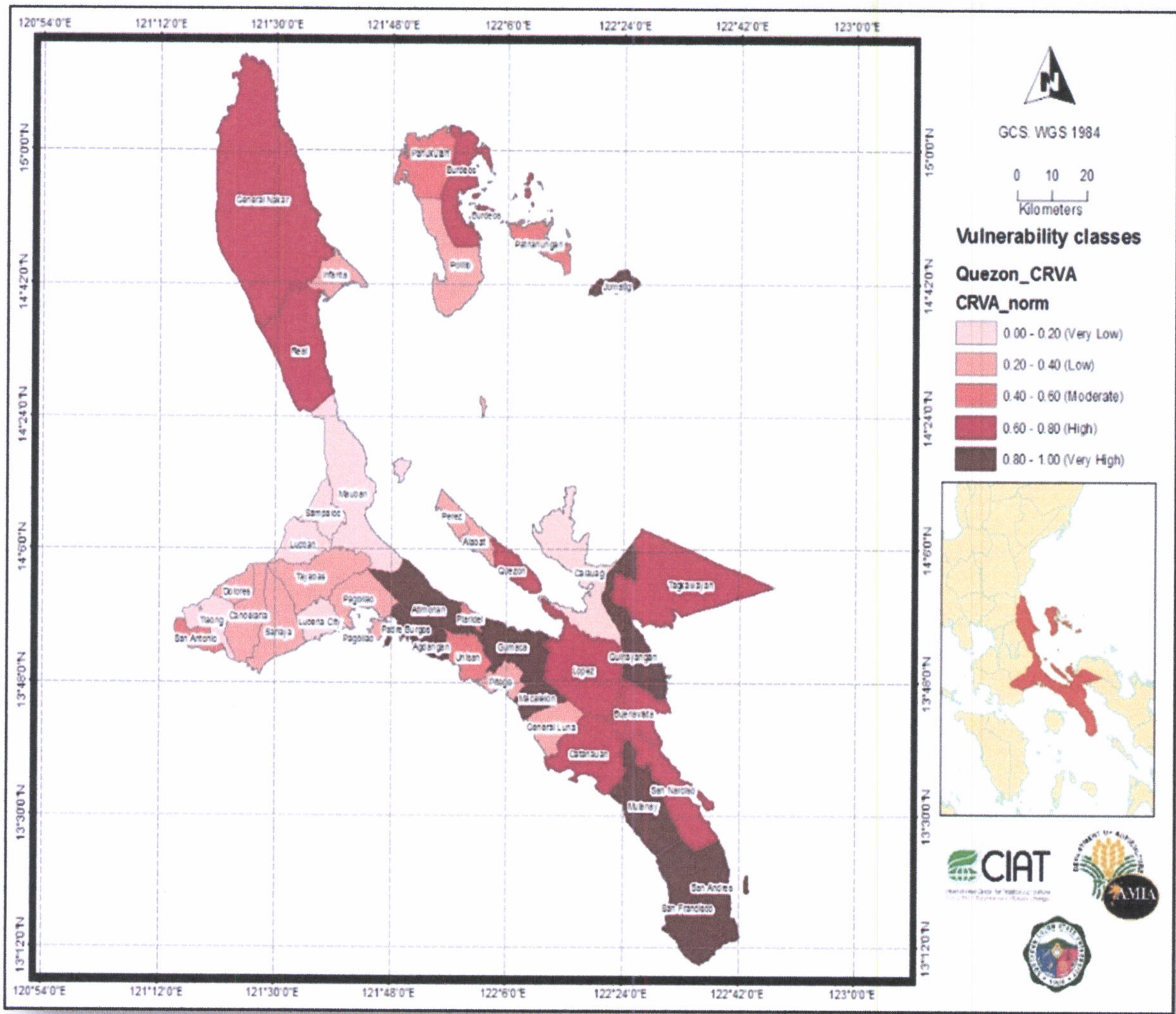

Figure 8. *Vulnerability map index of Quezon Province*

Table 5. Climate Risk Vulnerability Assessment Results in Quezon Province

Municipality/City	Vulnerability Index	Vulnerability Class
Agdangan	**0.810**	**Very High**
Alabat	0.358	Low
Atimonan	**0.805**	**Very High**
Buenavista	0.633	High
Burdeos	0.627	High
Calauag	0.187	Very Low
Candelaria	0.372	Low
Catanauan	0.756	High
Dolores	0.235	Low
General Luna	0.289	Low
General Nakar	0.727	High
Guinayangan	**1.000**	**Very High**
Gumaca	**0.901**	**Very High**
Infanta	0.292	Low
Jomalig	**0.898**	**Very High**
Lopez	0.600	High
Lucban	0.134	Very Low
Lucena City	0.000	Very Low
Macalelon	**0.821**	**Very High**
Mauban	0.102	Very Low
Mulanay	**0.819**	**Very High**
Padre Burgos	**0.951**	**Very High**
Pagbilao	0.254	Low
Panukulan	0.510	Moderate
Patnanungan	0.425	Moderate
Perez	0.313	Low
Pitogo	0.320	Low
Plaridel	0.570	Moderate
Polillo	0.395	Low
Quezon	0.790	High
Real	0.623	High
Sampaloc	0.165	Very Low
San Andres	**0.865**	**Very High**
San Antonio	0.515	Moderate
San Francisco	**1.101**	**Very High**
San Narciso	0.753	High
Sariaya	0.237	Low
Tagkawayan	0.798	High
Tayabas	0.257	Low
Tiaong	0.161	Very Low
Unisan	0.523	Moderate

2.1 CROP SUITABILITY ANALYSIS

The Province of Quezon has seven (7) priority commodities namely Rice, Maize, Eggplant, Squash, Cacao, Coffee, and Tilapia. Changes in climatic conditions (e.g. change in annual mean temperature, annual precipitation and variables) can lead to decrease in crop production if the crops planted are sensitive to any of the climatic parameter that will change with the changing climatic condition.

Suitability of each of the priority crops was analyzed using the crop model MaxEnt. The low and high suitability index per crop was shown on the figures below. The blue color indicates high suitability and red color indicates unsuitability of the crop in particular municipality. The projected changes in climatic condition from present to year 2050 are the increases of both temperature and precipitation. The increases will also affect other parameters resulting to possible decrease or increase in crop productivity.

Rice

Figure 9 shows the resulting suitability index for lowland rice for the current condition and projected climatic condition for 2050. Map shows that the municipalities in 2nd district of Quezon which includes Tiaong, Candelaria, Sariaya, and Lucena City are currently planted with these crops and found to be highly suitable in the area, particularly the lowland areas. By year 2050, the same areas were found to be no longer suitable for rice production. The climatic factors that could possibly affect the crop suitability is the availability of water.

Municipalities surrounding Banahaw are found to be suitable for crop production. It could be attributed to the Banahaw watershed that supply sufficient amount of water through its rivers and streams (Ecological Profile in

Quezon Province, 2015). However, due to the changing of climate by year 2050, on the same areas, the result is low suitability. The map proved (as shown in attachment C) that rice is sensitive to increasing temperature than precipitation; consequently, drought may happen, particularly to San Francisco and San Andres. The International Rice Research Institute reported that, when temperature rises, rice production will be to slow or decreases its yield. In addition, the higher day-time temperature increases yield on rice, on the other hand higher night-time temperature can affect the future yield loss because temperature is rising faster at night (Welch,2010). Furthermore, the Philippine Rice Research Institute (PhilRice), recommends low-cost drip irrigation system that can withstand the impact brought by climate- related stresses in particular to drought, wherein the project team also selected similar practice (small water impoundment) to adapt on climate change.

This figure also seen white portion, it shows that rice is not suitable in the area. However, based on the consultation with the farmers, there is upland rice planted in the area. Therefore, upland rice is suitable in the area but it is highly sensitive given the topography behaviour (e.g. prone in erosion when prolonged rains happen) but suited and can thrive in sloping areas. Small-scale farmers have existing strategies (Sloping Agricultural Land Technology) and need to improve or develop in order to adapt and maintain the productivity.

Overall, rice appears to be resilient to climate change, due to the existing practices of the farmers or if adaptation strategies are appropriate on the landscape. The project team suggested the basic farming practices (e.g., adjust in planting calendar, changing in crop variety depending upon in projected climatic conditions and agricultural management practice) in order to grow crops and increase the yield and productivity.

Maize

Figure 9 shows that maize suitability is high at present condition pertaining to 3rd & 4th district. However, due to changing of climate or weather patterns, maize suitability by year 2050 will change and classified as low suitability on the same district. Maize is more sensitive to changes in precipitation (annual precipitation) than changes in temperature (annual mean temperature) as shown in attachment D. According to Goldenberg 2014, productivity of maize is sensitive to changing in rainfall pattern, higher incidence and intensity of flood that affect the pollination process and reduced its productivity.

The white portion explains that it is not suitable in the area. However, based on the discussion with the farmers, there is maize planted. It implies that on this white portion, it is suitable thus; it is highly sensitive to climate-related stresses (e.g., flood and typhoon). In addition, the hilly or sloping areas is highly sensitive to prolong rains and surface runoff and possibly rising temperature is a limiting factor but possibly increase crop yield, while in lowland areas, will increase the risk of water stress (Thornton et al. 2009). Furthermore, precipitation variability is expected to intensify the magnitude and frequency of flood and drought events that are both detrimental to productivity of a crop especially in rainfed agriculture (Pachauri and Reisinger 2007). The large variations in suitability index on maize will adversely affect the maize yield and this indicates that decreasing on maize production will happen on the projected year.

Squash & Eggplant

Squash and Eggplant had a similar findings with the results, the most affected area is in 2nd district (San Antonio, Tiaong, Candelaria, Sariaya, Lucena City, Pagbilao) and 4th district (Atimonan, Plaridel, Gumaca, Lopez, Guinayangan, Perez, Alabat, Quezon, Calauag, and Tagkawayan) given the largest change areas in terms of suitability. Figure 10 shows that in present condition these areas are experiencing high suitability, but in year 2050 low suitability will happen. This indicates that, the parameter of low mean temperature with high annual precipitation of squash and eggplant resulted to highly suitable. Alarmingly, in year 2050, low suitability might happen due to low annual precipitation with high mean temperature (See attachment E & F). Thus, these crops are more sensitive in annual mean temperature than in annual precipitation. According to Kembel J.K. and Sanders D.C. 2000, the study revealed that squash & eggplant requires adequate amount water because of shallow root system. However, excessive water requirement can leach the nutrients from the soils and encourage the development of diseases and nutrient deficiencies. In addition, squash is most sensitive to drought stresses that affect the flowering, fruits and seed development (www.fao.org). Therefore, irrigation can increase the survival rate and high quality of production (Kembel J.K. and Sanders D.C., 2000). Food and Agriculture Organization suggested the basic management practices in order to adapt in changing of climatic condition are maintained soil moisture and controlling weeds. In response to climate change, Provincial Government of Quezon has establishing strategies within the community (e.g., integrated pest management and intercropping) and needs the better improvement for the appropriate strategies depending upon on the impact of climate or changing in weather patterns.

Cacao

The results shown in figure 11 that the biggest change that affect cacao production from high suitability at present to low suitability in year 2050 are found in 2nd district (San Antonio, Tiaong, Candelaria, Sariaya, Lucena City, Pagbilao) and 4th district of Quezon (Atimonan, Plaridel, Gumaca, Lopez, Guinayangan, Perez, Alabat, Quezon, Calauag, and Tagkawayan). This explains that changing of climatic variables has an implication to the productivity of cacao.

Attachment G, this indicators revealed nearly a similar findings of annual mean temperature and annual precipitation. But, in year 2050, it proved that increasing of annual mean temperature than annual precipitation can decrease the yield or production. Therefore, cacao is more sensitive in increasing temperature than precipitation. In addition, the results of mean temperature on driest quarter are projected to become a limiting factor as compared to precipitation of driest quarter. Thus, it is also sensitive to drought. This implies that cacao's productivity compensating losses and gains in the future productivity and can affect the economic viability on small-scale farms. According to Parry, M. L. 1990, reduced rainfall and increased temperatures, which lead to prolonged periods of drought, are causing a reduction in soil moisture during the dry seasons and decreased soil fertility. Furthermore, M. Wessel., 2015, the study suggested, to reduce the vulnerability of cacao to extreme temperature that may lead to drought should have systematic adaptation strategies such as shaded trees will be necessary in the farm and an integrated farming with cacao. Therefore, the current cacao growing practice need changes to mitigate or adapt the impact of climatic variables on the said districts. This can improve the economic and environmentally sound or sustainable production of cacao within the community. The study of Nwachukwu, I. N. et.al., (2012), concluded that adopting new measures to cope with the negative effect of climate change. Overall, results presented above indicate that cacao is more resilient than coffee. Projected impact without climate change adaptation could lose its productivity.

Coffee

Figure 11 revealed the major changes are located in 2nd district (San Antonio, Tiaong, Candelaria, Sariaya, Lucena City, Pagbilao) and 4th district of Quezon (Atimonan, Plaridel, Gumaca, Lopez, Guinayangan, Perez, Alabat, Quezon, Calauag, and Tagkawayan). From moderately suitable to low suitable, respectively. The results of the parameter that involved these changes which are annual mean temperature and annual precipitation. Almost similar findings at present condition of the parameters, while in year 2050 decreasing temperature and precipitation will be experienced as compared to present condition (See attachment H). This implies that, coffee is more sensitive when both parameters are decreasing in the future (2050) that affect the productivity and seed development. However, based on the study of Adhikari, Umesh et.al (2015), the report was concluded that an increase in precipitation could increase coffee yield. The projected impact on coffee may threaten its productivity, although negatively quantitative results are limited and possibly will shift to higher altitudes.

Tilapia

Tilapia is found to be highly suitable in Lucena, Pagbilao, Atimonan, Padre Burgos, Agdangan, and Unisan, however by year 2050, it becomes moderately suitable on the said locations. Also, in year 2050, changes in suitability may occur from low to moderate index (Figure 12). These municipalities are Lopez, Guinyangan, Buenavista, Macalelon, General Luna, and Pitogo. The results of climatic variable (annual mean temperature and annual precipitation) from present to year 2050 (See attachment I) this explains that, it is highly suitable when moderate temperature and precipitation happen. According to Food and Agriculture Organization, tilapia is sensitive with fluctuations of temperature and precipitation. The preferred temperature of tilapia ranges from 31 to 36°C and the recommended water temperature for spawning process reaches 24°C. Tilapia farmer should monitor and maintain the temperature for survival and growth.

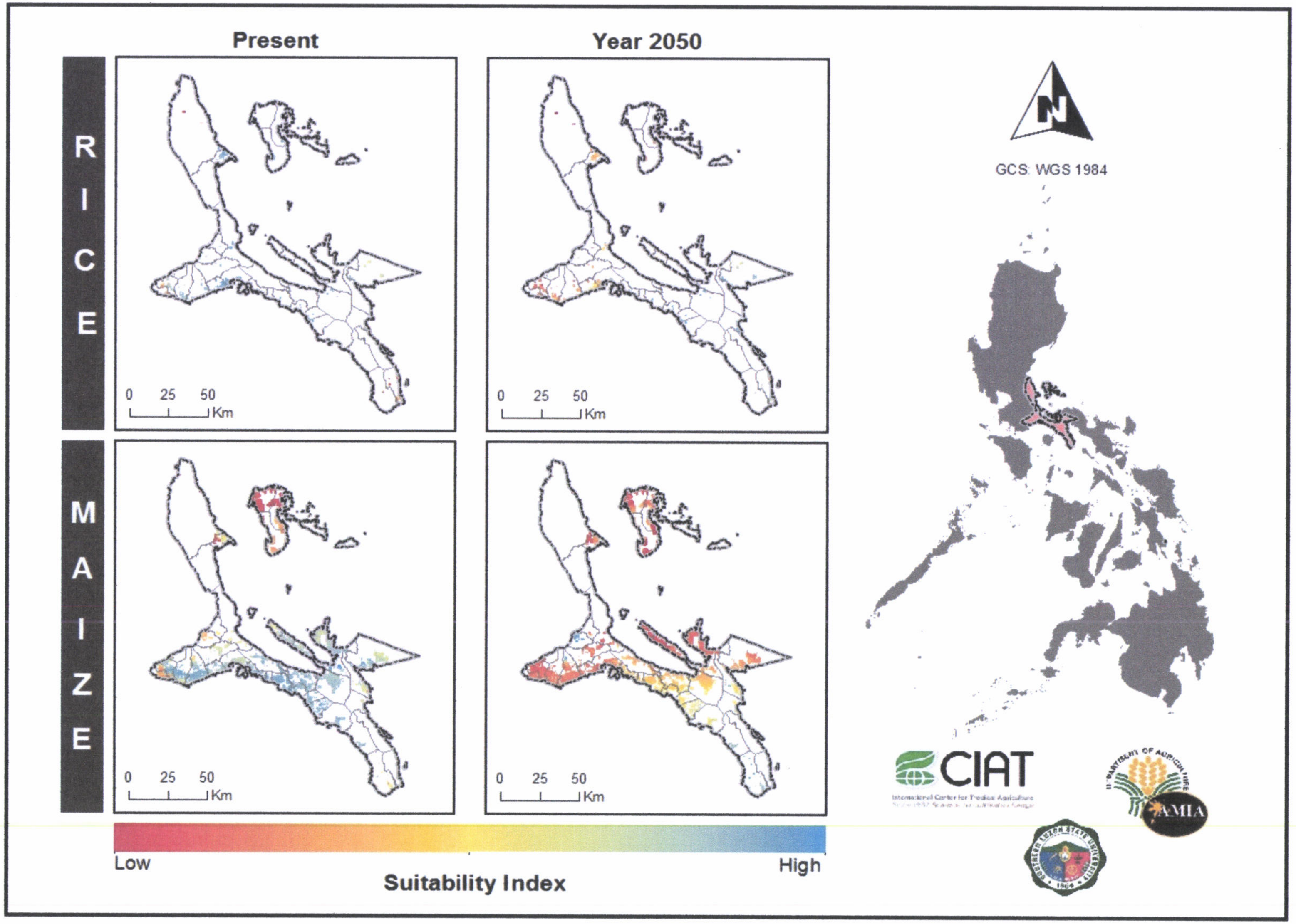

Figure 9. Suitability map index of rice and maize (Present Condition & Year 2050).

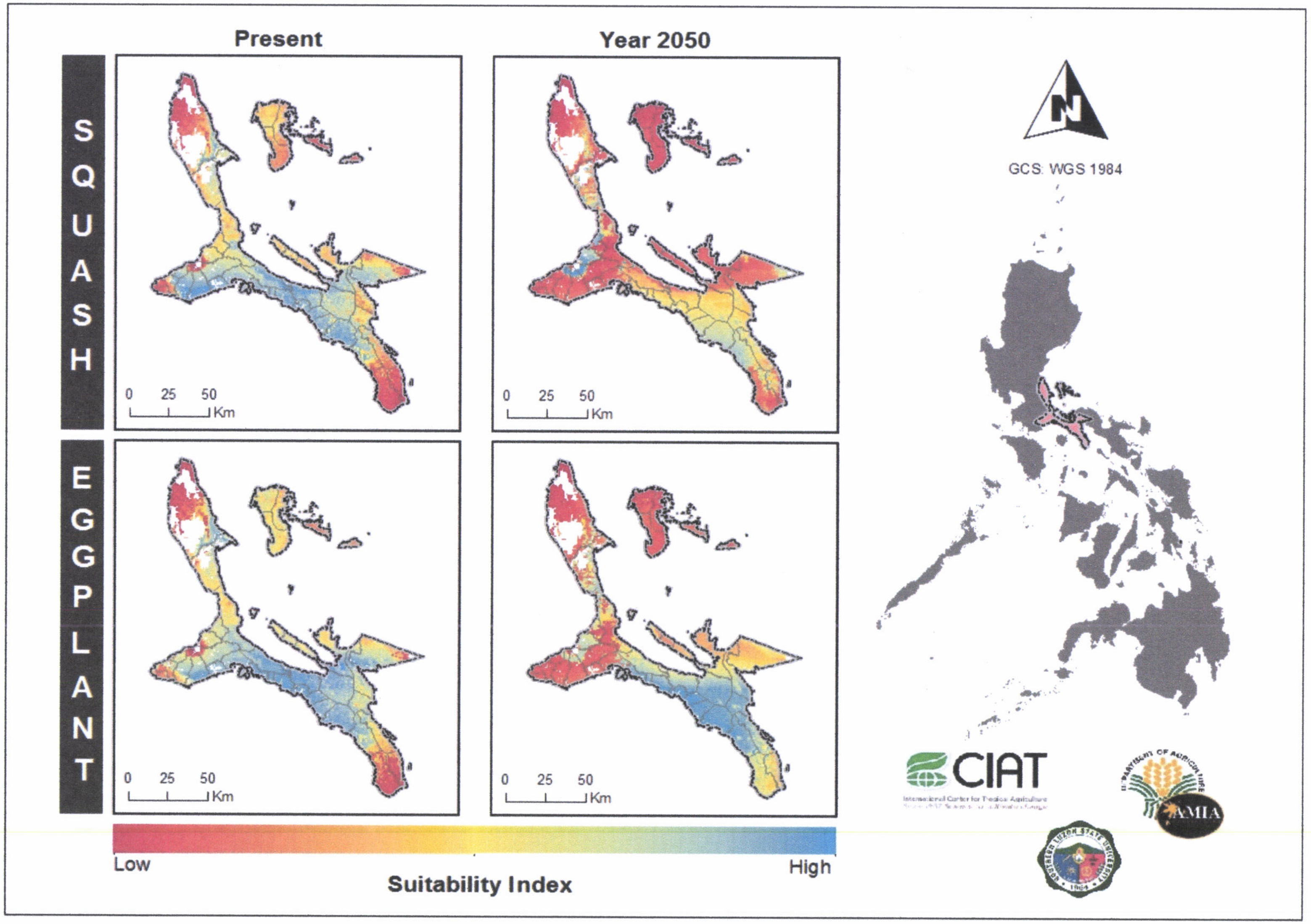

Figure 10. Suitability map index of Eggplant and Squash (Present Condition and Year 2050).

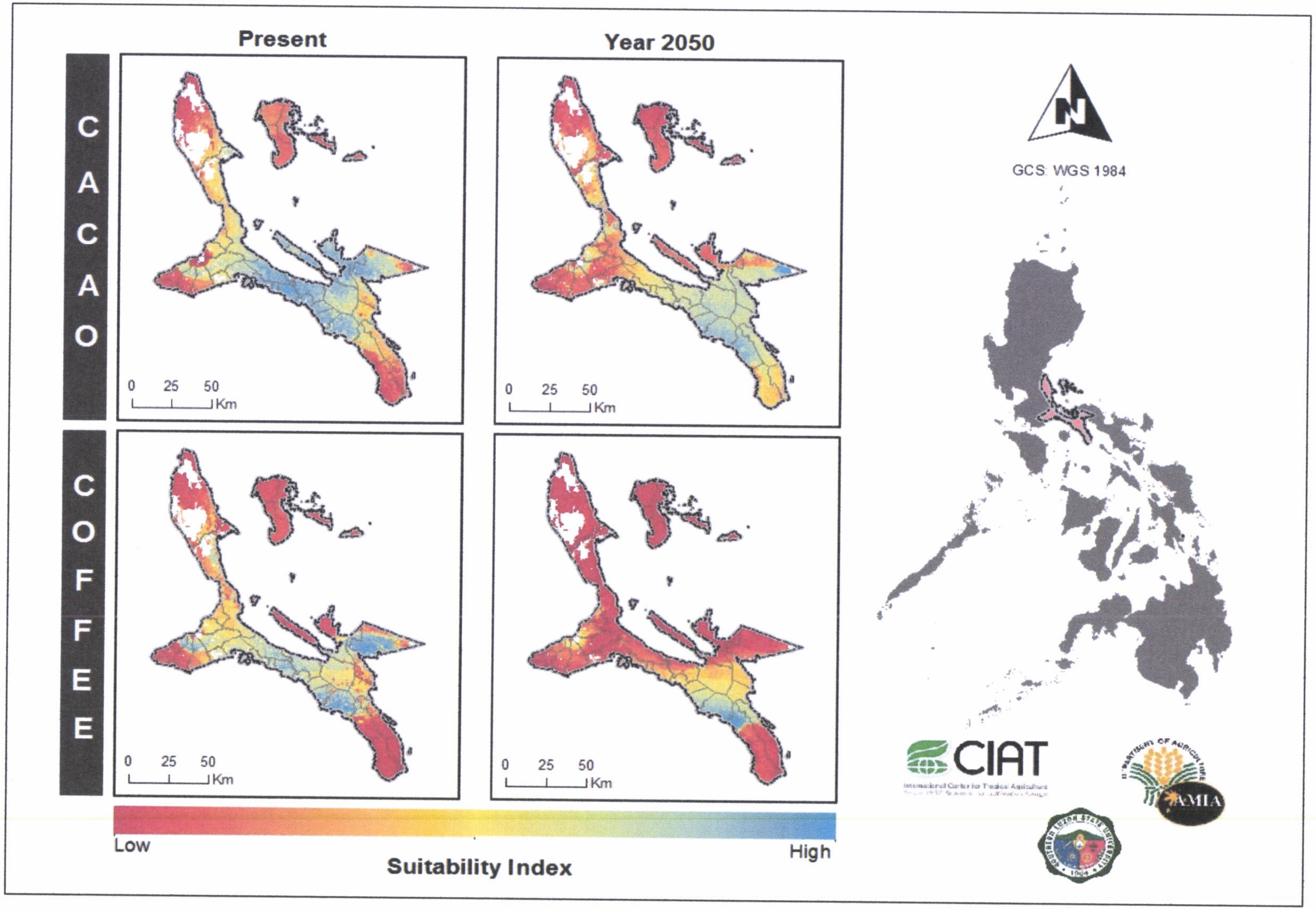

Figure 11. Suitability map index of Cacao and Coffee (Present Condition and Year 2050).

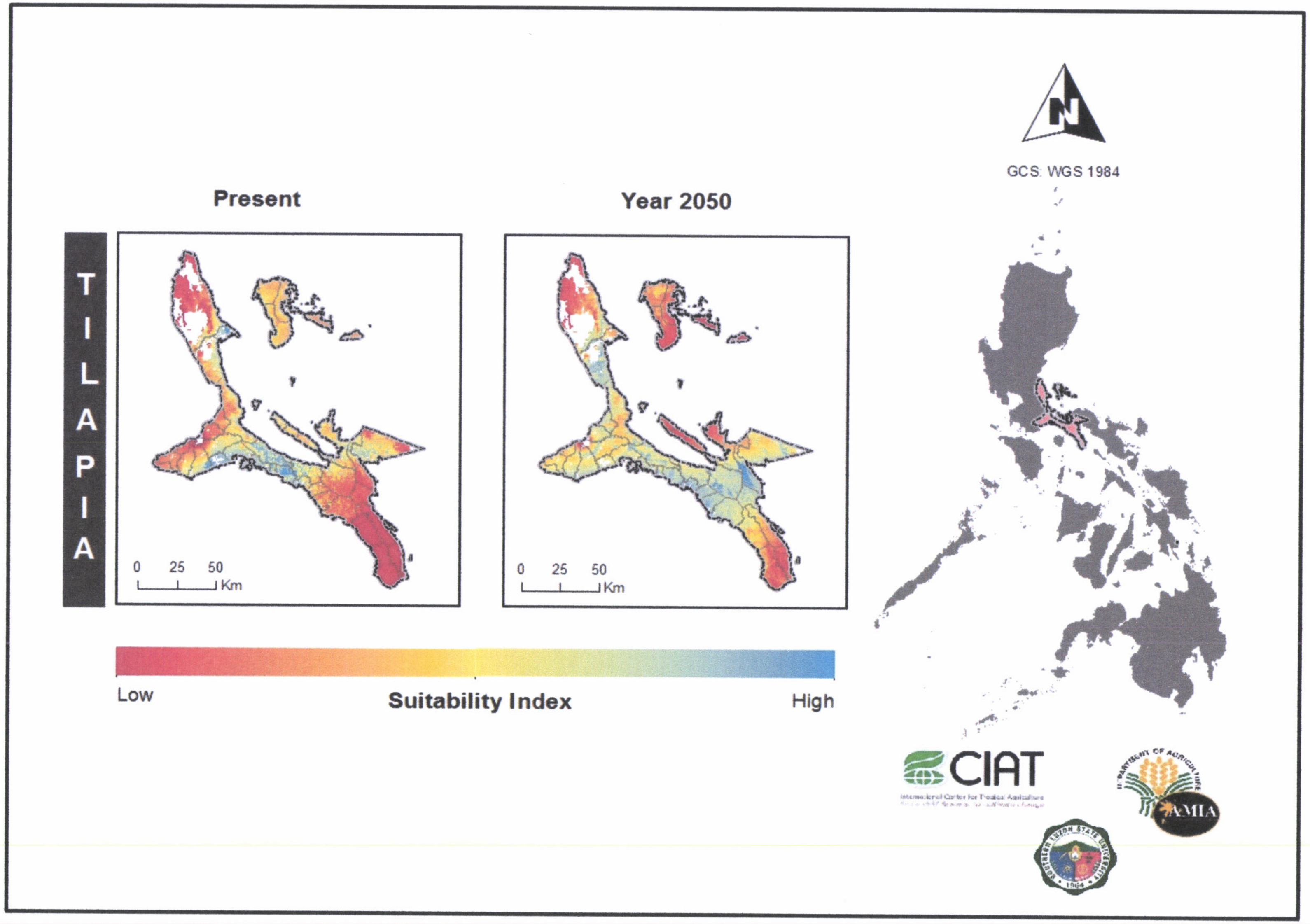

Figure 12. Suitability map index of Tilapia (Present Condition and Year 2050).

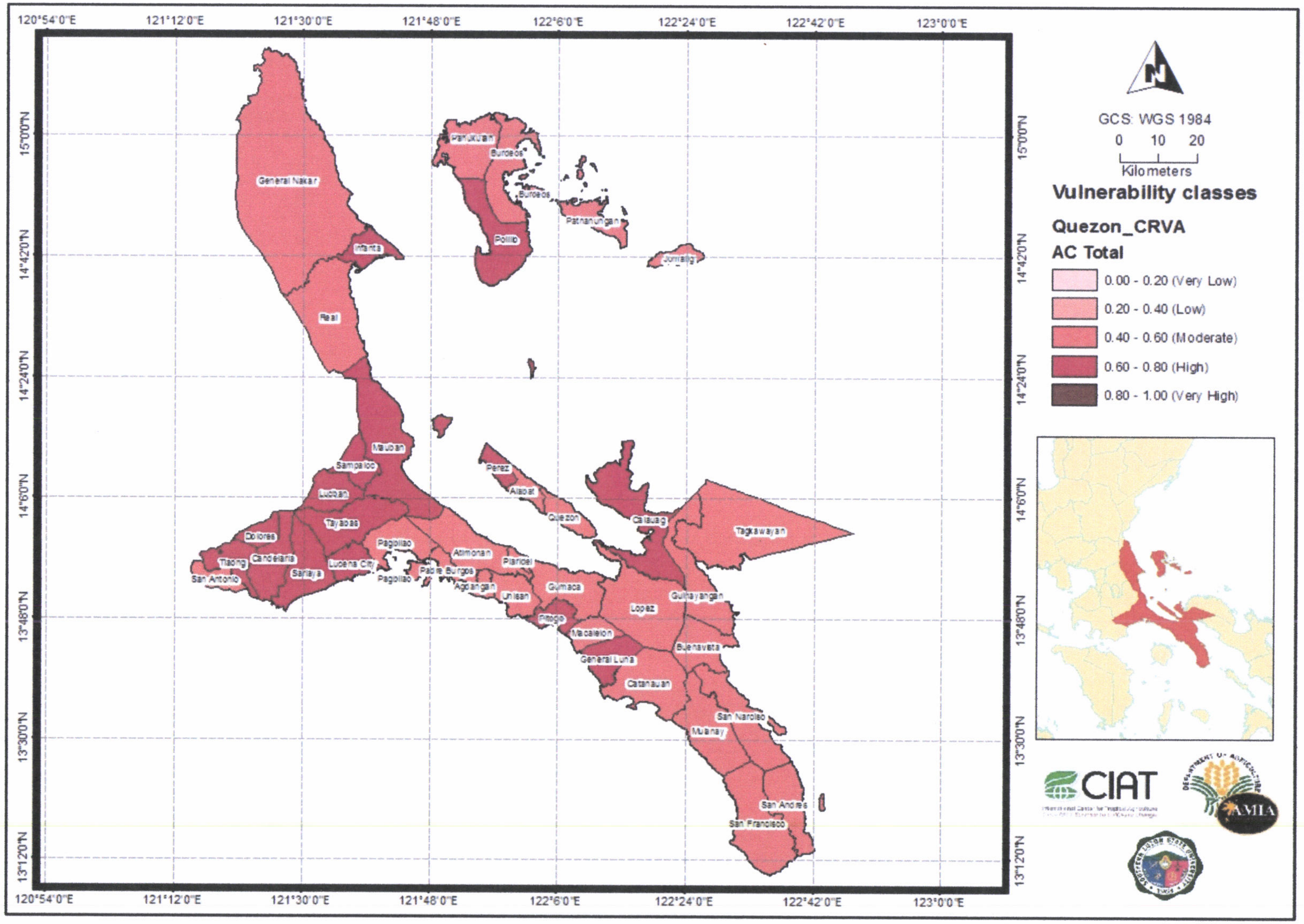

Figure 13. *Results of Adaptive Capacity Index in Quezon Province*

Table 6. Adaptive capacity and vulnerability of the municipalities in Quezon.

Municipality/City	Adaptive Capacity (70%)	Vulnerability Category
Agdangan	0.470	Moderate
Alabat	0.600	Moderate
Atimonan	0.421	Moderate
Buenavista	0.588	Moderate
Burdeos	0.553	Moderate
Calauag	0.653	High
Candelaria	0.605	High
Catanauan	0.506	Moderate
Dolores	0.658	High
General Luna	0.667	High
General Nakar	0.498	Moderate
Guinayangan	0.411	Moderate
Gumaca	0.439	Moderate
Infanta	0.618	High
Jomalig	0.491	Moderate
Lopez	0.569	Moderate
Lucban	0.750	Very High
Lucena City	0.706	Very High
Macalelon	0.468	Moderate
Mauban	0.695	High
Mulanay	0.544	Moderate
Padre Burgos	0.418	Moderate
Pagbilao	0.600	Moderate
Panukulan	0.547	Moderate
Patnanungan	0.600	Moderate
Perez	0.622	High
Pitogo	0.638	High
Plaridel	0.533	Moderate
Polillo	0.622	High
Quezon	0.450	Moderate
Real	0.526	Moderate
Sampaloc	0.699	High
San Andres	0.509	Moderate
San Antonio	0.582	Moderate
San Francisco	0.432	Moderate
San Narciso	0.544	Moderate
Sariaya	0.651	High
Tagkawayan	0.483	Moderate
Tayabas	0.636	High
Tiaong	0.694	High
Unisan	0.545	Moderate

Among the 41 municipalities in Quezon, Lucban was found to have the highest adaptive capacity index values, followed by Lucena City. This could be attributed to the availability of needed data for adaptive capacity analysis. Having complete information is an advantage over other municipalities to be more equipped on Climate Change (CC) impact. Lucban has high natural capital (goods and services) that can support and satisfy the need of their constituents. The area also shows low poverty incidence rate. Other parameters that are found to be contributively to high adaptation capacity of Lucban are the institutional capital and good governance of the leadership in terms of having functional DRRM and CCA committees.

3. To determine local stakeholders, perceptions, knowledge and strategies to adapt with climate risks.

The regional project team determined the local stakeholders, perceptions, knowledge and strategies for adapting to climate risks through this following activities (see table 7). Through these activities, the team had able to determine twenty six (26) common CRA practices for crops, thirteen (13) common CRA practices for fisheries and four(4) common CRA practices for livestock as analysed and summarize by the regional project team(see attachment R).

Table 7. Activities conducted by the project team.

Date	Place	Activity	How it was
July 27,2016 August 11,2016 August 25-26,2016 October 11-12,2016	Provincial Capitol of Quezon	Collection of Secondary data	*Key Informant Interview to Provincial Planning and Development Office (PPDO) and Office of Provincial Agriculture (OPA) concerned officers * Informal Survey to different MAOs of Quezon, Province during the Niyogyugan Festival
August	Pagbilao,	Data	* Key Informant

31,2016 September 2,2016 September 5-6,2016 September 8-9,2016 September 12-17,2016 December 7-9,2016 December 12,2016 January 5-6,2017 January 19-20,2017 January 24-26,2017 January 27,2017 January 30,2017 February 24,2017 March13-15,2017 March 10,2017	Quezon Agdangan, Quezon Padre Burgos, Guinayangan,Unisan Infanta and Real, Quezon Polillo Group of Islands Sariaya, Quezon, Alabat, Lucena City Lopez, Quezon Dolores,Tiaong, San Antonio, Candelaria, Lucena City Real, General Nakar, San Francisco, San Andres Macalelon, Mulanay, Catanauan, Gen. Luna, San Andres, San Francisco, San Narciso Sariaya, Quezon San Antonio, Quezon PCAARRD, Los Banos, Laguna Pagbilao and San Francisco Lucena City and	Collection and Site Identification	Interview to Municipal Agriculturists ,Agricultural Technician, Municipal Planning Officer and Municipal Disaster Risk Reduction Management Officer * Informal Survey to Farmers and Farm Leaders * Collected Geo spatial data through GPS * Mapping out of Crop Occurrences and Hazards * Conducted KII for Cost Benefit Analysis * Site Validation * Data Collection for Cost Benefit Analysis

	Atimonan, Quezon		
October 14,2016 May 12,2017	Office of the Provincial Agriculture	Presentation of the project to Municipal Agriculturists Presentation of the Pre-final result of the Project	*Presented the Project Overview and had some insights coming from MA's *Presented pre-final result of the project *Conducted CRA practices validation
October 26-27, 2016 November 21-22, 2016 April 18-19 and April 25-26,2017	Southern Luzon State University	Workshop on CRA-AMIA2 Project Results Sharing and Validation Workshop on CRA-AMIA2 Project	*Conducted FGD for Data collection *Mapping Out of Hazards and Crop Occurrences. *Sharing of Experiences and Results of the Project * Validation workshop of the results

Results shows that municipalities in Quezon province experiences changes in climatic condition and aware that climate is changing and will continue to change. They are not aware however, that PAGASA already have projection for the next 100 years and that seasonal climatic forecast is now being prepared through AMIA phase2. Some municipalities like Mulanay and San Francisco have on-going projects initiated by UPLB scientist to enable them to adapt to the changing climatic condition. Lucban, Lucena, Tiaong, Sariaya are also found to be knowledgeable about impacts of climate change on crops. This could be attributed to the extension activities initiated by the university and colleges near these municipalities to disseminate information about climate change which include the SLSU-Team Energy Foundation Inc. funded project entitled "Building Resilient Communities (BRACE) Quezon Program".

Table 8. List of CRA Practices in Quezon Province, as identified by farmers, technicians and stakeholders during the workshops held.

	Pre-Workshop		Validation and Final Workshop
1.	Planting of Early maturing Variety	1.	Planting of early maturing crops
2.	Diversified Farming	2.	Cover cropping
3.	SWIP	3.	Diversified Farming
4.	Mulching	4.	Agroforestry
5.	Alternate Cropping method	5.	SWIP
6.	Use of flood resistant variety	6.	Mulching
7.	Use of drought tolerant variety	7.	Alternate Cropping Method
8.	Reforestation	8.	Tillage
9.	Organic farming	9.	Used of wind breakers
10.	Text Blast	10.	Adequate Drainage
11.	STW	11.	Contour Farming
12.	Integrated Pest Management	12.	Use of Flood Resistant Variety
13.	Alternate wet and dry	13.	Prunning
14.	System Rice Intensification	14.	Used of Drought-tolerant Variety
15.	Establishment of Small Farm Reservoir	15.	Planting of Vetiver
16.	Drip Irrigation	16.	Reforestation
17.	Intercropping	17.	Organic Fertilization
18.	SALT	18.	Planting of leafy vegetables during high tide
19.	Coco-based Integrated Farming	19.	Planting of fruit bearing trees during low tide
20.	Low external input rice production	20.	Companion Gardening
21.	Confined management for goats	21.	STW
22.	Microducing	22.	Integrated Pest Management
23.	Multi-storey cropping	23.	Introduction of Parasitoids
24.	Rain water Harvesting	24.	Use of Trichograma
25.	Bio-fertilizer and green leaf manuring	25.	Community Seed Banking
26.	Community seed banking	26.	Alternate wet and dry
27.	Climate Information System	27.	System Rice Intensification
28.	Forage and Pasture Management	28.	SALT
29.	Seed dispersion	29.	Establishment of Small Farm Reservoir
30.	Creation of Farmers Learning group	30.	Used of DRIP Irrigation
31.	Techno-demo	31.	Urban Gardening
32.	Crop rotation	32.	Intercropping
		33.	Vermicomposting
		34.	Planting on sloping areas

Table 8 shows the different CRA practices by farmers before and after the project were implemented in the province. It can be noted that the perception of farmers about climate change had improved as indicated in the list of CRA practices gathered in the field. The intensified implementation of the project paved way to dissemination of the proper knowledge on climate change and vulnerability assessment. The project team and the university commits that the results of this project will be cascaded to the community and to different municipalities for them to integrate the produced maps in their respective long term development planning.

4. To document and analyse local CRA practices to support AMIA2 knowledge-sharing and investment planning.

Climate Resilient Agriculture as quoted in Christian Aid, Time for Climate Justice 2015 can be defined as 'agriculture that reduces poverty and hunger in the face of climate change, improving the resources it depends on for future generations (CORDAID, 2016).

Climate Resilient Agricultural (CRA) practices in Quezon province were identified during the FGD conducted in the clustered municipalities. Identified climate resilient practices that already exist in their community are listed in attachment J. These practices were identified through the 3 pillars of Climate Resilient Agri-fisheries which are: (A) Sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development; (B). Adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and (C). Reducing greenhouse gas emissions from agriculture (Climate Smart Agriculture 101). Among all the practices identified by the municipalities the project team selected two (2) most common and most effective practices. This was selected by looking into the different characteristics or indicators such as the currency of occurrence of hazards in the area and its physiographic characteristics. These two practices are Rain Water Harvesting and Coconut-based Integrated Farming Systems. Another factor that affects the selection of CRA is the current and frequent occurrences of the coconut areas and vegetable farms that are usually observed in the province. In this case, the said practices were studied for investment planning.

As the result of validation and analysis on the ground the two practices which was Rain Water Harvesting and Coconut Based Integrated Farming Systems were prioritized and processed for Cost Benefit Analysis were 15 farmers are interviewed 7 for Rain water harvesting and 8 for Coconut-based Integrated Farming Systems. Validation happened through secondary data collection on different agricultural and research agencies in the region. After the collection and validation it was processed on the CBA Tool spearheaded by International Center for Tropical Agriculture and happened to be privately profitable with an NPV of USD 6,866.7 for Rain water harvesting (see attachment K) from an initial Investment of USD400.00 for a 1hectare vegetable farm and an NPV of USD 4,408.04 for Coconut Based Farming Systems (See Attachment L) from an initial investment of USD200.00. In this kind of result farmers will be benefited if they used the said practices for future, not just economically but also socially. It may also be used to eradicate poverty since mostly of the population of the province is dependent for agriculture.

H. Summary and Conclusion

The project "Regional Climate-Resilient Agri-fisheries Assessment, Targeting and Prioritization for the Adaptation and Mitigation Initiative Phase 2" was conducted in partnership with Department of Agriculture – Bureau of Agricultural Research and International Center for Tropical Agriculture (CIAT) under the AMIA program of the Department of Agriculture.

CIAT capacitated each partner SUC through a series of training-workshops. These trainings include trainings on CRVA and GIS Mapping, CRA practices and CBA.

Hazard exposure mapping was conducted using the baseline maps provided by CIAT. These were validated with each municipality before maps were finalized. Validation confirmed that Quezon province experiences a number of climate related hazards which include typhoon, flooding, drought, storm surge and landslides.

Based on the result of CRVA Mapping, the most vulnerable areas were found to be San Francisco, followed by Guinayangan and Padre Burgos.

Each municipality was also found to have adaptation strategies to cope with the impacts of changing climate. Respondents however, claimed that their practices are not enough, especially when they are not aware of the projected weather and climate. It implies that, there is a need to reshape those existing adaptation strategies to enable them to cope with the impacts.

The decision makers need to be informed of what to come, what to expect and what are the alternatives. The community has knowledge, but it may not be enough, they need to be equipped and challenge to become more pro-active in coping with the impacts of changing climate.

The team came up to introduced two CRA practices namely Rain water harvesting for vegetable production and Coconut-Based Integrated Farming Systems since Quezon Province is the top producer of coconut. These practices are expected to be introduced and enhance in the selected vulnerable areas as mentioned above. These two practices are processed and analyse on the CBA tool to determine whether the practice is profitable or not profitable. As the result of the CBA tool the above mentioned practices are privately profitable and socially profitable.

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Attachments

Attachment A

Weights (%) à																		
Criteria	**Typhoon**		**Flooding**		**Drought**		**Erosion**		**Landslide**		**Storm Surge**		**Sea Level Rise**		**Salt Water Intrusion**		**TOTAL**	**WEIGHT**
	Rate	Weight	Rate	Weight	Rate	Weight	Rate	Weight	Rate	Weight	Rate	Weight	Rate	Weight	Rate	Weight		
Probability of Occurrence																		
Impact to Local Household Income																		
Impact to Key Natural Resources to Sustain Productivity (i.e., water quality & quantity, biodiversity, soil fertility)																		
Impact to Food Security of Luzon																		
Impact to Food Security of the Country																		
Impact to Nat'l Economy																		
TOTAL																		

Attachment B

33 GCM Models

18. bcc_csm1_1
19. bcc_csm1_1_m
20. bnu_esm
21. cccma_canesm2
22. cesm1_bgc
23. cesm1_cam5
24. cnrm_cm5
25. csiro_access1_0
26. csiro_access1_3
27. csiro_mk3_6_0
28. ec_earth
29. fio_esm
30. gfdl_cm3
31. gfdl_esm2g
32. gfdl_esm2m
33. giss_e2_h
34. giss_e2_r

34. inm_cm4
35. ipsl_cm5a_lr
36. ipsl_cm5a_mr
37. ipsl_cm5b_lr
38. lasg_fgoals_g2
39. miroc_esm
40. miroc_esm_chem
41. miroc_miroc5
42. mohc_hadgem2_cc
43. mohc_hadgem2_es
44. mpi_esm_lr
45. mpi_esm_mr
46. mri_cgcm3
47. ncar_ccsm4
48. ncc_noresm1_m
49. nimr_hadgem2_ao

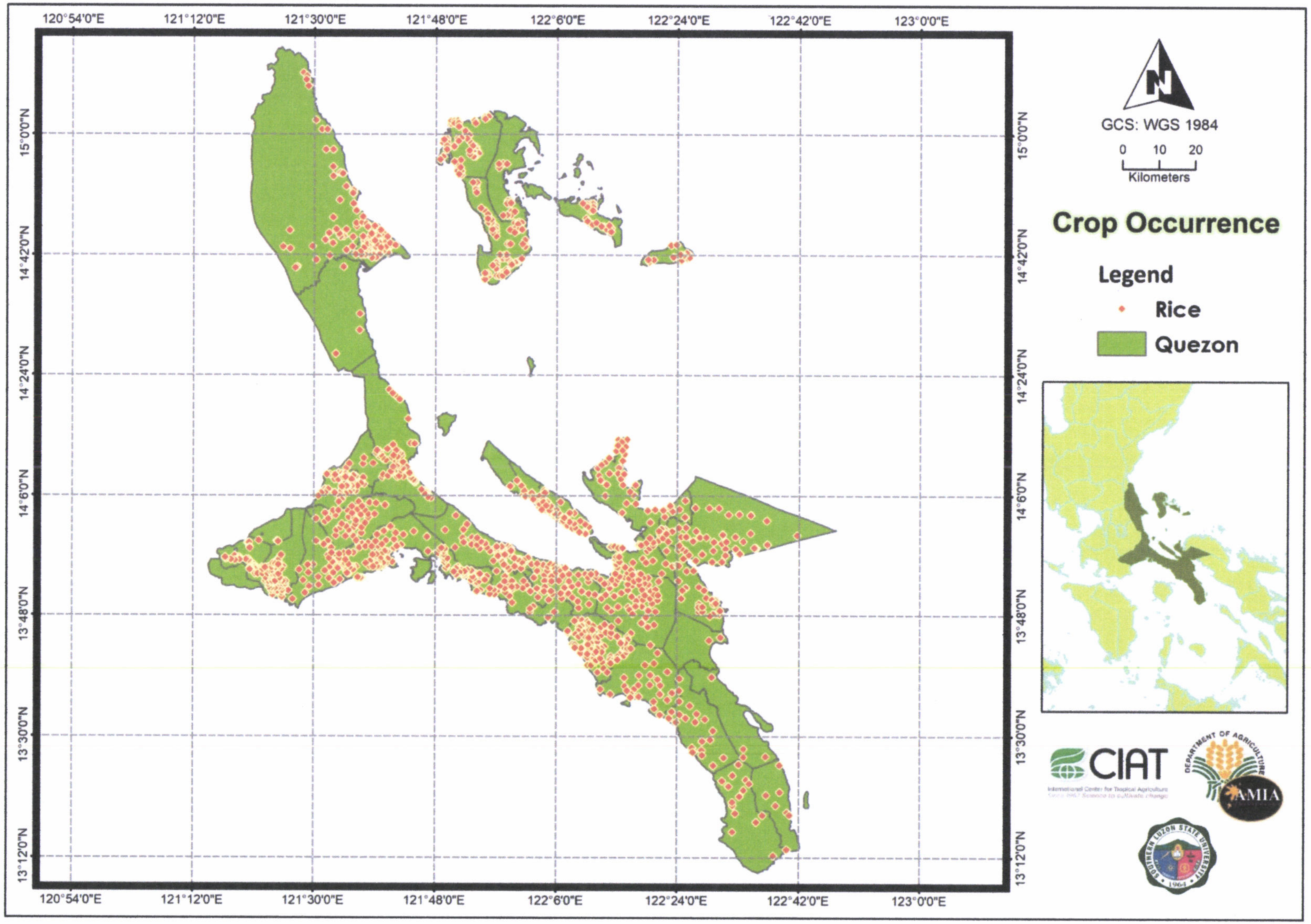
Attachment C

20 Bioclimatic Variables

- Bio1 = **Annual mean temperature**
- Bio2 = **Mean diurnal range**
- Bio3 = **Isothermality**
- Bio4 = **Temperature seasonality**
- Bio5 = **Maximum temperature of warmest month**
- Bio6 = **Minimum temperature of coldest month**
- Bio7 = **Temperature annual range**
- Bio8 = **Mean temperature of wettest quarter**
- Bio9 = **Mean temperature of driest quarter**
- Bio10 = **Mean temperature of warmest quarter**
- Bio11 = **Mean temperature of coldest quarter**

- Bio12 = **Annual precipitation**
- Bio13 = **Precipitation of wettest month**
- Bio14 = **Precipitation of driest month**
- Bio15 = **Precipitation seasonality**
- Bio16 = **Precipitation of wettest quarter**
- Bio17 = **Precipitation of driest quarter**
- Bio18 = **Precipitation of warmest quarter**
- Bio19 = **Precipitation of coldest quarter**
- Bio 20 = **No. of consecutive dry days**

Attachment D



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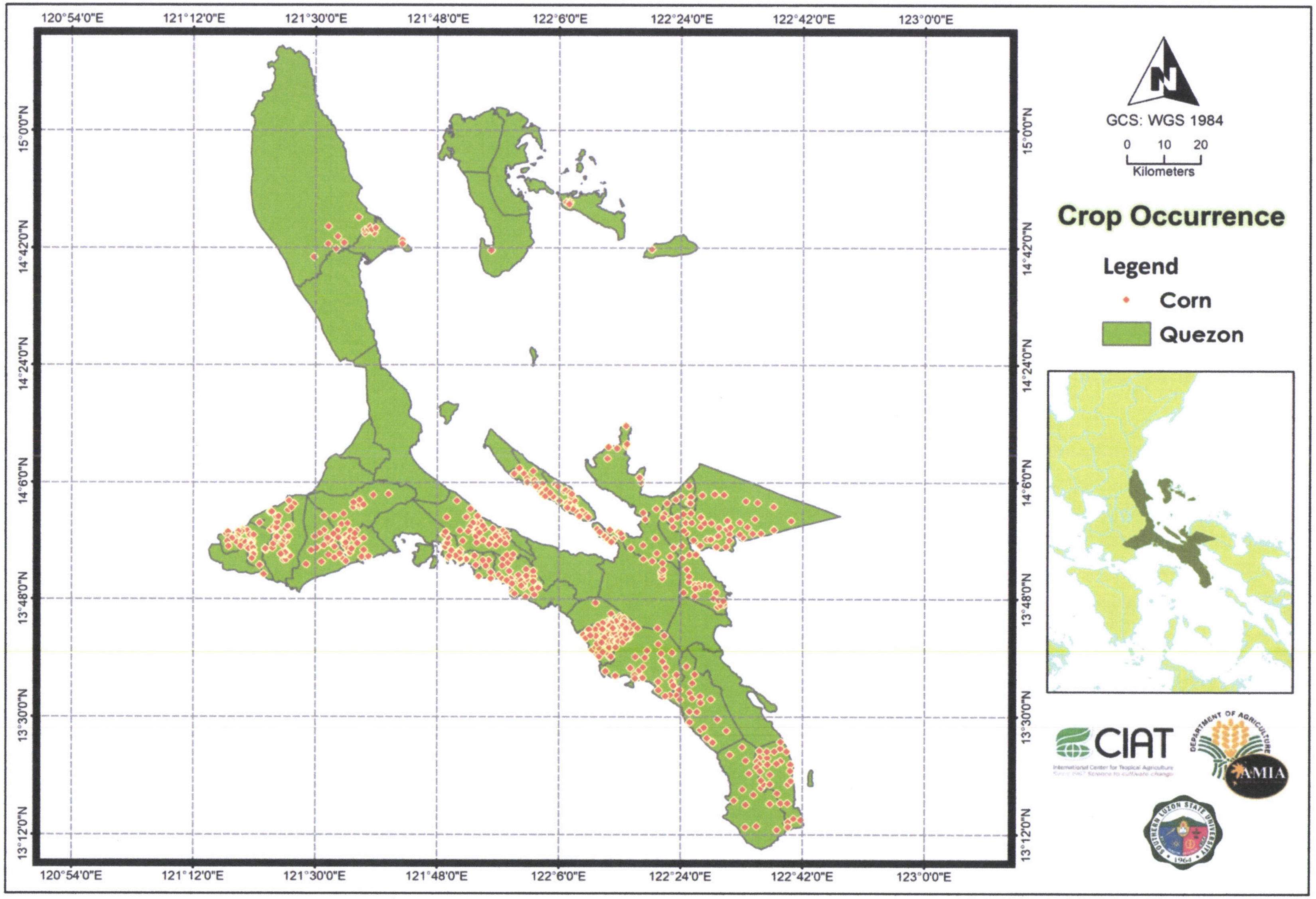

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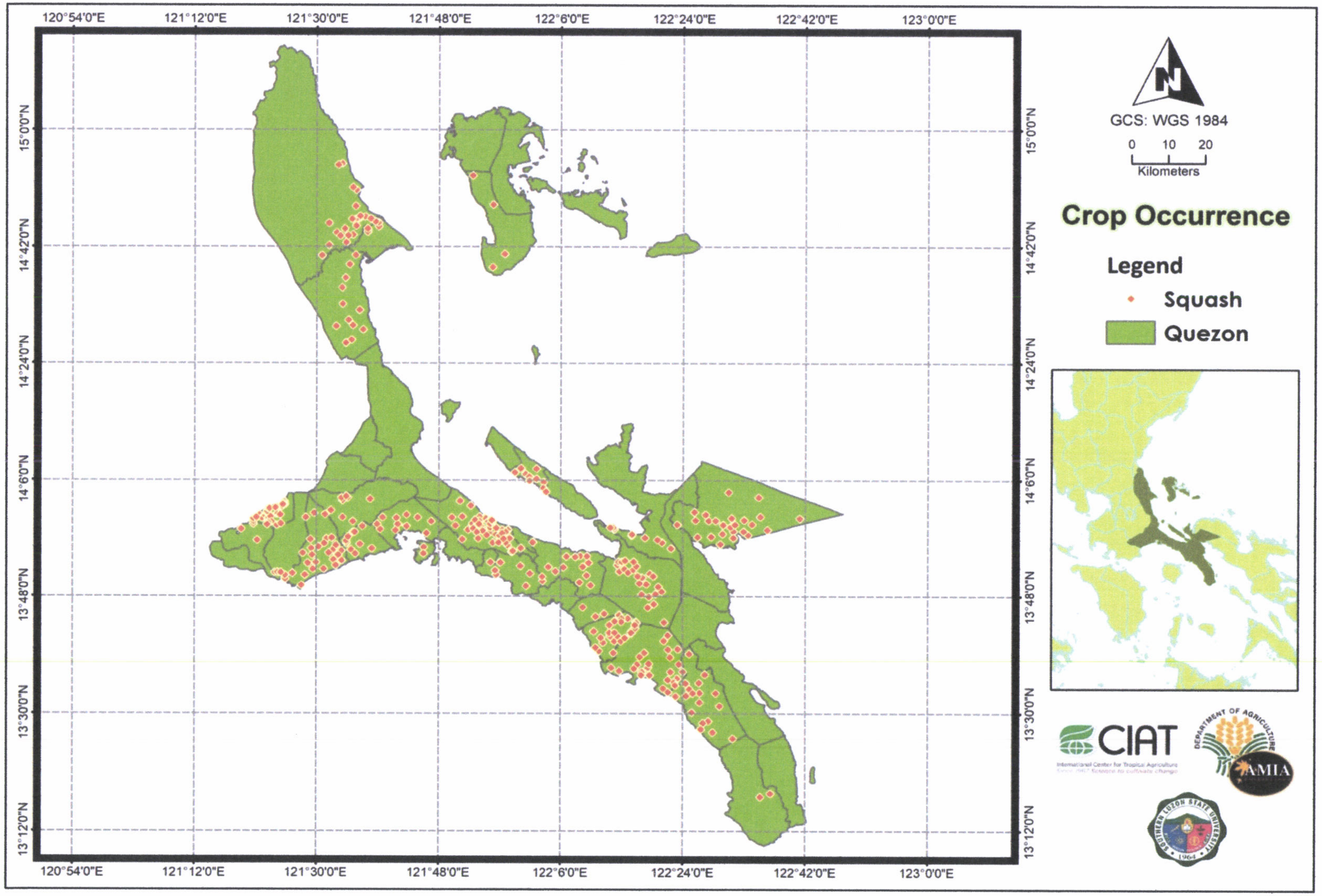

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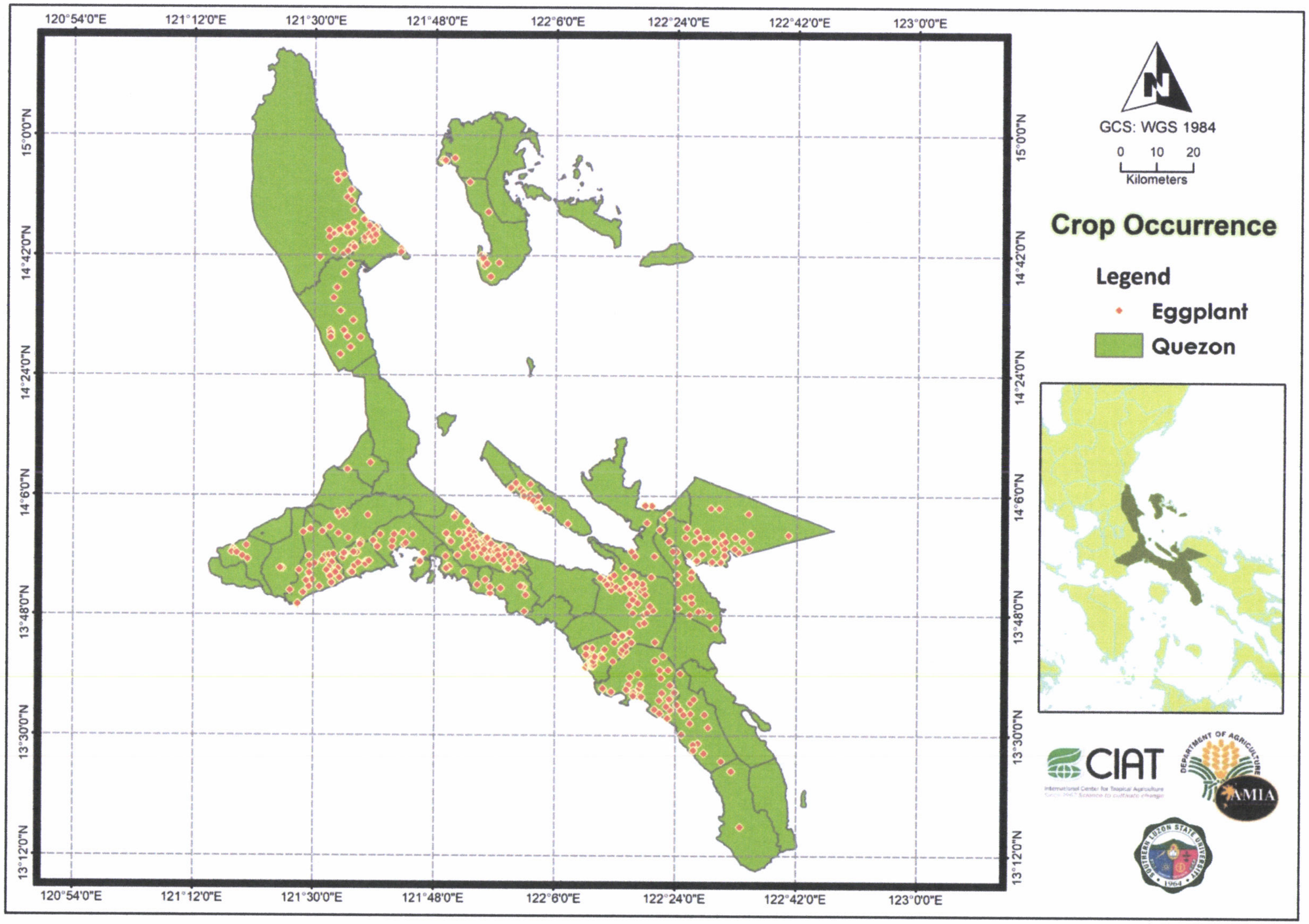

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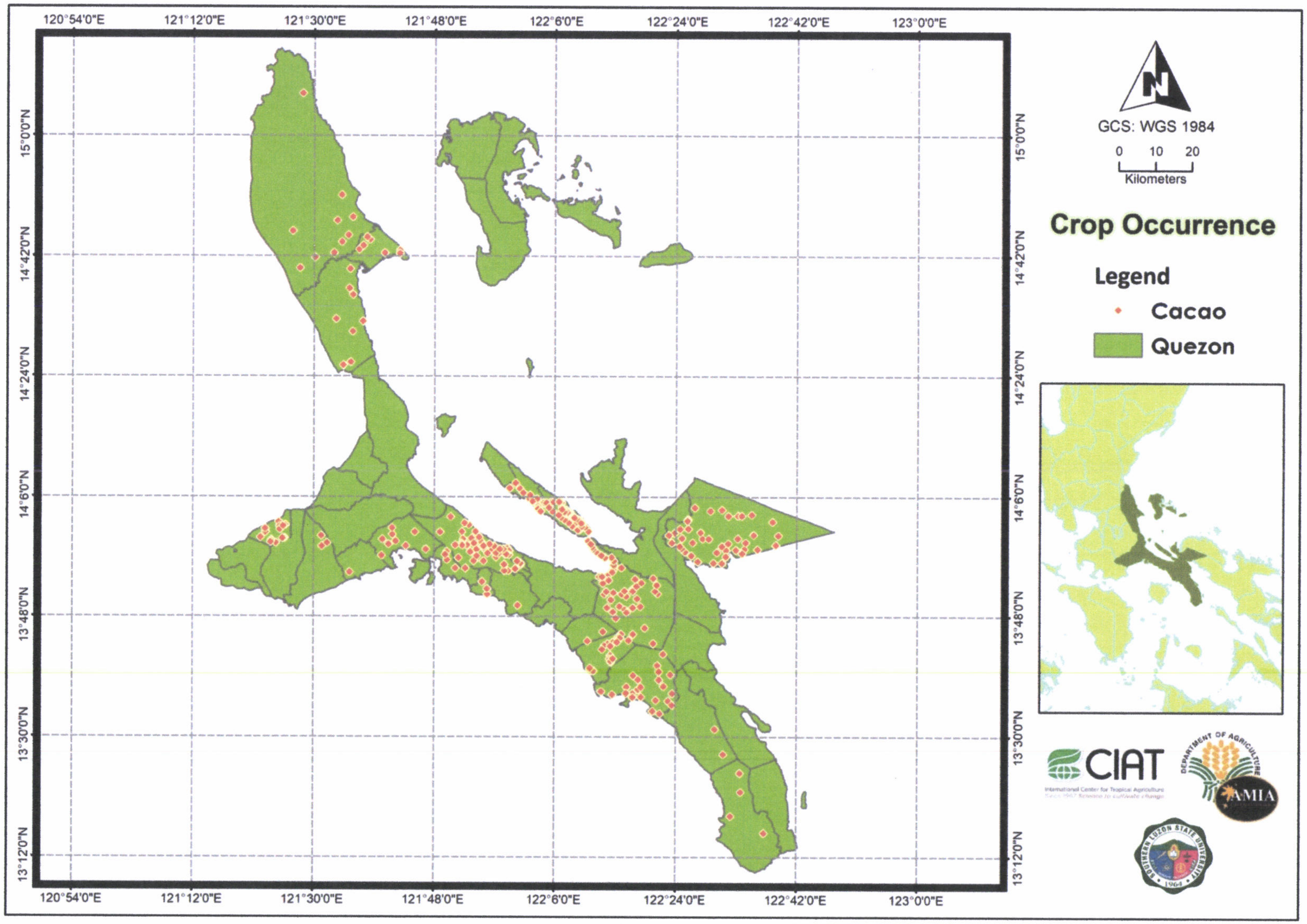

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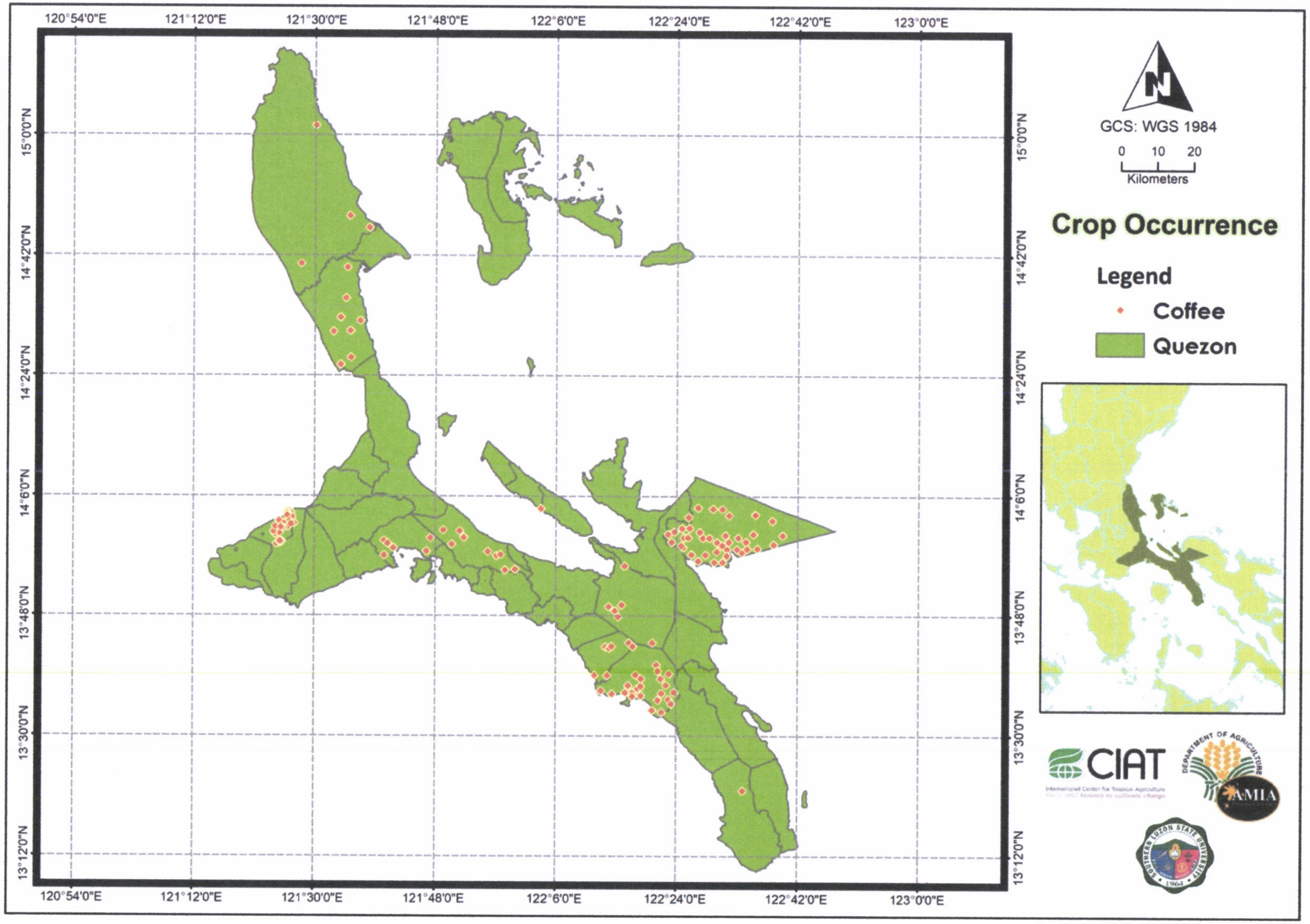

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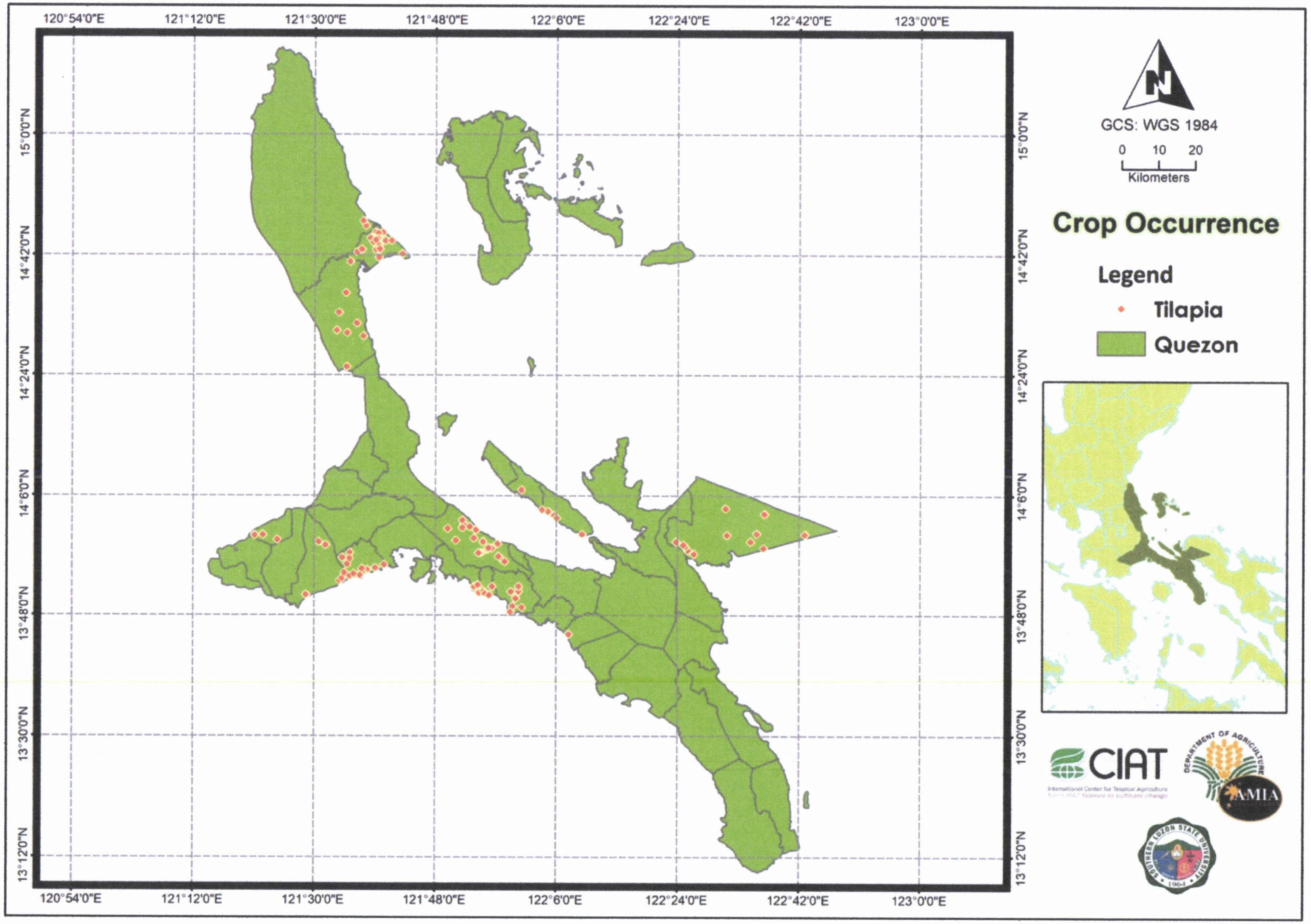

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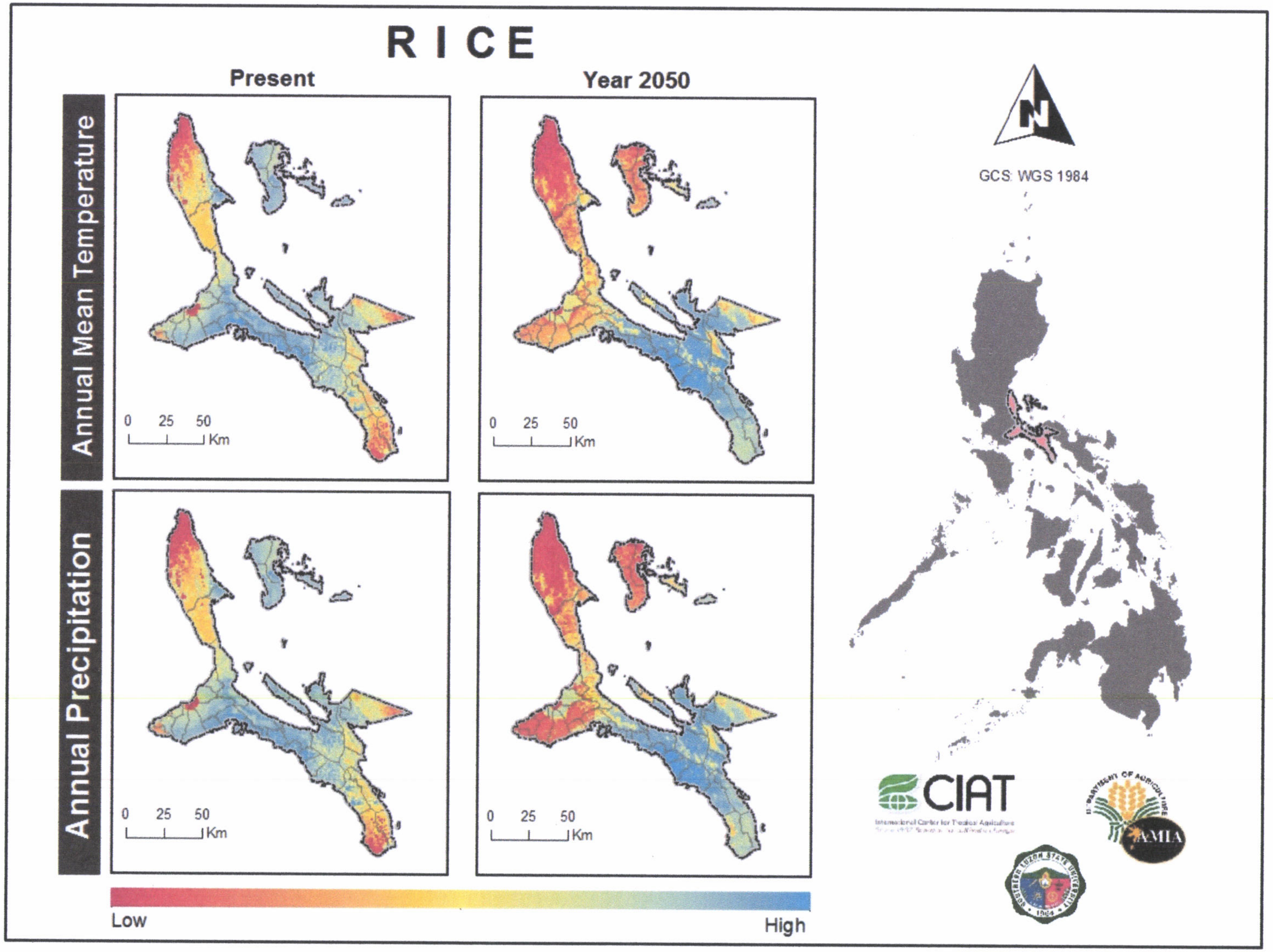

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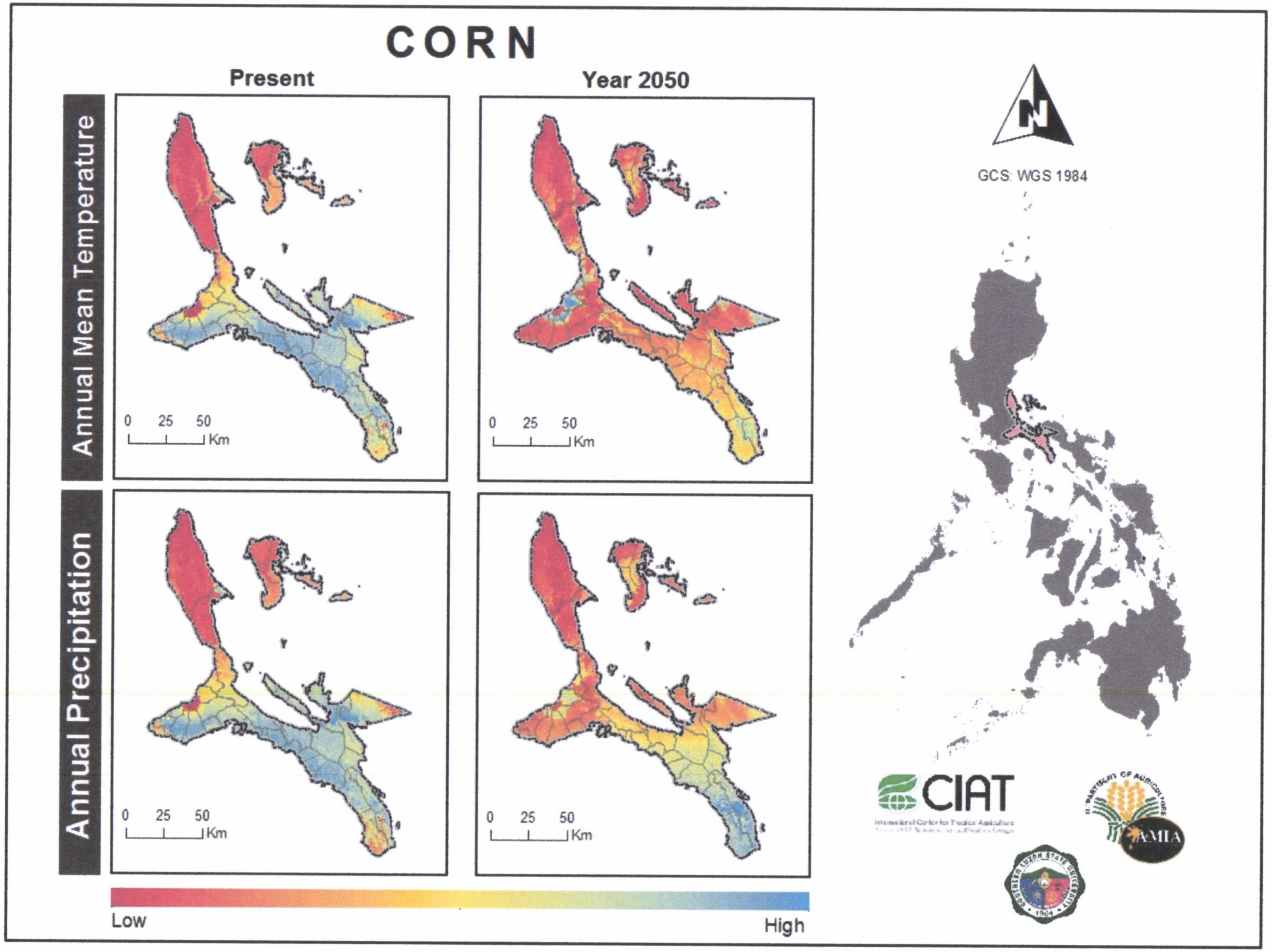

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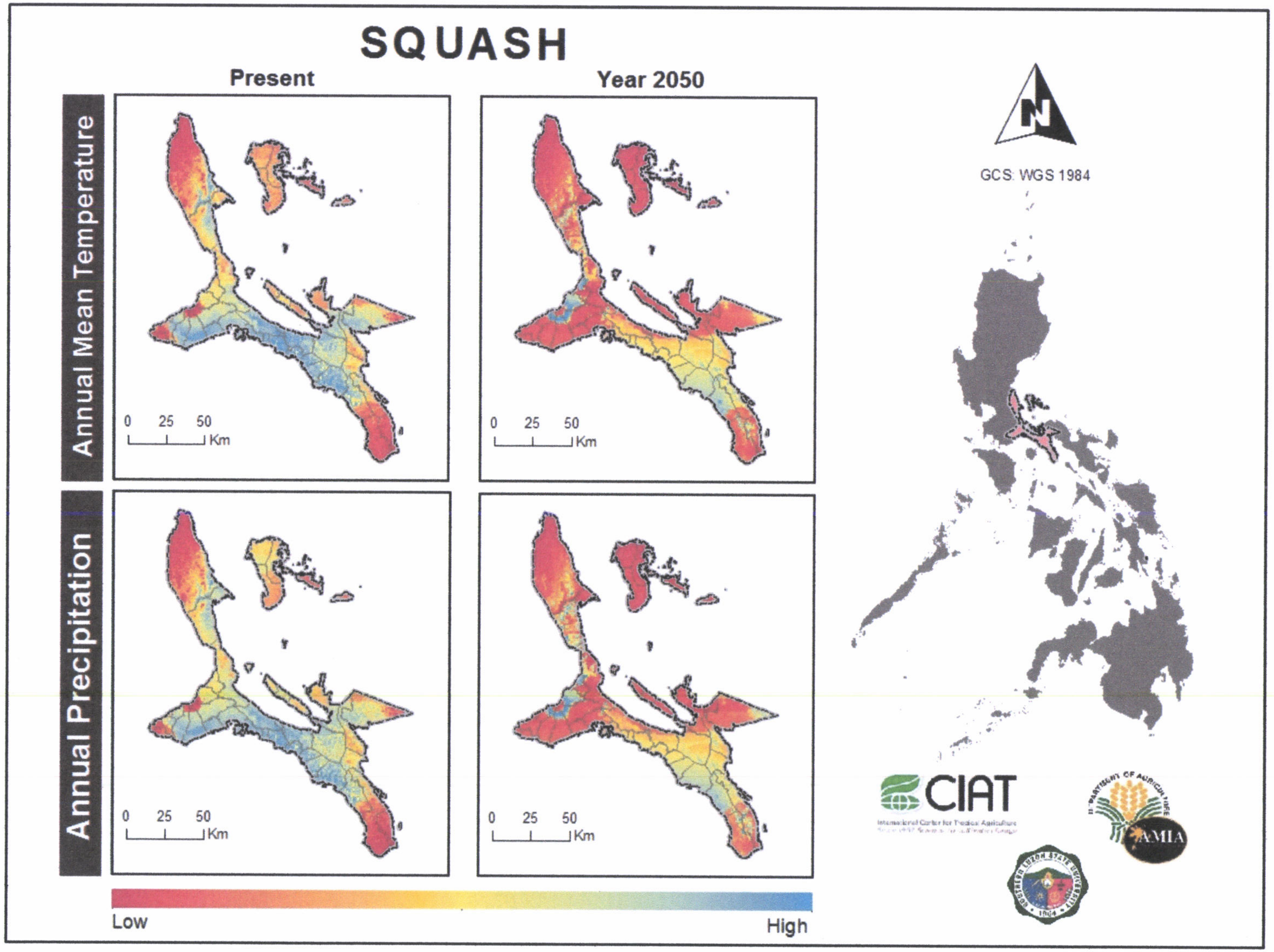

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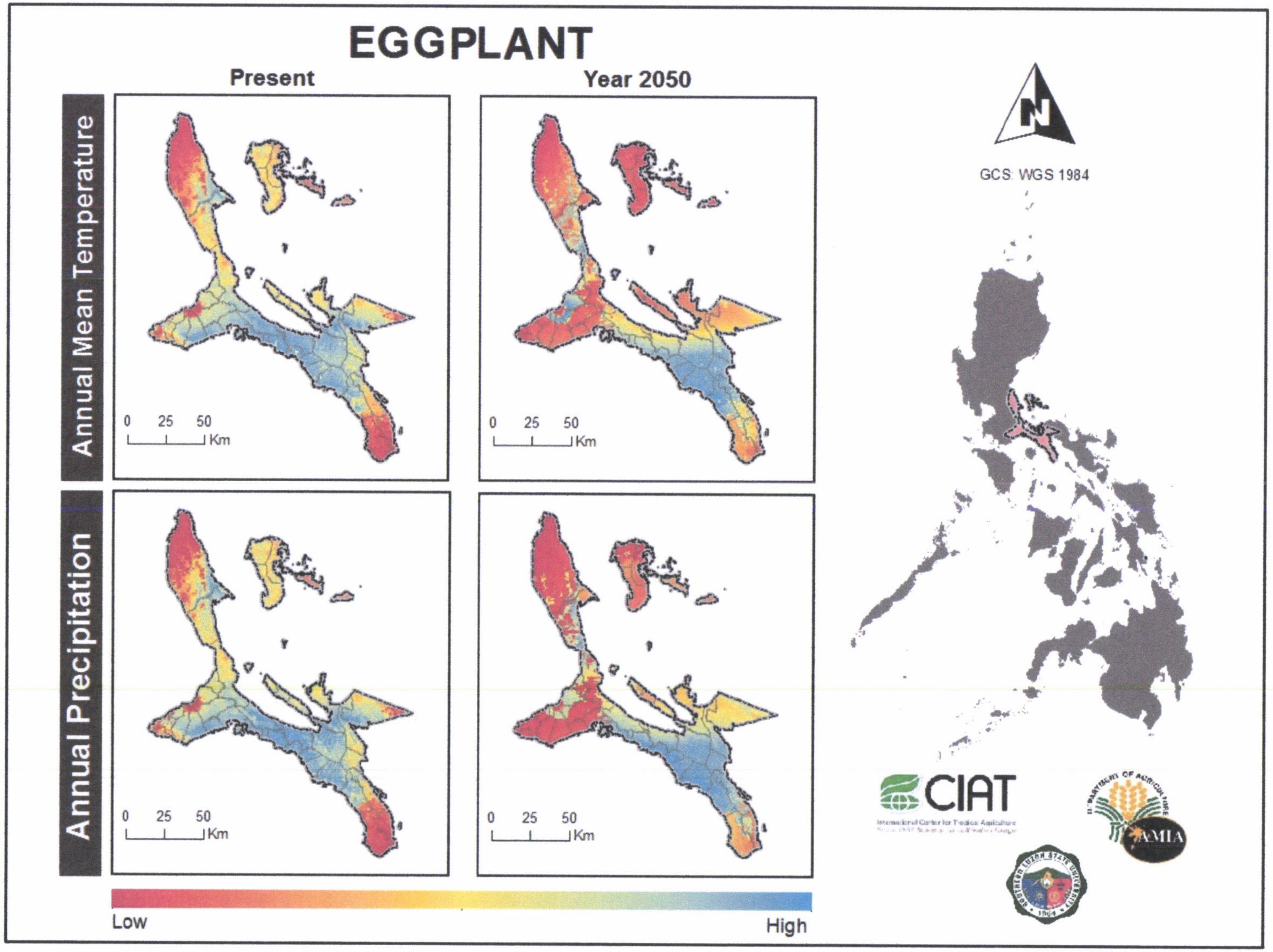

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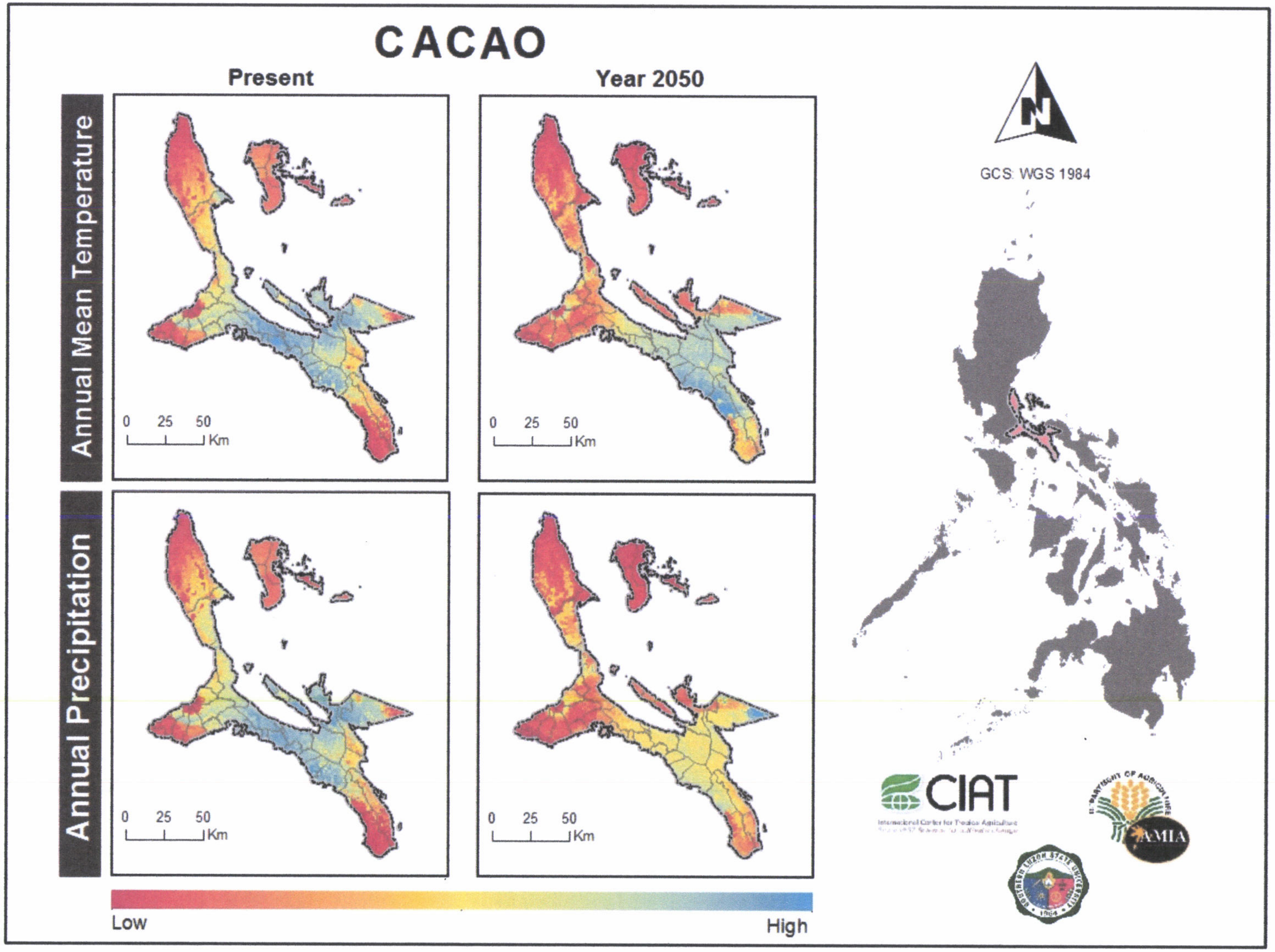

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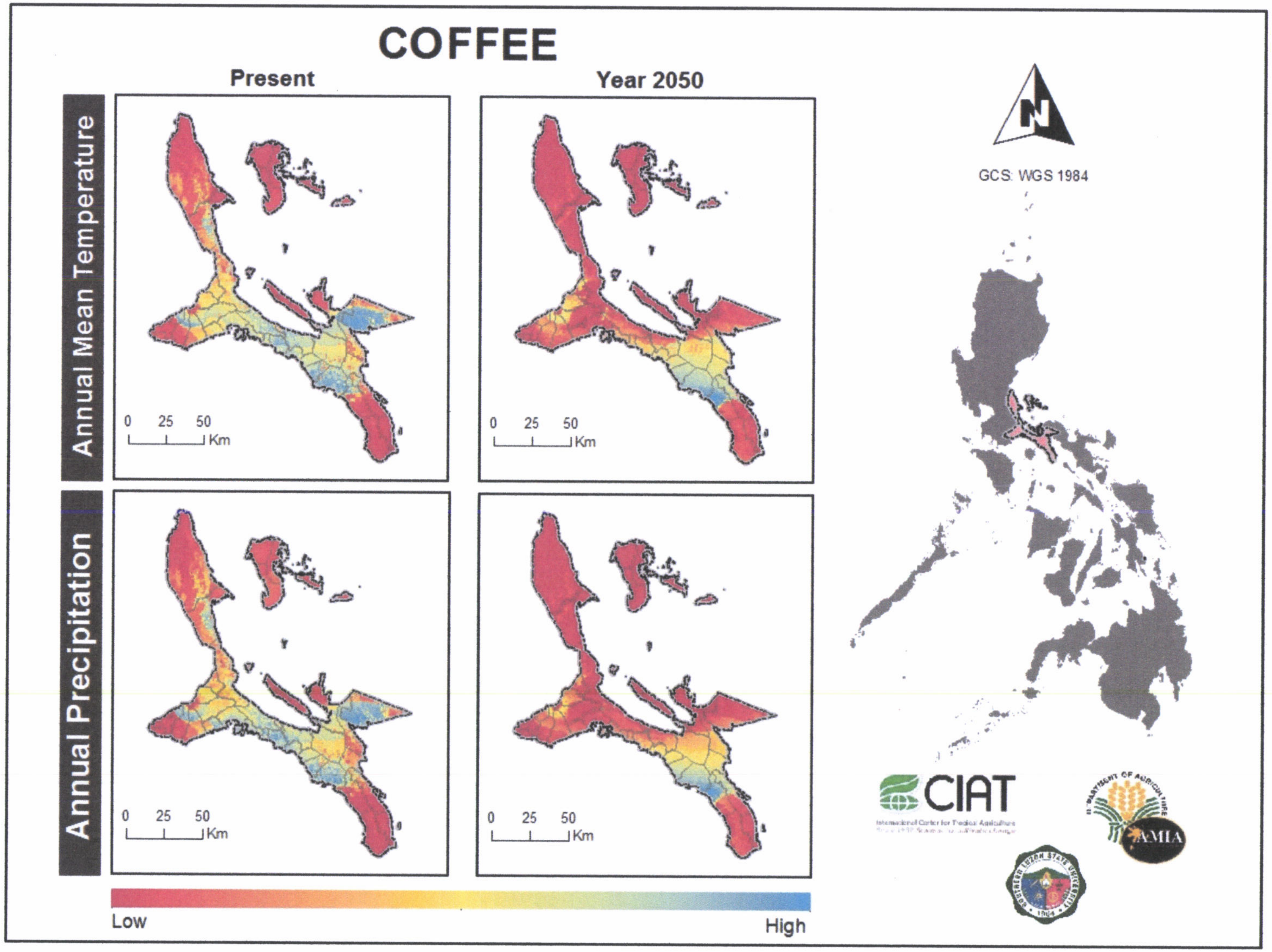
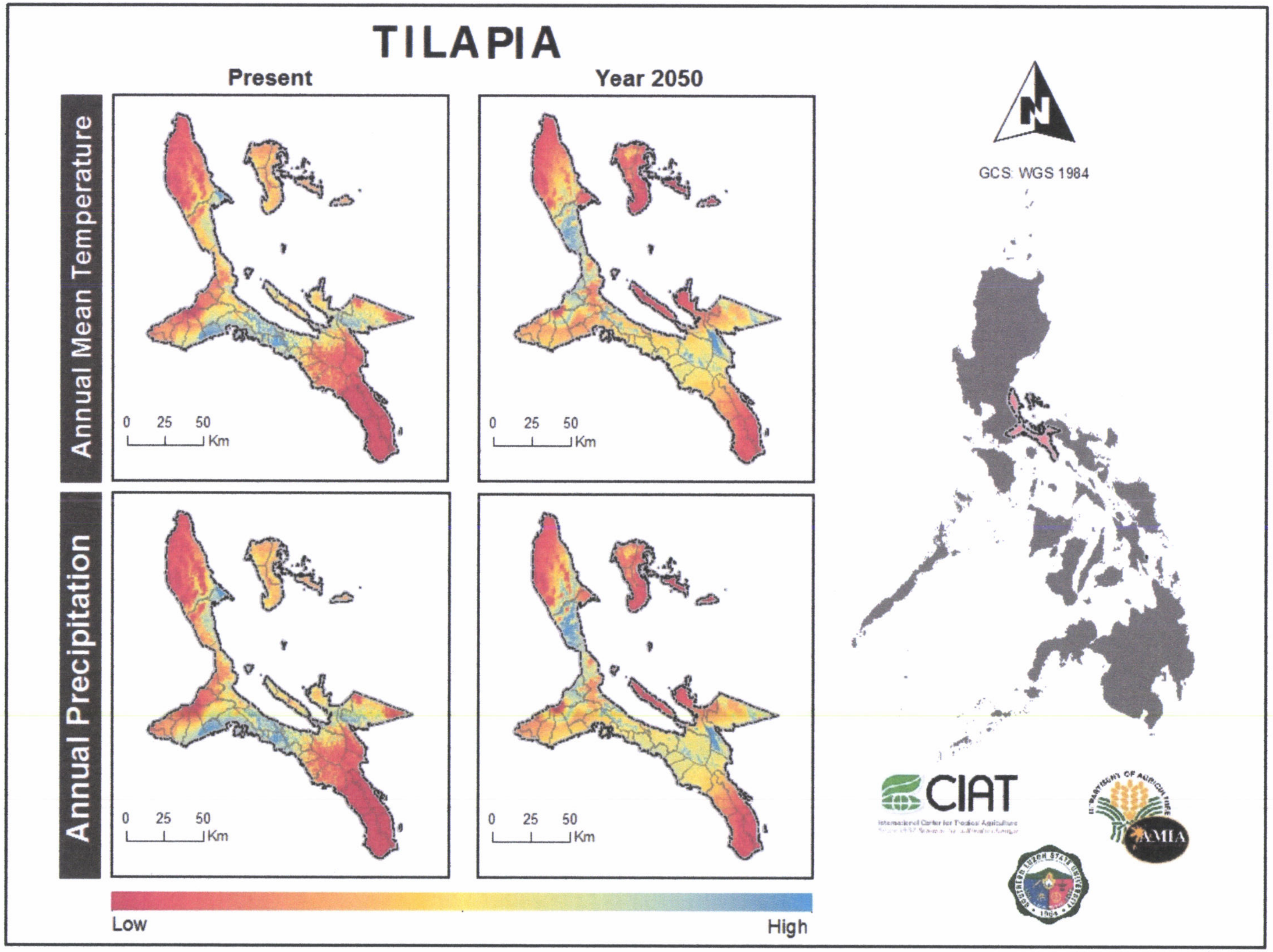


Attachment Q



Attachment R

Climate Resilient Practices

	Municipality	Agriculture	Fisheries	Livestock
1	Agdangan	Strengthening Farmers Organization Farmers Training Program (FFS) Biodiversity Conservation	Strengthening Fisher folks Organization Bantay Dagat	
2	Alabat	Automated Weather Station Seed Dispersals Integrated Farming Water Pumping Mulching	Mangrove reforestation Strengthening fisher folks organizations	
3	Atimonan	Organic Farming Farmers Organizations Alternate Wetting and Drying Intercropping Water Pumping Mulching	Mangrove reforestation Strengthening fisher folks organizations	Introduction of Native Pigs
4	Buenavista	Watering Synchronize planting Flood tolerant variety		

		Mulching		
5	Burdeos			
6	Calauag	Organic Farming	Seaweed farming	
7	Candelaria	Used of drought tolerant variety Used of Flood-tolerant Variety Intercropping Mulching Multi-cropping		
8	Catanauan			
9	Dolores	Organic Farming SALT Small Water Impounding Water Catching Facility Integrated farming Intercropping Crop Rotation		
10	General Luna	Agricultural Weather Station Establishment of Dikes and Canals Small Water Impounding Crop Insurance Mulching		

		Integrated Pest Management		
11	General Nakar	Climate Resiliency Field School Climate Information Board Agricultural Weather Station		
12	Guinayangan	Used of flood tolerant variety Used of Drought tolerant variety Intercropping Irrigation Green Leaf Manuring Change in cropping calendar		Introduction of Native pig Establishment of Housing Breeding
13	Gumaca	Organic farming Mango production CIS Capability Bldg.	Mangrove Reforestation	
14	Infanta	Integrated Pest Mgt Diversified Farming Crop Insurance Multi-cropping Used of	Enclose pond with fishnet Dredging and riprapping	

		submarine variety		
15	Jomalig			
16	Lopez	Increase Alternative Livelihood Mulching Irrigation Facilities Used of sub-marine variety Organic Agriculture Intercropping IPM Diversified farming Used of Wind Breaks Multi-cropping Seed dispersal		
17	Lucban	Organic Agriculture Strengthening Farmers Organization System Rice Intensification	Genetic Improvement	
18	Lucena	Alternate wetting and drying Used of submarine		

		variety Used of Early Maturing Variety Change in cropping calendar Crop Insurance Used of Drought-tolerant variety Small water impounding		
19	Macalelon	Farmer Field School Intercropping Used of Early Maturing Variety Shallow Tube well Organic Farming IPM Small Reservoir Irrigation Small Water Impounding		
20	Mauban	Small Water Impounding Organic Agriculture Seed Dispersal Alternate wetting and drying		
21	Mulanay			

22	Padre Burgos			
23	Pagbilao			
24	Panukulan	DRIP Irrigation Fallow System RWH		
25	Patnanungan	RWH		
26	Perez	Intercropping	Seaweed farming	
27	Pitogo			
28	Plaridel	Water Pumping Organic Farming	Organic Hatchery	
29	Polillo			
30	Quezon	Water pumping	Feeding Practice Water Management	
31	Real	Multi-hazard Training Organic farming	River Bank Establishment	
32	Sampaloc			
33	San Andres			
34	San Antonio	FFS Techno Demo Package STW Improvement of irrigation canals		
35	San Francisco	Farmer's Field School Intercropping		

		Multi-cropping Used of Early Maturing variety Organic Agriculture IPM Crop Insurance Integrated Farming		
36	San Narciso	Organic Farming IPM STW Crop rotation Used of flood tolerant variety Used of Drought tolerant Variety Minus 1 Element Technique Soil Analysis FFS MAFC-FARMC	Fisher folks Federation	
37	Sariaya	Mulching SWIP STW SRI Organic Farming Used of Drought tolerant Variety		
38	Tagkawayan			

39	Tayabas			
40	Tiaong	STW Used of early maturing variety Organic Fertilizer		
41	Unisan			

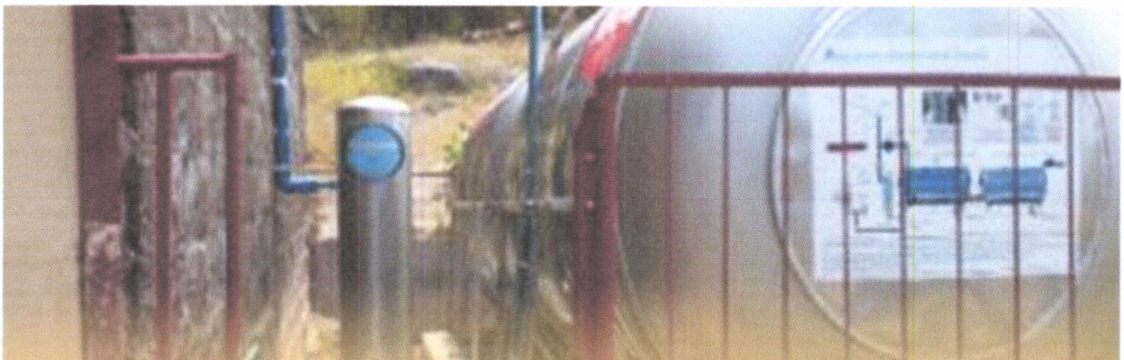
Summary Lists of CRA Practices

CRA for Crops	**CRA for Fisheries**	**CRA for Livestock**
Strengthening Farmer's Organization	Strengthening Fisher folks organization	Introduction of Native Species
Farmer's Training Program	Bantay Dagat Implementation	Housing Establishment
Increase in Alternative Livelihood	Mangrove Reforestation	Breeding
Biodiversity Conservation Program	Seaweed Farming	Artificial Insemination
Automated Weather Station	Establishment of Fish Ponds	
Seed Dispersal	Dredging and riprapping	
Integrated Farming	Genetic Improvement	
Irrigation practices(SALAK,Water Pump,Watering)	Seaweed Farming	
Intercropping(synchronize planting)	Organic Hatchery	
Organic Farming	Feeding Practice	
Alternate Wet and Dry	Water Management	
Mulching	River Bank Establishment	
Flood tolerant variety		
Used of Drought-tolerant Variety		
Used of Early Maturing Variety		
CRA for Crops	**CRA for Fisherie**	**CRA for Livestock**
Multi-cropping		
Water Catching Facility		
Crop Rotation		

Establishment of Dikes and Canal		
Crop Insurance/Gov't subsidy		
Integrated Pest Mgt.		
Use of Submarine Variety		
Shallow Tube Well		
System Rice Intensification		
Minus 1 Element Technique		
Soil Analysis		

Attachment S

Investment Briefs



Climate-Smart Agriculture Practices Investment Prioritization

Investment Prioritization for Region IV CALABARZON : Rain water Harvesting– Vegetable Production

Overview

Quezon Province is one of the provinces in the CALABARZON Region. It is the largest in the area and the leading province in crop production and the region source of staple crop. The province stretches as a tapered belt alongside the eastern shore of Luzon and on the north it is sandwiched between Sierra Madre mountain range and Philippine Sea. It has a land area of 8706.6 km^2 and considered as the second largest province in Southern Luzon. It is composed of 39 municipalities and 2 cities which are administratively divided into 4 congressional districts. Their major income sources are agriculture, fishing and forestry. This province is reported to have 513, 618 hectares of land dedicated for agricultural production and has a coastline area of 1066.36km.

Quezon province is also considered as a top producer of High valued crops in the region that accounts for 30.69% average share of production from 2010-2014 based on the Philippine Statistics Authority data. According to them Quezon province has a total of 3,885.36 has that are planted with lowland vegetables and high land vegetables.

Quezon also topped in number of agricultural issues and concern. It is frequently visited by different climatic hazards specifically typhoon and has the highest observed poverty incidence. In the last 10 years, the province suffered from the five (5) typhoons that passed in the Philippine Area of Responsibility (PAR), namely Typhoon Nina, Lando, Pepeng, Ondoy and Glenda, where almost half of the municipalities' agricultural area and yield are greatly affected. Last 2016, the PAGASA office told that the province is experiencing a dry spell where most of the agricultural production were highly affected specifically those areas in the coastlines. Several practices were introduced in different municipalities in Quezon to address its effect. Quezon, being an area where the most common source of living is on agriculture provided a program where farmers could survive in their living and addressed the issue on food security. With the government's initiative to eradicate poverty the Quezon's farmers community will be not at stake.

Prioritized CRA Practice

Quezon being the food bowl of the country and being the top producer for agricultural production, is highly affected by the devastation of the changing climate particularly El Nino where it constitutes typhoon and drought/dry spell. It will also greatly affect the farmers in the province since it is located in beside the Pacific Ocean where the drought usually developed.

In order to address these problems, Rain water harvesting for vegetable production will be introduced in the Province particularly to those areas who are highly vulnerable to different climatic changes. It is a method of inducing, collecting, storing and conserving local surface runoff for agricultural production. It is an alternative way of irrigation where mostly of the farmers can afford and can access. Through rain water harvesting the vegetable farm production will increase even in the time when there is an occurrence of drought. Farmers could still have their source of income even in dry season.

Data Gathering and Methodology

1. Identification of Sensitive areas

   This was done through collection of secondary data and primary data (workshops, Key informant Interviews) and provide a maps through different indicators.

2. Identification of Climate Resilient Agriculture Practices

   The team collected some information about the different CRA Practices of each municipality through workshops, Key Informant Interview and site visitation. The team produce a lists of 25 practices and selected the most dominant and effective practice.

3. Site Visitation and Key Informant Interview with farmers and Municipal Agriculturists

   This activity was done by the team to collect data for the Cost-Benefit Analysis and have some validation on the practices that the team selected.

4. Consolidation of data and Processing of CBA Tool

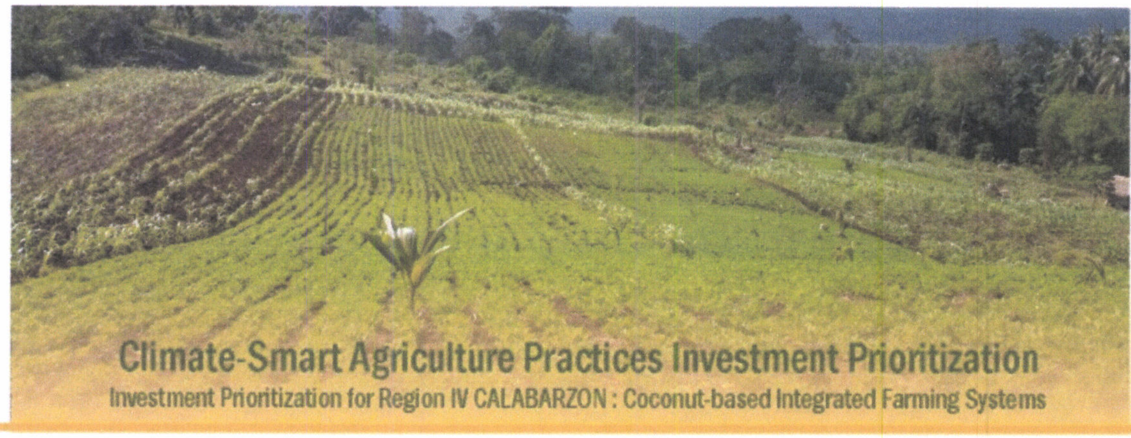
   Data collected were consolidated and processed through the CBA Tool.

AMIA

Rain Water Harvesting

Attachment T

Investment Briefs



Overview

Quezon stretches as a tapered belt alongside the eastern shore of Luzon and on the north it is sandwiched between Sierra Madre mountain range and Philippine Sea. It has a land area of 8706.6 km^2 and considered as the second largest province in Southern Luzon . It is composed of 39 municipalities and 2 cities which are administratively divided into 4 congressional districts. Their major income sources are from agriculture, fishing and forestry. It was said that there is a 513, 618 hectares of land dedicated for agricultural area[1]. Quezon also has a coastline area of 1066.36km.

Palay and corn is the major temporary crop that the province produced in terms of area planted. Their most dominant crop is coconut where 84% of the trees in the region are grown by the provinces' farmers. In terms of their production the province contributes 40,896.79 MT of the total corn production in the region(PSA). In rice the province contributed around 155,403.4 MT per annum in the region.For high value crops Quezon accounts for 30.68% average share of production from 2010-2014 based on Philippine Statistics Authority data. Even in the fisheries sector the province is also the top producer among all provinces in the Region.

Quezon is frequently visited by different climatic hazards specifically typhoon. In the last 10 years, the province suffered for five(5) typhoons such as Typhoon Nina, Lando, Pepeng, Ondoy and Glenda where almost half of the municipalities agricultural area and yield are greatly affected.In 2009, the province experienced a tropical cyclone which was the typhoon Pepeng and Ondoy they created a great impact on the production of coconut in the industry. To further improved the yield of the coconut industry the Philippine Coconut Authority Region IVA implemented a *"Participatory Coconut Planting Project"* and *"Corn intercropping Project"*. Another problem of the province is the increasing poverty incidence, that for them to eradicate it the province will focus on agricultural modernization and mechanization since its economy is predominantly agricultural. As of 2016 the Provincial Government of Quezon provided a rehabilitation program for HVCC-high value crops.

Prioritized CRA Practice

Quezon is one of the top producers of coconut in the region. Obviously, vast coconut plantations are found all over the province. Coconut oil, copra, lambanog – these are three products coming from the tree of life which are abundantly produced in Quezon. Several problems are been faced by the province between the agricultural production and poverty incidence, since the province is dedicated for agricultural area and mostly of the community are relying on the benefit of their farms.

In order to addressed this problems, Coconut-based Integrated Farming Systems will be introduced in the Province particularly to those areas who are highly vulnerable to different climatic changes. It is a system in coconut production where the available farm resources are being utilized to produce both nuts, food and non-food agricultural products from the farm in a profitable way. With this practice farmers will be benefited since the practice will provide them a good source of income by planting alternative crops and survival crops instead on just relying on the coconut tree could give. Also, through Coconut based-Integrated Farming Systems the provinces' problem in increasing poverty incidence will be eradicated.

Data Gathering and Methodology

The team collected some secondary data from different offices in the province and from different municipalities. Identification of crop occurrences, hazard exposure and adaptive capacity was done and map through the Focus Group Discussion or workshop together with the Municipal Agriculturists and Agricultural Technicians. After the map was produced we selected the most vulnerable area in the province and selected farmers randomly. We selected 3 farmers from each selected Municipalities and conducted a Key Informant Interview for Cost Benefit Analysis. Data were summarized and analyzed statistically.

Coconut-based Integrated Farming Systems

Attachment U

	Hazards							
Crops	**Typhoon**	**Flood**	**Drought**	**Landslide**	**Erosion**	**Salt Water Intrusion**	**Sea Level Rise**	**Storm Surge**
Rice	X	X	X	X	X	X	X	X
Corn	X	X	X	X	X	X	X	X
Eggplant	X	X	X					
Squash	X	X	X					
Cacao	X	X	X		X	X		
Coffee	X	X	X		X		X	X
Tilapia	X	X	X					

Note: In each column **'x'** (mark) represents if the crop is exposed to the particular hazard.

Attachment V

	Sensitivity per crop								
Municipality/City	Rice	Corn	Squash	Eggplant	Cacao	Coffee	Tilapia	Vulnerability	Adaptive Capacity
Agdangan	0.122	-0.446	-0.232	-0.031	-0.290	-0.360	-0.172	0.810	0.470
Alabat	-0.117	-0.470	-0.296	-0.219	-0.447	-0.014	-0.281	0.358	0.600
Atimonan	0.027	-0.370	-0.359	-0.165	-0.300	-0.451	-0.211	0.805	0.421
Buenavista	0.261	-0.244	-0.034	0.117	0.067	0.009	0.344	0.633	0.588
Burdeos	-0.369	-0.050	-0.237	-0.253	-0.080	-0.047	-0.226	0.627	0.553
Calauag	0.157	-0.464	-0.292	-0.203	-0.391	-0.222	-0.211	0.187	0.653
Candelaria	-0.242	-0.401	-0.337	-0.283	-0.093	-0.084	0.052	0.372	0.605
Catanauan	0.237	-0.352	-0.148	0.036	-0.077	-0.055	0.266	0.756	0.506
Dolores	-0.191	-0.271	-0.298	-0.232	-0.236	-0.229	0.126	0.235	0.658
General Luna	0.234	-0.368	-0.149	0.053	-0.097	-0.090	0.263	0.289	0.667
General Nakar	-0.113	-0.018	-0.100	-0.088	-0.028	-0.079	0.022	0.727	0.498
Guinayangan	0.159	-0.305	-0.162	-0.044	-0.062	-0.160	0.190	1.000	0.411
Gumaca	0.146	-0.423	-0.318	-0.126	-0.208	-0.368	-0.106	0.901	0.439
Infanta	-0.191	-0.169	-0.397	-0.379	-0.355	-0.042	-0.461	0.292	0.618
Jomalig	0.011	-0.180	-0.125	-0.103	-0.027	-0.028	-0.198	0.898	0.491
Lopez	0.174	-0.354	-0.197	-0.021	-0.104	-0.154	0.175	0.600	0.569
Lucban	0.024	0.068	-0.003	0.067	-0.011	-0.160	0.205	0.134	0.750
Lucena City	-0.266	-0.501	-0.480	-0.511	-0.284	-0.360	-0.348	0.000	0.706
Macalelon	0.174	-0.390	-0.231	0.024	-0.153	-0.127	0.194	0.821	0.468
Mauban	-0.110	-0.180	-0.249	-0.181	-0.212	-0.288	-0.061	0.102	0.695
Mulanay	0.262	-0.234	0.015	0.118	0.195	0.207	0.270	0.819	0.544
Padre Burgos	0.092	-0.426	-0.255	-0.050	-0.329	-0.370	-0.208	0.951	0.418
Pagbilao	-0.176	-0.412	-0.371	-0.326	-0.372	-0.435	-0.225	0.254	0.600
Panukulan	-0.387	-0.020	-0.310	-0.321	-0.126	-0.031	-0.158	0.510	0.547
Patnanungan	-0.150	-0.158	-0.066	-0.034	-0.016	-0.033	-0.214	0.425	0.600
Perez	0.081	-0.412	-0.230	-0.136	-0.533	-0.015	-0.376	0.313	0.622
Pitogo	0.154	-0.428	-0.249	0.012	-0.211	-0.226	-0.031	0.320	0.638
Plaridel	0.133	-0.460	-0.462	-0.267	-0.270	-0.375	-0.280	0.570	0.533
Polillo	-0.354	-0.094	-0.219	-0.278	-0.046	-0.058	-0.278	0.395	0.622
Quezon	0.120	-0.450	-0.209	-0.177	-0.557	-0.030	-0.224	0.790	0.450
Real	-0.057	0.016	-0.166	-0.072	-0.057	-0.256	0.072	0.623	0.526
Sampaloc	-0.163	-0.131	-0.184	-0.224	-0.149	-0.240	0.166	0.165	0.699
San Andres	0.346	-0.099	0.116	0.224	0.155	0.024	0.063	0.865	0.509
San Antonio	-0.085	-0.199	-0.016	-0.086	-0.016	-0.034	0.141	0.515	0.582
San Francisco	0.368	-0.021	0.107	0.302	0.198	0.047	0.118	1.101	0.432
San Narciso	0.272	-0.217	0.019	0.144	0.096	0.101	0.215	0.753	0.544
Sariaya	-0.217	-0.388	-0.373	-0.348	-0.115	-0.179	-0.042	0.237	0.651
Tagkawayan	0.183	-0.288	-0.227	-0.113	-0.083	-0.447	-0.014	0.798	0.483
Tayabas	-0.217	-0.278	-0.281	-0.276	-0.268	-0.346	-0.056	0.257	0.636
Tiaong	-0.242	-0.395	-0.182	-0.201	0.007	-0.008	0.110	0.161	0.694
Unisan	0.134	-0.451	-0.260	-0.044	-0.270	-0.385	-0.223	0.523	0.545

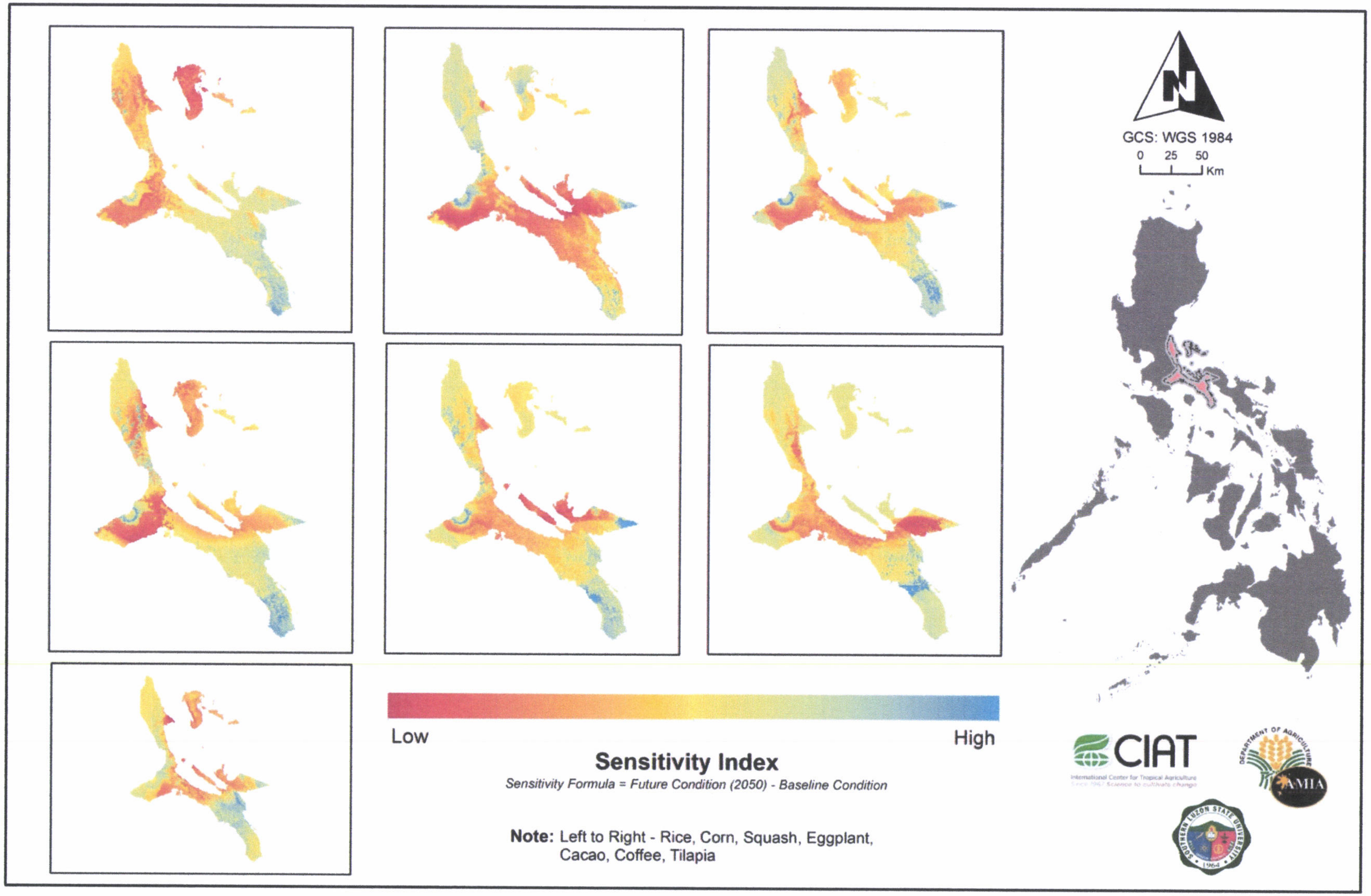
Note: The highlighted color is the most sensitive crop in Quezon Province.

Atttachment W

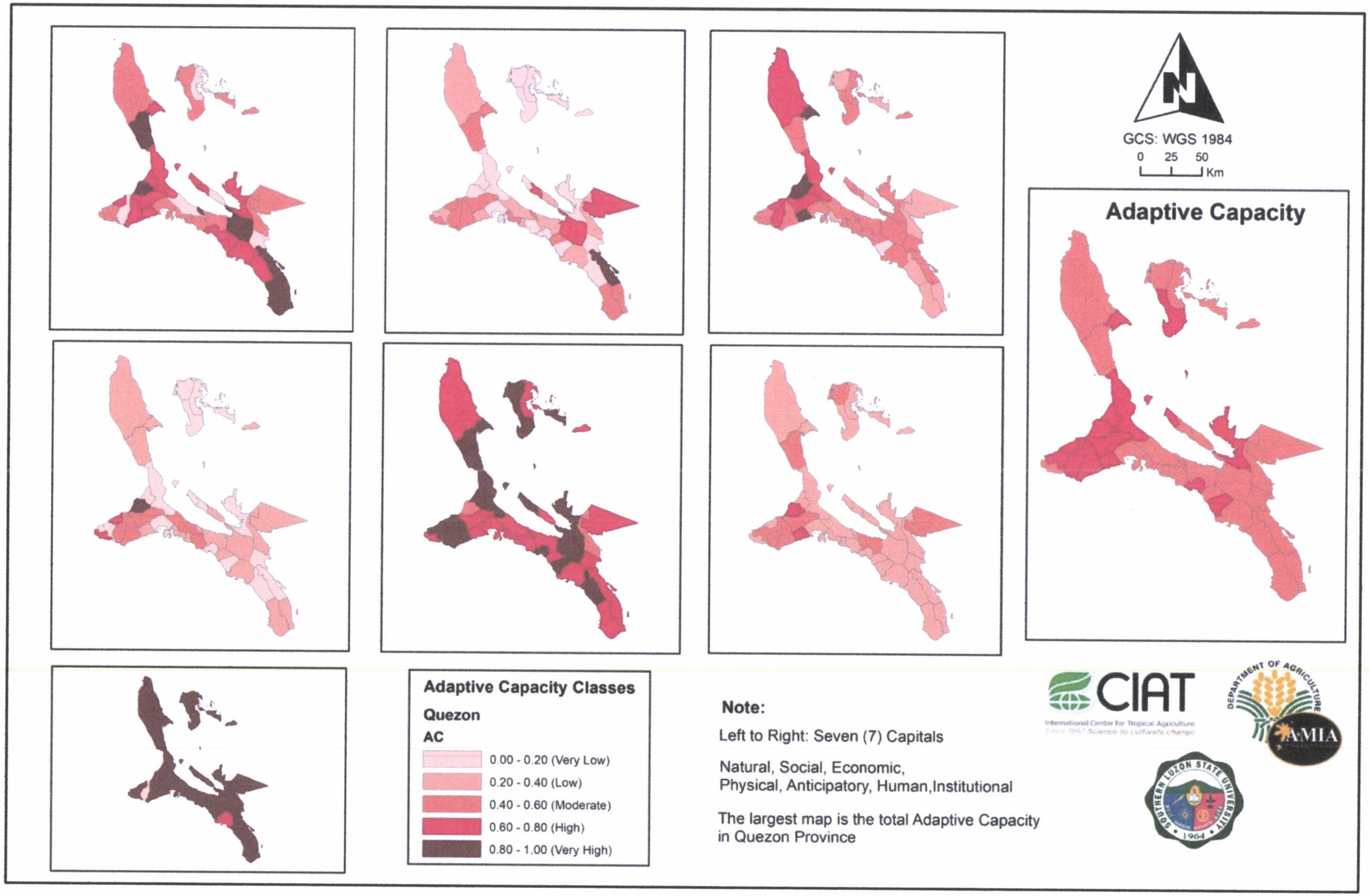
Municipality/City	CRVA-Rice	CRVA-Corn	CRVA-Eggplant	CRVA-Squash	CRVA-Cacao	CRVA-Coffee	CRVA-Tilapia	Hazard Exposure	AC Total	Vulnerability
Agdangan	0.436	0.350	0.413	0.382	0.374	0.363	0.392	0.310	0.470	0.810
Alabat	0.300	0.247	0.285	0.273	0.250	0.315	0.275	0.250	0.600	0.358
Atimonan	0.429	0.369	0.400	0.371	0.380	0.357	0.393	0.130	0.421	0.805
Buenavista	0.372	0.297	0.351	0.328	0.343	0.335	0.385	0.300	0.588	0.633
Burdeos	0.315	0.362	0.332	0.334	0.358	0.363	0.336	0.380	0.553	0.627
Calauag	0.295	0.202	0.241	0.228	0.213	0.238	0.240	0.190	0.653	0.187
Candelaria	0.275	0.251	0.269	0.261	0.297	0.299	0.319	0.230	0.605	0.372
Catanauan	0.412	0.323	0.381	0.354	0.365	0.368	0.416	0.200	0.506	0.756
Dolores	0.248	0.236	0.242	0.232	0.241	0.242	0.296	0.250	0.658	0.235
General Luna	0.300	0.210	0.273	0.243	0.250	0.251	0.304	0.210	0.667	0.289
General Nakar	0.359	0.373	0.363	0.361	0.372	0.364	0.379	0.160	0.498	0.727
Guinayangan	0.465	0.395	0.435	0.417	0.432	0.417	0.470	0.190	0.411	1.000
Gumaca	0.461	0.376	0.420	0.391	0.408	0.384	0.423	0.310	0.439	0.901
Infanta	0.276	0.279	0.248	0.245	0.252	0.298	0.236	0.250	0.618	0.292
Jomalig	0.424	0.395	0.407	0.404	0.418	0.418	0.393	0.440	0.491	0.898
Lopez	0.373	0.294	0.344	0.317	0.331	0.324	0.373	0.300	0.569	0.600
Lucban	0.224	0.230	0.230	0.220	0.218	0.196	0.251	0.300	0.750	0.134
Lucena City	0.211	0.175	0.174	0.179	0.208	0.197	0.198	0.300	0.706	0.000
Macalelon	0.427	0.342	0.404	0.366	0.378	0.382	0.430	0.190	0.468	0.821
Mauban	0.227	0.217	0.217	0.206	0.212	0.201	0.234	0.200	0.695	0.102
Mulanay	0.411	0.336	0.389	0.374	0.401	0.402	0.412	0.350	0.544	0.819
Padre Burgos	0.468	0.390	0.447	0.416	0.405	0.399	0.423	0.310	0.418	0.951
Pagbilao	0.276	0.241	0.254	0.247	0.247	0.237	0.269	0.150	0.600	0.254
Panukulan	0.286	0.341	0.296	0.297	0.325	0.339	0.320	0.180	0.547	0.510
Patnanungan	0.286	0.285	0.303	0.299	0.306	0.304	0.276	0.190	0.600	0.425
Perez	0.314	0.240	0.282	0.267	0.222	0.300	0.246	0.250	0.622	0.313
Pitogo	0.313	0.225	0.292	0.252	0.258	0.256	0.285	0.240	0.638	0.320
Plaridel	0.392	0.303	0.332	0.302	0.331	0.315	0.330	0.300	0.533	0.570
Polillo	0.262	0.301	0.274	0.283	0.309	0.307	0.274	0.340	0.622	0.395
Quezon	0.433	0.348	0.388	0.384	0.331	0.411	0.381	0.200	0.450	0.790
Real	0.344	0.355	0.342	0.328	0.345	0.315	0.364	0.140	0.526	0.623
Sampaloc	0.227	0.232	0.218	0.224	0.229	0.215	0.276	0.270	0.699	0.165
San Andres	0.435	0.368	0.416	0.400	0.406	0.386	0.392	0.260	0.509	0.865
San Antonio	0.310	0.292	0.309	0.320	0.320	0.317	0.343	0.200	0.582	0.515
San Francisco	0.488	0.430	0.479	0.449	0.463	0.440	0.451	0.240	0.432	1.101
San Narciso	0.401	0.327	0.381	0.363	0.374	0.375	0.392	0.270	0.544	0.753
Sariaya	0.252	0.226	0.232	0.229	0.267	0.258	0.278	0.270	0.651	0.237
Tagkawayan	0.433	0.362	0.388	0.371	0.393	0.338	0.403	0.290	0.483	0.798
Tayabas	0.258	0.249	0.249	0.248	0.250	0.239	0.282	0.240	0.636	0.257
Tiaong	0.214	0.191	0.220	0.223	0.251	0.249	0.267	0.240	0.694	0.161
Unisan	0.370	0.282	0.343	0.311	0.309	0.292	0.317	0.210	0.545	0.523

Note: The highlighted color is the most vulnerable crop and exposed on climate-related hazards in Quezon Province.

Attachment X

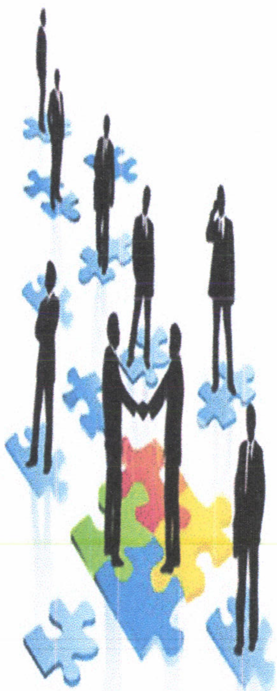


Attachment Y



C. Contingencies(15%)	16987.00
Grand Total Cost(A+B+C)	266,950.5
Gross Income(range)ᵃ	300,000-500,000
Net Income(range)	69,762.50-169,672

a with marketable yield of 10-15t/haat farmgateprice of PhP 20/kg



Acknowledgement:

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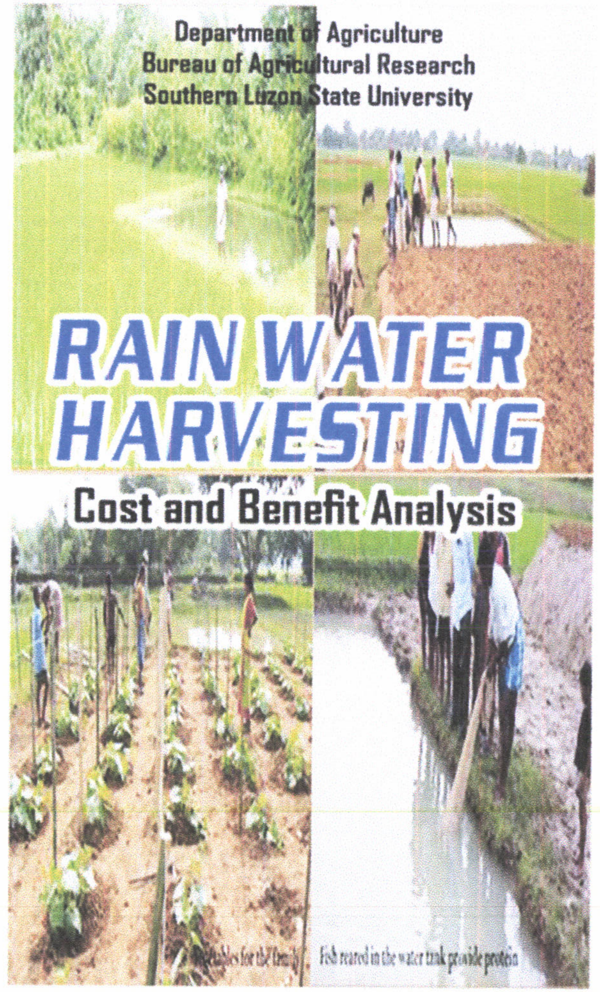

RainWater Harvesting

One of the most promising alternatives for supplying freshwater in the face of increasing water scarcity and escalating demand. It is the collection and storage and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and hydrological studies and engr. inventions, aimed at conservation and efficient utilization of the limited water endownment of physiographic unit such as watershed.
-Dr Cecilia Gascon,2013.

Benefits of RainWater Harvesting

Rainwater is a renewable, sustainable and a high quality water source for your home. Some of the benefits of collecting and storing rainwater include*:

- Diminishing flooding, erosion and the flow to stormwater drain by reducing peak storm water runoff
- Reducing water bills and demand on your community's drinking water supply by using rainwater for flushing toilets, washing clothes, watering the garden and washing cars
- Improving plant growth by using rainwater for irrigation because stored rainwater is free from pollutants as well as salts, minerals, and other natural and man-made contaminants
- Making use of a valuable resource that is FREE.

Rainwater Harvesting for Agriculture

Rainwater harvesting in agriculture is one of the ancient acitivities in the past years. It can be used for watering gardens in our homes and crop plants in agricultural fields. These reduce the reliance of garden owners and farmers on other sources of water supply, thus saving them money. This particular activity is still been practiced and evolving today, since this kind of saving water can help the farmers to save and survived in the midst of disaster (e.g. Drought).

Farmer's Situationer

According to studies farmers and fisherfolks are the poorest group of people in the country. One of the factors that affect them is that mostly of our farmers depend on what the nature could give to them.It was also found out by the PAGASA that mostly of our farmers rely on the rain to be the source of their water for their living.When drought occurs they cannot even provide for their everyday needs. and most of their crops are being destroyed.

Capital Costs for the Rainwater Harvesting System

Item	Unit	Costs (USD)
First Flush Filter	6pcs	720.00
Underground Storage Tank	5pcs	120,612.50
Plumb Tank	5pcs	12,708.00
Pump	5each/tank	16,890.00
Floating Intake	5each/tank	1,280.00
Distribution Piping	1500linearfeet	19,200.00
Booster Pumps	5each/tank	7,390.00
Roof Metal	23,387Sq.ft	-
Downspout	4160linear ft	-
	Sub-Total	**178,800.50**

Item(Tomato)	Total Amount (PhP/1ha)
Plowing	2,500.00
Harrowing	1500.00
Bed Preparation	2500.00
Seedling Prod'n	3750.00
Mulching	2500.00
Planting	2500.00
Organic Fertilizer Application	2500.00
Irrigation	5000.00
Fertilization	2500.00
Weeding	2500.00
Vine training	2000.00
Harvesting	5000.00
Seeds	2000.00
Trellis	30,000.00
Organic fertilizer	1500.00
FPFS	1500.00
Bio-pesticides	400.00
Mulching film	12500.00
Net Bags	500.00
Miscellanous	5000.00
Sub-Total	**88,150.00**

Attachment AA

Table 1. Cost and Return Analysis for a hectare of Coconut-based Integrated Farming Systems for a year

Items	Quantity	Total (P/ha)
I.Costs		
A. Seedlings		
1. Coconut	100 nuts	Gov't subsidy
2. Banana Sucker	1000 sucker	1000.00
3. Corn Seeds	50 cans	9000.00
4. Peanuts	25 cans	6250.00
B. Materials		
1. Complete	2 sacks	3800.00
2. Urea	2 sacks	3560.00
3. Foliar	10 kgs	3500.00
4. Bio-N	10 kgs	3500.00
5. Larvin	1 sack	1080.00
6. Glyphosate	1 sack	1100.00
7. 2-4d	1 sack	290.00
8. Insecticide	2 liter	700.00
9. Rodenticide	1 liter	75.00
C. Labor		
1. Land Preparation	60 MAD	18000.00
2. Planting	70MD	17500.00
3. Weeding	40 MD	10000.00
4. Watering	20 MD	5000.00
5. Hilling-up	3 MD	750.00
6. Harvesting	80 MD	20000.00
Total Costs		105105.00

II. Income from Harvest		
1. coconut	5000 nuts	40,000.00
2. Banana	n/a	n/a
3. Corn		
Yellow	1500 pcs	18000.00
Green	1500pcs	36000.00
4. Peanuts		
Dry	200kgs	8200.00
Wet	130kgs	3770.00
Total Income from harvest		105,970.00
Net Income		865.00
IV. Return on Investment		0
V. Breakeven Price (Php/kg)		n/a

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Cost-Benefit Analysis

Coconut-based Integrated Farming Systems

Bureau of Agricultural Research
Department of Agriculture

Office of Extension Services
Southern Luzon State University

Overview

Quezon Province

- Land Area: 8,989.39 sq. km
- 8th largest province in the Philippines
- Agricultural Area: 513,618 ha
- Major Annual Crop: Palay and Corn
- Dominant Perennial Crop: Coconut (84%)
- Major Source of Income: Agriculture, Fishing and Forestry

Quezon's Agro– industry

Country's leading producer of coconut products such as virgin coconut oil, desiccated coconut, coconut juice, copra and coconut oil.

Large companies geared towards the Coconut production and this companies are located in Quezon Province. Because of the great state of coconut industry in the province the provinces of Romblon, Marinduque and Masbate were trading their copra.

Production:

Corn: 40,896.79MT

Rice: 155,403.4 MT/year

Quezon's Fishing Sector

- Coastline area: 1066.36 km
- Quezon accounts for 33% or around 132,239 MT of fish produced in the region.
- It has 3 fish districts and 4 fishing ports which serve as hubs for the trade of fish and other aquatic resources like round scad, anchovies, tuna, and groupers.

Coconut-Based Integrated Farming System

It is a system in coconut production where the available farm resources are being utilized to produce nuts, food and non-food agricultural products from the farm in a profitable way. With this practice farmers will be benefited since the practice will provide them a good source of income by planting alternative crops and survival crops instead on just relying income from coconut production.

Quezon's Coconut Industry

Quezon has the largest coconut production area in CALABARZON and the top coconut producing province in the country. Quezon Province contributes 84%of the total coconut production in the region (PSA).

Table 1. Cost and Return Analysis for a hectare of Coconut

Items	Quantity	Total (P/ha)
I.Costs		
A Nuts	100 nuts	Gov't subsidy
B. Labor		
1. Land Preparation	20 MAD	6000.00
2. Planting	20MD	5000.00
3. Harvesting		5000.00
Total Cost		16,000.00
II. Income from Harvest (8.00/ pc)	3000 nuts	24,000.00
III. Net Income		8,000.00
IV. Return on Investment		0.5
V. Breakeven Price (Php/kg)		5.3

Pictures

For. Felino Gutierrez discussed the CRA-AMIA2 Project with Ms. Ella of DA-RFO4A.

Ground working and Visitation in Polillo Group of Islands with MA Elizabeth of Jomalig, Quezon.

Key Informant Interview with the Municipal Agriculturist of Sariaya.

Key Informant Interview with the farmer in Patnanungan, Quezon.

Dr. J.O Coladilla presented her lectures about CRA-AMIA2 Workshop to the participants coming from different Municipalities in Quezon Province.

For. F.J. Gutierrez Jr. presented about the overview of the CRA-AMIA2 Project during the pre- training workshop.

Workshop on Mapping with Sariaya Employees and SLSU Students facilitated by Dr. Coladilla

Pre-training workshop attendees
October 21, 2016

Coordination to other SUCs about the CRA-AMIA2 Project.

Dr. Dindo Campilan discussed about concept of AMIA Program during CRVA Workshop in UPLB, Los Baños, Laguna, last January 10-12 2017

Coordination to other SUCs about CRVA Methodology in UPLB, Los Baños, Laguna, last January 10-12, 2017.

Roll-Out Pictures

Roll Out training of CRA-AMIA2 Project in Lucban, Quezon

Roll Out training of CRA-AMIA2 in Padre Burgos, Quezon.

Dr. Coladilla presented the the CRA-AMIA Project methodology and results in the roll-out training in Gen. Nakar in partnership with DA-Agriculural Training Institute IVA.

For. F.J. Gutierrez Jr., presented the CRA-AMIA2 Project results on Institute of Environmental Governance Training in Nawawalang Paraiso Resort in partnership with Tanggol Kalikasan