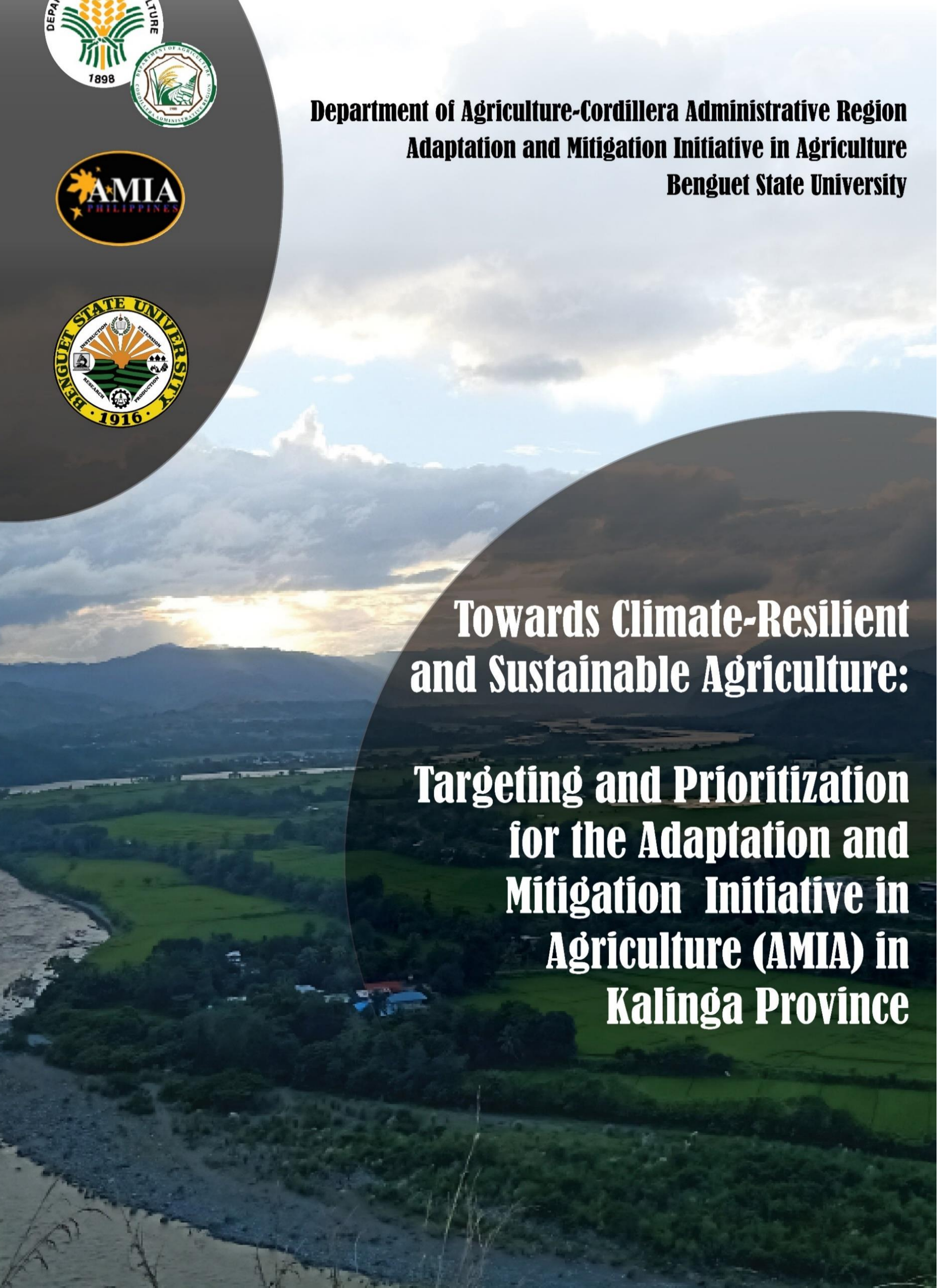

Department of Agriculture-Cordillera Administrative Region
Adaptation and Mitigation Initiative in Agriculture
Benguet State University

Towards Climate-Resilient and Sustainable Agriculture:

Targeting and Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in Kalinga Province

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EXECUTIVE SUMMARY

The Adaptation and Mitigation Initiative in Agriculture (AMIA) is a program launched by the Department of Agriculture (DA) – the principal government agency responsible for the promotion of agricultural development, to enable the local communities in the agri – fisheries sector to pursue sustainable livelihood while effectively managing climate risks. In 2017, AMIA2 was implemented in Cordillera Administrative Region (CAR) and Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon and Palawan (MIMAROPA) to which only Benguet province was included for CAR focusing on the highland vegetable farming communities. The project was in collaboration with the University of the Philippines Los Baños (UPLB), Benguet State University (BSU) and the DA – Regional Field Office – CAR (DA – RFO – CAR). Thus, with the natural geographical and topographical differences in the region of Cordillera, there is a need to do location – specific profiling and assessment for the rest of the provinces as basis for enhancing the climate – sensitive adaptation and mitigation interventions.

With the same methodology from the previous AMIA projects, this project entitled "*Climate – Resilient and Sustainable Agriculture: Targeting & Prioritization for the Adaptation and Mitigation Initiative in Agriculture (AMIA) in Kalinga Province*" was implemented to support the DA in planning, implementing strategies, targeting and prioritization of climate – resilient agri – fisheries technologies and practices, and identification and establishment of AMIA Villages in Kalinga Province.

The program is consisted with three (3) projects namely, Climate Risk Vulnerability Assessment (CRVA), Climate – Resilient Agriculture (CRA) and Cost – Benefit Analysis (CBA). CRVA project aimed to assess climate risks of the agriculture sector of Kalinga through geospatial and climate modeling tools, also, the project developed a baseline data platform for prioritizing climate adaptation and mitigation interventions for the province. On the other hand, CRA specifically aimed to assess the climate risk and resilience level of the agricultural communities of Kalinga Province and documented and analyzed local CRA practices adapted. CBA project aimed to determine and analyze the socio – economic benefit of the technology for adaptation.

This year – long undertaking has resulted into the following outputs: 1) CRVA – geospatially – based analysis of sensitivity and climate risk vulnerability of crops (conventional rice, heirloom rice, hybrid corn, banana and Robusta coffee), adaptive capacity of the different municipalities' agriculture sector in the effects of climate change in Kalinga province and exposure to climate related hazards. 2) CRA – comprehensive profile of climate risk and resilience level of local CRA practices of Kalinga province. Also, a socio – economic based analysis of technology for adaptation and mitigation strategies on rice, corn, coffee and banana production. CBA – feasibility of availing crop insurance through Philippine Crop Insurance Corporation (PCIC) and partial budget analysis of combine harvester for rice and corn production. In addition, for banana and coffee production, there were no adaptation/mitigation practices mentioned by the farmers that are considered in management practices for their production. Hence the study catches the farmers' perception and awareness of different adaptation technologies.

ABSTRACT

Climate change is contributing significant negative impacts on the agricultural sector which threatens food security and causes devastating effect to subsistence farmers who are heavily dependent on agriculture as their sustenance and livelihood. Therefore, there is a must to identify climate - related vulnerabilities, and adaptation and mitigation options that address this climate risk/vulnerabilities to minimize production losses and attain sustainable and high production of major crops especially on rice, corn, coffee and banana. CRVA of the five crops in the seven (7) municipalities and one (1) city in Kalinga Province was implemented to provide maps on exposure to hazard, sensitivity and adaptive capacity of the agri-fishery sector and subsequently identify target municipalities for the implementation of adaptation measures that improve resilience of agri – fishery communities. The crop occurrence (location of production areas) and yield were determined through participatory mapping with local experts. Crop sensitivity was determined through the use of the Maximum Entropy (MaxEnt) crop distribution modeling tool using the climatic variables of the current and future conditions (year 2050) based on Representative Concentration Pathway (RCP) 8.5 developed by the Intergovernmental Panel on Climate Change (IPCC). Results showed that for conventional rice, hybrid corn, and banana there is either a gain or loss in crop suitability per municipality; for heirloom rice, there is a general gain in crop suitability except in Lubuagan and Balbalan; while for Robusta coffee, a loss in crop suitability throughout the province was observed. Hazards were taken from the combination of different historical climate-related natural hazards (tropical cyclone, flood, landslide, drought, soil erosion, salt water intrusion, sea level rise, and storm surge) in the Philippines. Based on the overall hazard index, Pinukpuk and Tabuk City are the most exposed to these hazards followed by Rizal. Various indicators that were categorize into economic, human, physical, institutional, and anticipatory capital were used to determine the adaptive capacity of the local government units of Kalinga. Tabuk City, the provincial capital, has the highest adaptive capacity index for the different capitals. The CRVA result showed that by the projected year, the municipalities of Pinukpuk, Rizal and Lubuagan have the most vulnerable agriculture sector in Kalinga. This is mainly because these three (3) municipalities are characterized with high exposure to hazards, high sensitivity to climate change due to decrease in crop suitability, and at the same time, their adaptive capacity was low. In addition, through the conduct of focus group discussions (FGD) and key informant interviews (KII) with the local officials and farmers'/stakeholder representatives it was identified that in province of Kalinga the occurrence of typhoons accompanied by strong winds and heavy rains, and drought and/or prolonged dry season contributes greatly to the reduction of yield and income especially on rice and corn. However, in the occurrence of drought, coffee trees fruit better. To combat the effects of the various climatic hazards, various adaptation and mitigation strategies are employed by farmers like availing crop insurance from PCIC, selection and acquisition of appropriate seeds, use of water pump and combine harvesters for rice and corn production. Minimal to inadequate management is being done for coffee and banana production because it is mostly conspired as secondary crop in the province therefore no adaptation options/mitigation were identified. In order to determine the socio – economic benefit of the identified CRA adaptation technologies/strategies, CBA was done for the preferred adaptation technology/strategy and partial budget analysis was used for the other identified CRA adaptation technologies. Base from the farmer's costs and returns generated from their last cropping season (2020 wet season), adaptation strategies of the farmers and their perceived benefits and risks of availing crop insurance are also included. Given the high vulnerability of the target areas to climate risk as indicated in the vulnerability assessment, farmers will benefit from availing of crop insurance to mitigate the impacts of climate change. However, the total indemnity amount cannot fully recoup the potential losses of farmers in times of calamities.

In conclusion, in terms of prioritization in the selection of sites for the implementation of climate change adaptation and mitigation initiatives and projects, the municipalities of Pinukpuk, Rizal and Lubuagan were recommended. Also, it is recommended that climate smart technologies especially on Robusta coffee and banana production should be reemphasize to reduce impact

of climate change and increase yield and income. Hence for cost – benefit analysis, visitation of the crop insurance policies and procedures was recommended to have more financial impact on farmers. DA and concerned agencies can consider the provision of additional combine harvesters to farmers' associations and cooperatives to help farmers lessen their costs from rentals of the machine from private individuals. More units of combined harvesters available combined with accurate and timely dissemination of weather forecasts may result in less damage for corn and rice farmers during typhoons since more farmers can be serviced simultaneously.

I. RATIONALE

The world is already facing an inevitable increase in average temperatures of 0.5ºC to 1ºC by 2035, after which positive change will accelerate and approach a 2ºC increase (relative to 1990 levels) by 2050 **(**United Nations Development Programme, 2010). The impact of climate change is projected to worsen and could lead to increased stress on both human and natural system. However, climate change doesn't always give negative impacts, but can also bring benefits to other communities. The Philippines is highly vulnerable to climate change impacts. The country was the "*world's top climate victim"* in terms of damage caused by extreme weather events, and is among the top ten countries on a '*climate risk index'* from 1998 to 2007 on the basis of average damage from climate change (Raquedan, 2010).

Agriculture is one amongst the vulnerable sectors that is heavily affected by climate change though it is also one of the major sources of GHG emissions. Agricultural production is heavily dependent on weather and climate (Selvaraju *et. al.,* 2011) because of the shifting in the seasonal pattern of weather. For instance, rainfall affects the suitability of the agricultural land to the different types of crops which can lead to low productivity. In addition, risks of crop failures are already imposing great economic loss that threatens food security. These climatic variations are devastating especially to subsistence farmers who are dependent on agriculture as their sustenance and livelihood. Many small-scale farmers have always been affected by the damaging effects of drought, soil erosion, flooding and salinization – caused by tropical cyclones, sea level rise and salt water intrusions in groundwater aquifers. These events, coupled with land and water degradation, challenge agriculture production and strain the lives of farmers. The impacts are expected to be more severe with rising global temperature, sea level rise, more intense rainfall events and (thus more floods and landslides), longer dry spells, and stronger monsoon rainfall variability. In order to address the impacts of climate change, agricultural adaptation is an approach to manage potential risks.

Adaptation measures are needed urgently to reduce the adverse impacts of climate change by implementing strategic planning, identification and targeting of communities that are highly vulnerable to this change. Although farmers are already adapting by changing their cropping calendar and planting different varieties of the same crop, they need adaptation interventions with the help of experts. An effective approach to have a better understanding of major agricultural vulnerabilities is climate risks is vulnerability assessment, thus, it is fundamental in achieving more resilient farming systems, especially among poor rural households (Palao *et. al.,* 2017). CRVA is the starting point of understanding where could be the risks and vulnerabilities lie. Consequently, CRVA identifies the geographical areas that are most vulnerable in terms of these climate hazards.

In addition, cost-benefit analysis is fundamental in identifying the feasibility of the CRA practices compared to the non – CRA practice. In this project, crop insurance from PCIC as mitigation for typhoon and drought, and partial budget analysis for the use of combine harvester for drought in rice and corn production of Rizal, Tabuk and Pinukpuk were used for the CBA. Also, multi – stage stratified area probability sampling design was used.

II. OBJECTIVES

The overall objective is to assess and develop a climate – resilient agriculture platform as basis for prioritizing climate adaptation and mitigation technological interventions in the municipalities of Kalinga Province. Specifically, this program was conducted to:

1. assess climate risks of the agriculture sector through geospatial & climate modeling tools;
2. assess the climate risk and resilience level of the agricultural communities of Kalinga province;
3. document and analyze local CRA practices adapted;
4. determine and analyze the socio-economic benefit of the technology for adaptation; and
5. develop baseline data platform for prioritizing climate adaptation and mitigation interventions.

III. REVIEW OF LITERATURE

A. CLIMATE RISK VULNERABILITY ASSESSMENT

Sensitivity, adaptive capacity, and vulnerability of natural and human systems to climate change and to its potential consequences are the three (3) key dimensions of vulnerability that were assessed by the Intergovernmental Panel on Climate Change (IPCC, 2014). Vulnerability is usually depicted in negative terms, particularly, the inability to cope with adverse effects, the susceptibility to harm from exposure to stresses associated with environmental and social change, or the absence of capacity to adapt (Adger, 2006 and McCarthy *et. al.,* 2001). Sensitivity refers to the degree to which a system is affected, either adversely or beneficially, by climate-related stimuli. "*The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea-level rise)*" while adaptive capacity refers to *"the ability of a system to adjust to climate change – including climate variability and extremes – to moderate potential damages, to take advantage of opportunities, or to cope with the consequences"* (McCarthy et. al., 2001). Exposure is the character, magnitude and rate of climate change and variation (Läderach *et. al.,* 2011) and several biophysical indicators of exposure to climate change were factored-in and summarized as hazards (Paquit *et. al.,* 2018). Taking into account the foregoing dimensions, vulnerability assessment was developed to design and implement effective interventions, provide guidance, and support for adaptation planning to promote proactive adaptation in agriculture by identifying where the most vulnerable areas are located, what are the stressors, and how this might change in the future (Ford *et. al.,* 2018).

There were researches on CRVA conducted in the country to include:the CRVA for the AMIA program in the Philippines – Ilocos Sur, Isabela, Tarlac, Quezon, Camarines Sur, Iloilo, Bukidnon, Davao City, North Cotabato and Negros Occidental (Palao *et. al.,* 2017)**,** in Bukidnon (Paquit *et. al.,* 2018), and in Benguet (Daipan *et. al.,* 2018 & Lumbres *et. al.,* 2018).

The abovementioned researches identified and guided the decision makers such as government agencies, extension staff, and private sectors on where are the geographic areas that are in most need of interventions. These studies provided great contribution on the selection of AMIA Village sites which served as a lighthouse for other communities to learn and emulate. In addition, technological and institutional innovations are introduced in order that these villages may have access to climate-relevant support services.

B. CLIMATE – RESILIENT AGRICULTURE

The Philippines is endowed with nature that is fitted for agriculture. It is a place where tracks of farm lands, fruit trees, rivers and springs can be found. Ecologically and geographically the country is suited for agriculture (Fernandez, 2014). Agriculture is a major economic, social and cultural activity, and it provides a wide range of ecosystem services. Importantly, agriculture in its many different forms and locations remains highly sensitive to climatic variations, the dominant source of the overall variability of production and a continuing source of disruption to ecosystem services (Howden *et. al.,* 2007). This existing sensitivity and climate risk explain why a changing climate will have a subsequent impact on agriculture.

Weather and climate have a direct influence on cropping systems and plant yield. Thus, weather fluctuations and climate variability play a significant role in crop growth and yield. Climate variability can be readily observed from the fluctuations in rainfall, wind speed and direction, and temperature (Lansigan *et. al.,* 2000). Rainy season duration is one of the primary factors affecting crop production prospects. Within a specific location, rainy season onset and final rain date are varying greatly from one cropping season to another (Selvaraju, 2012).

Occurrence of El Niño Southern Oscillation (ENSO) is one of the most remarkable inter – annual climate phenomena in the world. El Niño usually result to: (a) late onset of the rainy season, (b) early termination of the rainy season, (c) weak monsoon events characterized by isolated heavy rainfall events of short-duration, and (d) weak tropical cyclone activity characterized by less intense cyclones and less number of tropical cyclones within Philippines. Tropical cyclones characterized by strong high winds and heavy rainfall are destructive to crops. Damage to crops may range from negligible to total wipeout depending on the intensity and duration of the storm event as well as prevailing crop growth stage during the occurrence of the cyclones (Lansigan *et. al.,* 2000).

As a result of weather fluctuations and climate variability, cultivated areas may become unsuitable for cropping and grassland may become more and more arid (Asfaw & Lipper, 2016). Enhance distribution and increase competitiveness of agronomically important and invasive weeds, which is generally not accounted for, could be quite significant as reported by IPCC (2014).

With the weather fluctuations and climate variability, there is an immense diversity of agricultural practices because of the range of climate and other environmental variables; cultural institution, and economic factors; and their interactions. This means there is a correspondingly large array of possible agricultural adaptation options. Adaptation is an important component of an integrated and balanced strategy to climate variability (MacIver, 1998). This agricultural adaptation aims to effectively manage potential climate risks over the coming decades as climate changes.

In the Philippines, rice is the most important staple crop, contributing roughly 20% of the country's agricultural GVA. Approximately 2.5 million household practice rice farming - most are engaged in production activities, 4% in post – production and 13% on ancillary activities (Gonzales, 2013). Typhoons, floods and drought caused 82.4% of the total rice (*Oryza sativa* L.) losses from 1970 to 1990 (Philippine Rice Research Institute & Bureau of Agriculture Statistics, 1994). Corn is the second most important crop. It is use as food stuff that is processed into corn flakes, chips and other products. It is used as feeds for poultry and livestock and an emerging used for bio – products like solvents, cleaners, deicers and plastics. It is also used as raw materials for starch oil, protein and fiber, production of ethanol compound blended in fuel and gasoline for clean and reduced smoke emissions of cars and automobiles.

Coffee is the second most traded commodity in the world. Thus, the countries with in the coffee belt have taken to harvesting the highly valued crop, and for many, coffee become one of their biggest income earners. Coffee is the second most important product in the international commerce based on volume traded, and it is estimated to be first because of value. The coffee growing and producing industry is very large and labour intensive. It is estimated that 60 million people earn some or all of their income from coffee, which is 1% of the world's population.

The Cordillera, according to a DA report, is one of the top producers of quality coffee in the country. Robusta coffee is mostly grown in warmer area such as Kalinga and Ifugao while Arabica variety thrives better in temperate and mountainous terrain areas like Benguet and Mountain Province.

Kalinga Robusta coffee accounts for almost 40% of commercial coffee production. Robusta coffee can flourish in hotter, harsher conditions. The optimal growing conditions for Robusta differ from those of Arabica: Robusta grows in lower elevations, from sea level to 700 meters (about 2,300 feet). It prefers higher temperatures: 24–30°C (75–86°F), and more rainfall: 2,000–3,000 millimeters (79 – 118 inches) (Lokker, 2014).

Kalinga was ranked as the seventh-largest coffee producer in the country, with 3,698.50 metric tons (MT) or 68% Robusta coffee of Cordillera's total coffee as of 2015, according to the DA. Tanudan, Kalinga has the widest production area for Robusta beans planted on 3,954 ha of land, almost half of the province's total production area, according to the DA. A total of 10,598 farmers tend to 7,418 ha of Robusta trees, which produce 3,784 MT of beans.

CAR produces 4.1% or 4,054.6 MT of the country's banana supply (Philippine Statistics Authority, 2021). This makes CAR the top 16 producer of banana in the Philippines. Banana is a source of weekly farm income in the region. In 2013, a sharp decline of banana production in the Philippines resulted from the occurrence of Typhoon Pablo (Department of Agriculture, 2019).

C. <u>COST – BENEFIT ANALYSIS</u>

In the wake of climate change, farmers and fishermen are vulnerable to disasters. As an effective safety net to protect them against losses from drought, flooding, and erratic rainfall, agricultural insurance is offered by government programs. Complementary approaches to build resilience and mitigating negative impacts of climate change are readily available for adoption and implementation. Agricultural insurance is seen as a promising strategy for building resiliency. Its goal is to transfer some of the production risks faced by farmers to the private insurance sector. The crop insurance compensates for the high losses incurred by farmers due to risks beyond their control. It is useful in reducing the negative coping adjustments of farmers, such as cost-cutting of farm inputs and decreased meal consumption. Farmers, or government agencies on their behalf, pay an amount at the start of the season to the insurance company for this protection. In the event of natural disasters affecting agricultural production, the PCIC offers multi – risk cover, compensating for losses due to natural disasters, pest infestation, and plant diseases. All rice varieties accredited by the National Seed Industry Council (NSIC) are insurable. Crop insurance coverage commences (granting that the certificate of insurance coverage is already issued) from direct seeding or upon transplanting to harvesting. Ideally, agricultural insurance is just part of a holistic climate risk mitigation strategy that provides a safety net for events that are beyond the control of the farmer; the farmer must still take steps to mitigate risks (Labios *et. al.,* 2020).

The PCIC is a government – owned and controlled corporation (GOCC) created by virtue of PD 1467 (June 11, 1978) and was amended by PD 1733 (October 21, 1980) and further amended by RA 8175 (December 29, 1995), as the implementing agency of the government's agricultural insurance program. PCIC is an attached agency of the DA. The PCIC's principal mandate is to provide insurance protection to farmers against losses arising from natural calamities, plant diseases, and pest infestations of their rice and corn crops as well as other crops. The PCIC also provides protection against damage to/loss of non-crop agricultural assets including but not limited to machinery. Equipment, transport facilities, and other related infrastructures due to peril/s insured against. The Philippines is vulnerable to natural disasters which cause devastation on crops and miseries to agricultural producers and lenders of agricultural credit. Because of the marginality of most landholdings, the result of these losses is devastating to the finances of the farmers. In 1976, an Interagency Committee for the Development of Crop Insurance undertook a nine – month full – blown feasibility study on the creation of crop insurance programs in the Philippines. It was concluded that the agricultural insurance system will address not only the welfare aspect of the after-loss event but also help in achieving the objective of stabilizing farm incomes and reverse the "risk – averse" nature of farmers and push them to invest more in new technologies that would help increase national productivity. Apart from protecting farmers from financial losses, crop insurance was also considered as an instrument to influence and encourage them to continue participating and supporting government credit programs. It ushered in the creation of the PCIC and the operationalization of the insurance program through the issuance of a presidential decree (PD No. 1467 promulgated on 11 June 1978) which had then the force of law (Philippine Crop Insurance Corporation, 2021).

To avail of any PCIC agricultural insurance package, the insurance client must submit all necessary documents, as listed below, to PCIC offices, PCIC authorized underwriting agents, or lending institutions where farmers obtained their production loans (for borrowing clients). For rice and corn insurance, filing of application must be before the data of planting up to 15 calendar days after planting (Reyes *et. al.,* 2017).

Requirements for insured application for rice and corn insurance:

1. Individual Borrowing Farmer:
    a. Application for Production Loan (APL), which also serves as the insurance application.
    b. Farm Plan and Budget (FPB), including the farm activities.
    c. Location Sketch Plan (LSP) or Control Map (CM), which shows landmarks and names of adjoining lot owners.
2. Farmers Borrowing as a Group:
    a. List of Borrowers (LOB), including the names, addresses, farm area, location, planting schedules, variety planted, amount of loan, and signature of borrowers.
    b. Standard Farm Plan and Budget.
    c. Control Map.
3. Self-financed Farmer:
    a. Application for Crop Insurance (ACI)
    b. Farm Plan and Budget (FPB)
    c. Location Sketch Plan (LSP) or Control Map (CM)

Where to File:

1. Lending institution where farmers obtained their production loans.
2. PCIC Regional Offices.
3. PCIC authorized underwriting agents.

Agricultural insurance has been free since 2014, through the implementation of the government's Agricultural Insurance Program for subsistence farmers and fisherfolks listed in the Registry System for the Basic Sectors in Agriculture (RSBSA). Under the 2018 General Appropriations Act (GAA), the government appropriated Government Premium Subsidy (GPS) to PCIC. This GPS is for the full (100%) cost of insurance premiums of subsistence farmers and fisherfolks registered in the RSBSA for crops (rice, corn, high – value crops), livestock, fisheries/aquaculture, and non – crop agricultural assets (Philippine Crop Insurance Corporation, 2021).

The Department of Agrarian Reform (DAR) and the DA are working double – time to expedite the enrollment of agrarian reform beneficiaries (ARBs) to the RSBSA (DAR, 2020).

i. Philippine Crop Insurance Incorporation Products

1. Rice and Corn Crop Insurance (RCCI) - An insurance protection extended to farmers against losses in rice and corn crops due to natural calamities as well as plant pests and diseases.
2. High – Value Crop Insurance (HVCI) -An insurance protection extended to farmers against losses in high – value crops due to natural calamities and other perils such as pests and diseases. High – value crops include *abaca*, *ampalaya*, asparagus, banana, cabbage, carrot, cassava, coconut, coffee, commercial trees, cotton, garlic, ginger, mango, mongo, onion, papaya, peanut, pineapple, sugarcane, sweet potato, tobacco, tomato, watermelon, white potato, etc.
3. Livestock Insurance (LI) - An insurance protection extended to livestock raisers against loss of carabao, cattle, horse, swine, goat, sheep, poultry, and game fowls and animals due to accidental death or diseases.
4. Non – Crop Agricultural Asset Insurance (NCI) - An insurance protection extended to farmers against loss of their non-crop agricultural assets like warehouses, rice mills, irrigation facilities, and other farm equipment due to perils such as fire and lightning, earthquake and other risks of direct physical loss or damage to the property insured from an external cause.
5. Fisheries Insurance (FI)- An insurance protection extended to fish farmer/fisherfolk/grower against losses in unharvested fish/stocks due to natural calamities and fortuitous events.
6. Credit and Life Term Insurance (CLTI)
   a. Agricultural Producers Protection Plan (AP3) - Is an insurance protection that covers the death of the insured due to accidents, natural causes, and murder or assault.
   b. Loan Repayment Protection Plan (LRP2) - Is an insurance protection that guarantees the payment of the face value or the amount of the approved and released agricultural loan upon the death or total permanent disability of the insured borrower.
   c. Accident and Dismemberment Security Scheme (ADS2) - Is an insurance protection that covers the death or dismemberment of the insured due to an accident.

ii. Types of Program Implementation

1. Regular Program - the premium is shared by the farmer, the lender, and the government. All PCIC insurance products are included under this program. Farmers who do not qualify in any of the Special Programs may insure under this category.
2. Special/Subsidized Program - the premium is fully subsidized by the Sponsoring Agency.

Table 1. Special Programs of the PCIC.

Special Program (100% Premium Subsidy)	Beneficiaries	Insurance Products
Agricultural Insurance Program for RSBSA - Premium is fully subsidized/ paid by PCIC Budget Allocation from the National Government	Farmers &Fisher folk are listed in the Registry System for Basic Sectors in Agriculture (RSBSA).	All Agricultural Insurance Products Except CLTI
Insurance Program for Agrarian Reform Beneficiaries (ARBs) Participating in the APCP & CAP- PBD - 100% premium discount is provided by PCIC	Borrowers under: • The Agrarian Production Credit Program (APCP) and • Credit Assistance Program (CAP) for Program Beneficiaries Development (PBD	All Agricultural Insurance Products
Sikat Saka Rice Program - 100% premium discounts is provided by PCIC	Farmers participating in the credit component of the Food Staples Sufficiency Program (FSSP) of the DA in partnership with the LBP	Rice Crop Insurance
Sikat Saka Corn Program - 100% premium discounts is provided by PCIC	Small corn Farmers listed in the Registry System for Basic Sectors in Agriculture (RSBSA) participating in the DA-LBP Sikat Saka Program for Corn	Corn Crop Insurance
Production Loan Easy Access (PLEA) Program	Small Farmers listed in the Registry System for Basic Sectors in Agriculture (RSBSA) participating in the DA-ACPC PLEA Program	All Agricultural Insurance Products

Farm Eligibility

As stated in the PCIC operations manual revised as of April 2021 farm will be eligible for insurance as long as it follows the following criteria:

- The farm must not be a part of riverbed, lakebed, marshland, shoreline, or riverbank; must be at least 200 meters away from any body of water, and must be at least 5 meters elevated if it is less than 200 meters;
- Must be suitable for production purposes in accordance with the recommended Package of Technology (POT), *e.g* right zinc content for rice; not more than 15 degrees slope for corn, except for those farmlands with contour structure using the Sloping Agricultural Land Technology (SALT);
- The farm must be planted within the cut-off date;
- The farm must have an effective irrigation and drainage system;
- The farm must be accessible to regular means of transportation; and
- Farm location must have generally stable peace and order conditions and not be hazardous to health.

Claims

In case of crop damage, a written Notice of Loss shall be sent to the PCIC Regional Office or PCIC Extension Office/Service Desk within the following prescribed period.

- Typhoon, flood, tomato, and hailstorm – within 20 calendar days from the occurrence of calamity but not later than the scheduled date of harvest or replanting.
- Drought, pests and diseases – upon discovery of damage but not later than 20 calendar days before the expected date of harvest per Certificate of insurance cover.

Assured farmer, an immediate member of the assured farmer's family with sufficient knowledge of the insured farm and duly authorized official of cooperative or farmer group where the assured farmer belongs can file or process notice of loss via personal delivery, mail (postal system, 24 – hour courier delivery, e-mail) or fax at the nearest PCIC offices.

Loss Category:

- Total loss - if loss is 90% and above.
- Partial loss - if loss is more than 10% and below 90%.
- No loss - if loss is 10% or less.

Corn, Rice Farming and Climate Change

Agriculture is one of the sectors that is adversely affected by climate change. In the Philippines, it is considered the dominant livelihood for the rural poor and it contributes 9.2% to the gross domestic product in 2019 (Philippine Statistics Authority, 2020). The production of staple crops, such as rice and corn, and cash crops will be negatively impacted by a changing climate.

White corn is used primarily as food while yellow corn is intended for feed. In 2019, corn recorded a total of 7.98 million MT harvested from a total of 2,516.7 ha. CAR accounts for 2.9% of the total corn production in the country. During the same period, yellow corn accounted for a total of 5.91 million MT while white corn is estimated at 2.07 million MT (Philippine Statistics Authority, 2020).

In 2019, the country's production of corn incurred an average cost of PhP 24,740/ha. Gross returns averaged PhP 41,337/ha. After deducting all costs, returns amounted to an average of PhP 16,598/ha. Farmers netted PhP 0.67 for every peso invested in corn production. The cost per kg of producing corn averaged PhP 7.80 while the farmgate price was quoted at an average of PhP 13.04/kg (Philippine Statistics Authority, 2020).

In the CAR, production of yellow corn in 2019 generated an average cost of PhP 37,594/ha. The average gross return is computed at PhP 48,799/ha. The average net return is PhP 11,205/ha and for every peso invested in producing yellow corn, farmers gained PhP 0.30. The average cost per kg of yellow corn is estimated at PhP 9.56 while the farmgate price is recorded at PhP 12.41/kg (Philippine Statistics Authority, 2020).

Rice is the most important crop in the country. In 2019, 18.81 million MT of rice were harvested from 4,651.5 ha. CAR accounts for 2.2% of the total rice production in the country (Philippine Statistics Authority, 2020).

In 2019, the country's production of rice incurred an average cost of PhP 24,740/ha. Gross returns averaged PhP 66,626/ha. After deducting all costs, returns amounted to an average of PhP 21,324/ha. Farmers netted PhP 0.47 for every peso invested in rice production. The cost per kg of producing rice averaged PhP 11.20 while the farmgate price was quoted at an average of PhP 16.47/kg (Philippine Statistics Authority, 2020).

In the CAR, the production of rice in 2019 generated an average cost of PhP 48,098/ha. The average gross return is computed at PhP 63, 002/ha. The average net return is PhP 14,904/ha and for every peso invested in producing rice, farmers gained PhP 3.78. The average cost per kg of rice is estimated at PhP 12.74 while the farmgate price is recorded at PhP 16.68/kg (Philippine Statistics Authority, 2020).

The province of Kalinga is the major producer of rice in the region, but apart from rice, there is also a significant number of farmers who are into yellow corn production. Like any other crop, the production of rice and yellow corn in the province is confronted with various production issues that range from the high cost of inputs to climate-related issues such as typhoons and drought.

Combine Harvester

Hossain *et. al.,* (2015) reported that timely harvesting is extremely important, as delayed harvesting leads to delays in seed bed preparation and sowing operations for the next crops. Currently, timely harvesting of rice is a big challenge due to the shortage of labor and high cost of labor as large number of labors are migrated from rural to city due to the rapid industrialization and urbanization. To overcome these problems, mechanical harvesting is urgently needed (Keerti & Raghuveer, 2018). Using technologies/mechanization can improve the timing of tasks (Jones *et. al.,* 2019). The modern combine harvester is a versatile machine designed to efficiently harvest a variety of grain crops. The name derives from its combining three (3) separate harvesting operations such as reaping, threshing, and winnowing into a single process. Thus, combine harvester is a time saving technology. Use of efficient machines saved 20 – 30% of operation time than ordinary machine (Tiwari *et. al.,* 2017). There is a positive trend of mechanization across the world in rice production, which contributes reducing the time consumption. Average time saving by using combine harvester over manual methods was found to be 97.50% (Hossain *et. al.,* 2015).

IV. METHODOLOGY

a. Study Site

Kalinga province is one of the six (6) provinces that composes the CAR (Figure 1). Based on its topographical features, the eastern portion of the province is rolling while the western area is crested peaks with isolated plateaus and valleys. The province is constituted of seven (7) municipalities namely, Balbalan, Lubuagan, Pinukpuk, Rizal, Tanudan, Tinglayan, Pasil and Tabuk, a component city. Kalinga has a total land area of 324,130 ha which accounts for 16% of the land area of CAR (Kalinga Agricultural Profile, 2020). From the total land area of the province, 101,430 ha is considered as potential agricultural production areas but only 52,464 ha is actually planted with agricultural crops. The province had the largest holding/farm area in CAR in 1980 and 2012 (Philippine Statistics Authority, 2012). As of 2016, there are 257,512 projected populates, 67% of which were considered as economically active labor force in agriculture, forestry and fishing, where 70.89% are male and 29.11% are female.

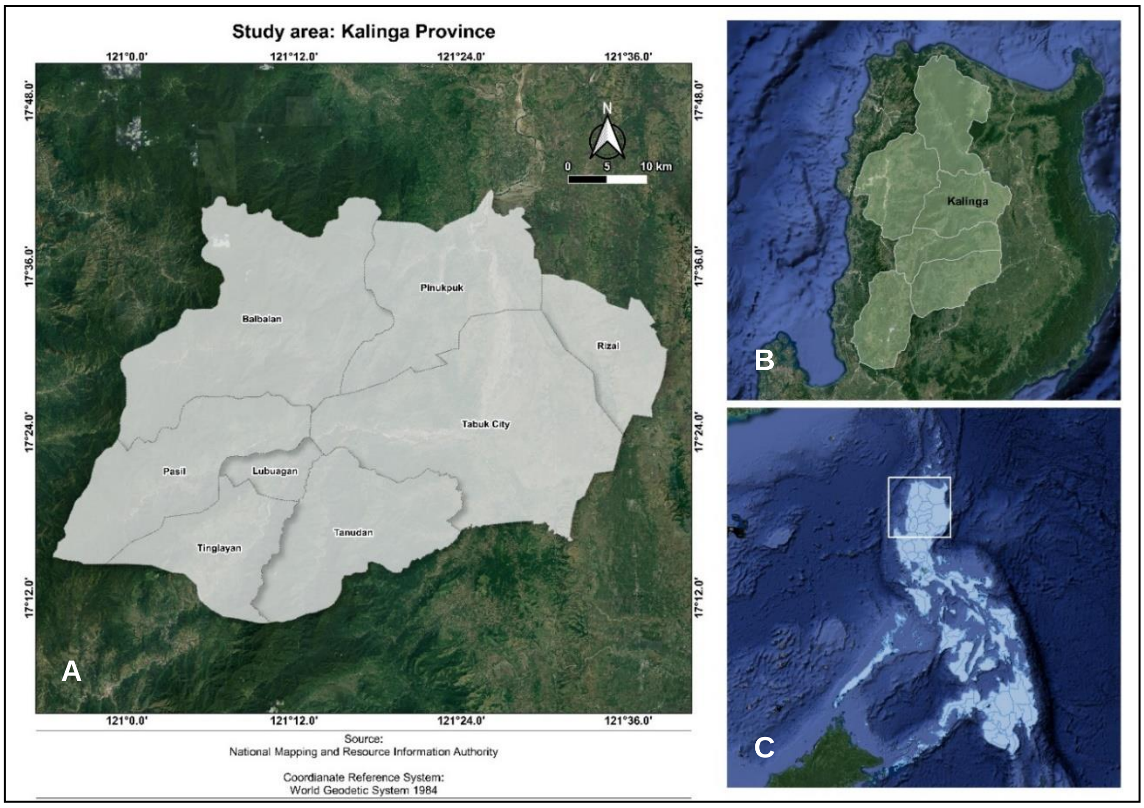

Figure 1. Geographical location of the study site. A) Kalinga Province, B) Cordillera Administrative Region, C) CAR in the Philippines.

b. Selected Crops

The province soil type is mostly suitable for rice, corn, coffee and banana production for all the municipalities. Based from the data of Philippine Statistics Authority (2019), 20,365.07 ha (irrigated, rainfed upland) and 4,118.64 ha (heirloom) are the total physical area for rice production, 13,256 ha for corn (white and yellow), 7,630.4 ha for coffee and 3,352.3 ha for banana. The above – mentioned crops were selected for the conduct of AMIA in Kalinga. Rice and corn are considered as the top two (2) most important crops in the Philippines given that rice is a staple food and corn is a good substitute for rice especially in poor or rural areas. Coffee, on the other hand, is one of the province's one town one product (OTOP) while banana had the most production among the high value crops (HVCs).

A. CLIMATE RISK VULNERABILITY ASSESSMENT

Under the DA – RFO – CAR project, the AMIA was conducted to plan and implement strategies to support local communities in managing climate risks from extreme weather events to long-term climatic shifts. In order to establish CRA communities, CRVA was proposed to guide AMIA in targeting and planning. CRVA would ensure that the AMIA investments are cost – effectively channeled to support the overall goals and outcomes and to address the inherent spatial and temporal variabilities within and across sites. The procedures followed was based on the (International Center for Tropical Agriculture (CIAT) methodologies using the CRVA framework as shown in Figure 2.

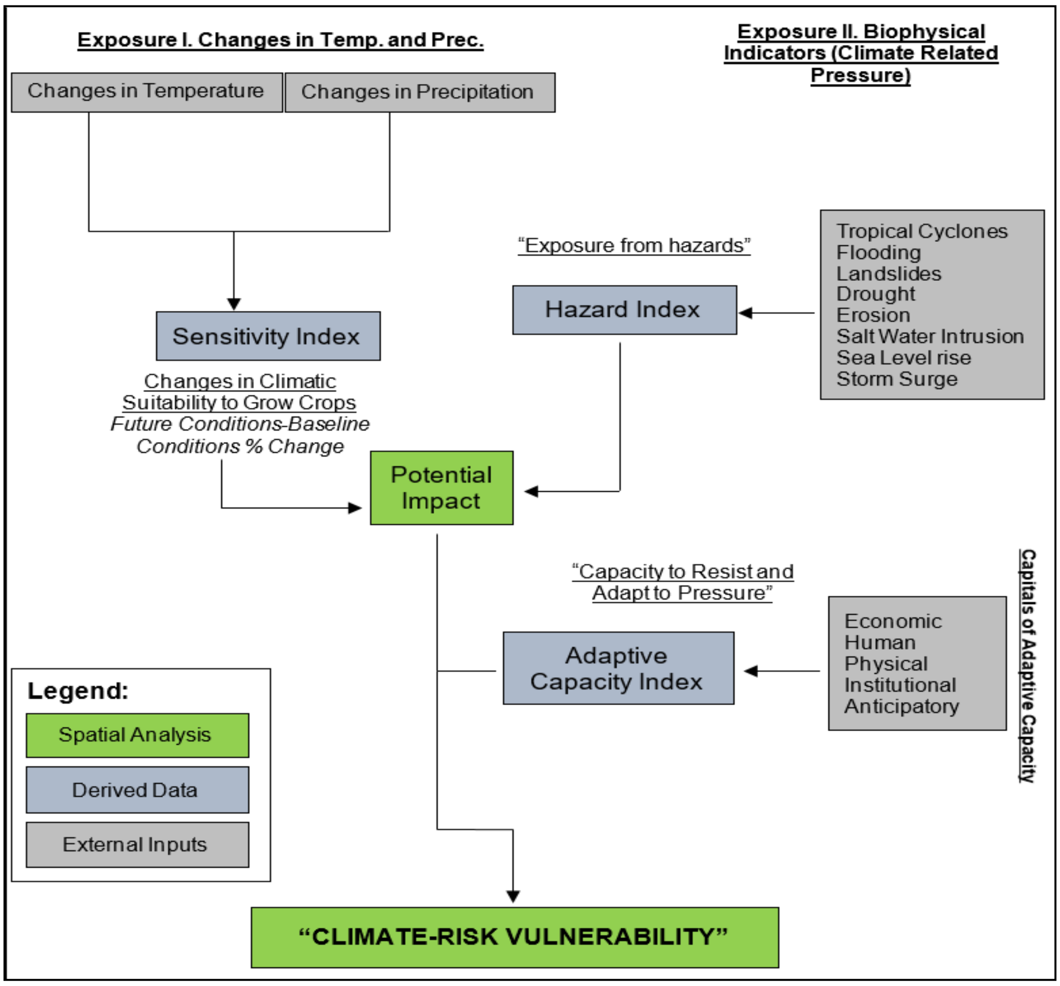

Figure 2. Climate risk vulnerability framework.
Source: Palao et. al., 2017

a. Sensitivity Index

Although there are other factors that could affect the suitability of a crop to grow in a certain condition, this study only focuses on climate – related factors which are the changes in the temperature and the changes in precipitation. The analysis of sensitivity was based on the assumption of a high emission scenario by 2050 (RCP 8.5 developed by the IPCC).

<u>Crop Occurrence Points</u>

Crop occurrence points were needed in order to identify the suitability each crop. A participatory mapping workshop with local experts (municipal agriculturists, agricultural technicians and/or banner program coordinators) of each municipality was carried out to locate the selected crops in their respective municipalities (Figure 3). Prior to the workshop proper, the participants were requested to bring a copy of the agricultural profile of their municipality that contains agricultural area, crop yield, and production data that are available at the barangay level to be used as a guide in mapping the occurrence of crops. Grid maps were printed for the participants to record the location and yield of each crop. Crop occurrence was processed with the aid of Quantum Geographic Information System (QGIS) software, satellite images from Google Earth that show the geographical features of their respective municipality such as road networks, river networks, municipal and barangay political boundaries, and grid maps with 1km-by-1km resolution.

Crop yield of each crop – rice (conventional and heirloom), hybrid corn, Robusta coffee and banana, were annotated as high, moderate, or low yield based from their existing data reports. This was used as a basis for the ranking of crop production (low – high) of the selected crops in Kalinga Province. The participants documented the crop occurrences of each crop. The results varied in terms of total number of points per crop. Each occurrence was georeferenced using the field calculator function of QGIS to identify the coordinates of each point. The reference system used for each point was set to World Geodetic System 1984 (WGS 84). Finally, the georeferenced crop occurrence data were formatted in comma separated value (.csv) since this is the format required by the crop distribution modeling tool that was used.

Current Conditions

A total of 19 bioclimatic variables (Table 2) were selected to assess the climate suitability of each crop. The bioclimatic variables were collected from WorldClim. These bioclimatic variables (representing annual trends, seasonality and extremes of the environment; accumulated from weather station data from the 1961–1990) were derived from monthly temperature and rainfall values for the purpose of producing variables that are biologically relevant (Hijman, *et. al.,* 2005). These are necessary to understand species responses to climate change (O'Donnell & Ignizio, 2012). Climatic variables that are related to temperature are Bio 1 to Bio 11 while those related to precipitation are Bio 12 to Bio 19.

Table 2. The Bioclimatic Variables used and their descriptions.

Code	Climatic variable	Description
Bio1	Annual Mean Temperature	Annual mean temperature derived from the average monthly temperature.
Bio2	Mean diurnal range	The mean of the monthly temperature ranges (monthly maximum minus monthly minimum).
Bio3	Isothermality (Bio2/Bio7)*(100)	Oscillation in day-to-night temperatures.
Bio4	Temperature seasonality	The amount of temperature variation over a given year based on standard deviation of monthly temperature averages
Bio5	Maximum temperature of warmest month	The maximum monthly temperature occurrence over a given year (time-series) or averaged span of years (normal).
Bio6	Maximum temperature of coldest month	The minimum monthly temperature occurrence over a given year (time-series) or averaged span of years (normal). Variation over a given period.
Bio7	Temperature annual range (Bio5-Bio6)	A measure of temperature
Bio8	Mean temperature of wettest quarter	This quarterly index approximates mean temperatures that prevail during the wettest season.
Bio9	Mean temperature of driest quarter	This quarterly index approximates mean temperatures that prevail during the driest quarter.
Bio10	Mean temperature of warmest quarter	This quarterly index approximates mean temperatures that prevail during the warmest quarter.
Bio11	Mean temperature of coldest quarter	This quarterly index approximates mean temperatures that prevail during the coldest quarter.
Bio12	Annual precipitation	This is the sum of all total monthly precipitation values.
Bio13	Precipitation of wettest month	This index identifies the total precipitation that prevails during the wettest month.
Bio14	Precipitation of driest month	This index identifies the total precipitation that prevails during the driest month.
Bio15	Precipitation seasonality (Coefficient of variation)	This is a measure of the variation in monthly precipitation totals over the course of the year. This index is the ratio of the standard

Code	Climatic variable	Description
		deviation of the monthly total precipitation to the mean monthly total precipitation and is expressed as percentage.
Bio16	Precipitation of wettest quarter	This quarterly index approximates total precipitation that prevails during the wettest quarter.
Bio17	Precipitation of driest quarter	This quarterly index approximates total precipitation that prevails during the driest quarter.
Bio18	Precipitation of warmest quarter	This quarterly index approximates total precipitation that prevails during the warmest quarter.
Bio19	Precipitation of coldest quarter	This quarterly index approximates total precipitation that prevails during the coldest quarter.

Source: http://www.WorldClim.org

Future Conditions

According to Woodward (1987), plant distribution is primarily being controlled by climate. To analyze the changes in crop suitability under climate change, crop distribution was modelled using a future downscaled climate data (IPCC, 2001). RCP provides potential trajectory that project future changes in climate by assessing a series of different uncertainties. Four scenarios – RCP2.6, RCP4.5, RCP6 and RCP8.5 were developed based on their total radiative forcing (i.e. cumulative measure of human emissions of greenhouse gas (GhG) from all sources expressed in Watts per square meter) pathway and level by 2100. The scenario's storyline describes a heterogeneous world with continuously increasing global population, resulting in a global population of 12 billion by 2100 (Riahi *et. al.,* 2011). Over the years, the GhG emissions and concentrations is considerably increasing following the trend of the 8.5 scenario reaching a radiative forcing of 8.5 W/m^2 by the year 2050.Thus, for this study, the RCP 8.5 was used as basis for future projection of climate change by year 2050 (Figure 3).

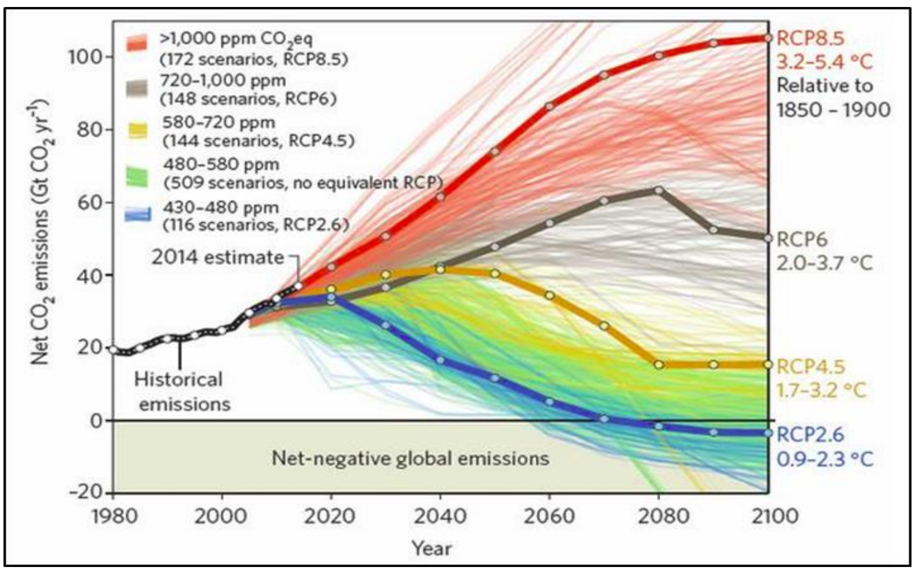

Figure 3. Representative Concentration Pathways (RCPs) developed by IPCC based on the projected amount of CO2 emitted.
Source: IPCC 5th Assessment Report, 2013

<u>Crop Distribution Modelling Tool</u>

Maximum Entropy (MaxEnt) species distribution model Ver. 3.3.3k was used to determine the crop suitability based on the crop occurrence points and environmental layers. The tool is commonly used to estimate most suitable areas for crops based on the probability in geographic areas where the distribution of crops is scarce (Elith & Burgman, 2001). MaxEnt compared to other modeling tools produces an impressive predictions of crop suitability (Phillips *et. al.,* 2008). This model makes use of a correlative model of the climatic conditions that meet the crop's environmental requirements and predicts the relative suitability of location (Davis *et. al.,* 2012). These environmental requirements were represented by bioclimatic variables (Table 2) which are combined to determine areas most suitable for the particular crop.

<u>Sensitivity Analysis</u>

Sensitivity is the degree to which a system is affected, either adversely or beneficially, by climate variability or change (Läderach *et. al.,* 2011). The climatic suitability of each crop was analyzed in QGIS. The crop suitability of each crop was determined by subtracting the future from baseline suitability (expressed as percentage). This reflects the degree of crop sensitivity to changing environmental conditions.

Crop sensitivity formula:

$$\frac{\text{(Future Conditions – Current Conditions)}}{\text{Current Conditions}} \times 100$$

(Source: Palao et. al., 2017)

To determine the percent change in suitability of each crop, crop sensitivity was reclassified based on the classification of CIAT as shown in Table 3. This index ranges from -1.0 to 1.0. Based from the sensitivity index, indication of low suitability ranges from 0.25 to 1.0, while - 0.25 to -1.0 signifies gain in suitability. The higher the change in a negative direction reflects a higher impact caused by climate change (Palao *et. al.,* 2017).

Table 3. Sensitivity index based on percent change in crop suitability from baseline to future condition.

Percent Change in Suitability (Range in %)	**Index**	**Description**
<= -50 (Very high loss)	1.0	Loss
>-50 & <= -25 (High loss)	0.5	
> -25 & <= -5 (Moderate loss)	0.25	
> -5 & <= 5 (No change)	0	No Change
> 5 & <= 25 (Moderate gain)	-0.25	Gain
> 25 & <= 50 (High gain)	-0.5	
> 50 (Very high gain)	-1.0	

Source: Palao et. al., 2017

b. Hazard Index

Hazard is the nature and degree to which a system is exposed to significant climatic variations and extreme events and are identified based on its known potential impact on the agricultural sector and characterized by their extent, magnitude, severity, duration and variability (Parker *et. al.,* 2019 and Bragais *et. al.,* 2020). The identification of hazard was based on its potential impacts on the agricultural sector.

Hazard Dataset

Eight (8) climatic hazards, namely tropical cyclone, flood, drought, soil erosion, landslide, storm surge, saltwater intrusion and sea level rise, were identified to affect agricultural production in the Philippines, especially rice and maize (Palao *et. al.,* 2017). Hazard datasets refer to the historical databases to evaluate the current susceptibility of a hazard to occur in a geographic area (Bragais *et. al.,* 2020). These datasets (Table 4) were based on the result of workshop and consultations conducted by CIAT with local and national experts – SUC experts/focal persons. Each of these hazards was weighted for each island group of the Philippines because these island groups are unique in terms of exposure to hazards, rainfall pattern, landform, and crop distribution. Also, each hazard has different degree, intensity and frequency, and the potential damage also varies (Palao *et. al.,* 2017). The hazards weights used for this study were the Luzon weights – typhoon (20%), flood (19.05%), drought (14.25%), erosion (11.43%), landslide (8.57%), storm surge (9.52%), sea level rise (5.71%), and salt water intrusion (11.43%).

Table 4. Hazard weights in the island group based from the workshop with experts.

Hazards	Island Group		
	Luzon (%)	Visayas (%)	Mindanao (%)
Typhoon	20.00	18.21	16.95
Flood	19.05	16.40	15.25
Drought	14.25	16.17	16.95
Erosion	11.43	12.57	12.71
Land Slide	8.57	10.72	14.41
Storm Surge	9.52	10.39	8.47
Sea Level Rise	5.71	8.33	5.08
Salt Water Intrusion	11.43	7.21	10.17

Source: Palao et. al., 2017

CIAT provided the raster (tropical cyclone, drought, sea level rise and salt water intrusion) and vector data (landslide, flood and soil erosion) for CAR. Processing of these hazards was mostly done in QGIS software. Since the given data were for the whole region, the raw data of hazard were clipped to get the needed feature for Kalinga province (Figure 4). Vector data were rasterized (vector to raster) then normalized to have values that ranges from 0 – 1. Using the zonal statistics tool of QGIS, mean values for the intensity of tropical cyclone, flood, soil erosion, and landslide were calculated while sum values for the occurrence of drought, sea level rise, salt water intrusion and storm surge. These were normalized and were multiplied to their equivalent hazard weights and were summed up. The overall hazard values were normalized and classified into very low (0 - 0.20), low (0.20 – 0.40), moderate (0.40 – 0.60), high (0.60 – 0.80) and very high (0.80 – 1.00).

Normalization formula:

$$hazidx\_norm = \frac{X_{min}}{X_{max} - X_{min}}$$

where: hazidx_norm is the normalized values of the hazard index, x is the value of a particular hazard, x_{min} *is the minimum value of the dataset and* x_{max} *is the maximum value of the dataset.*

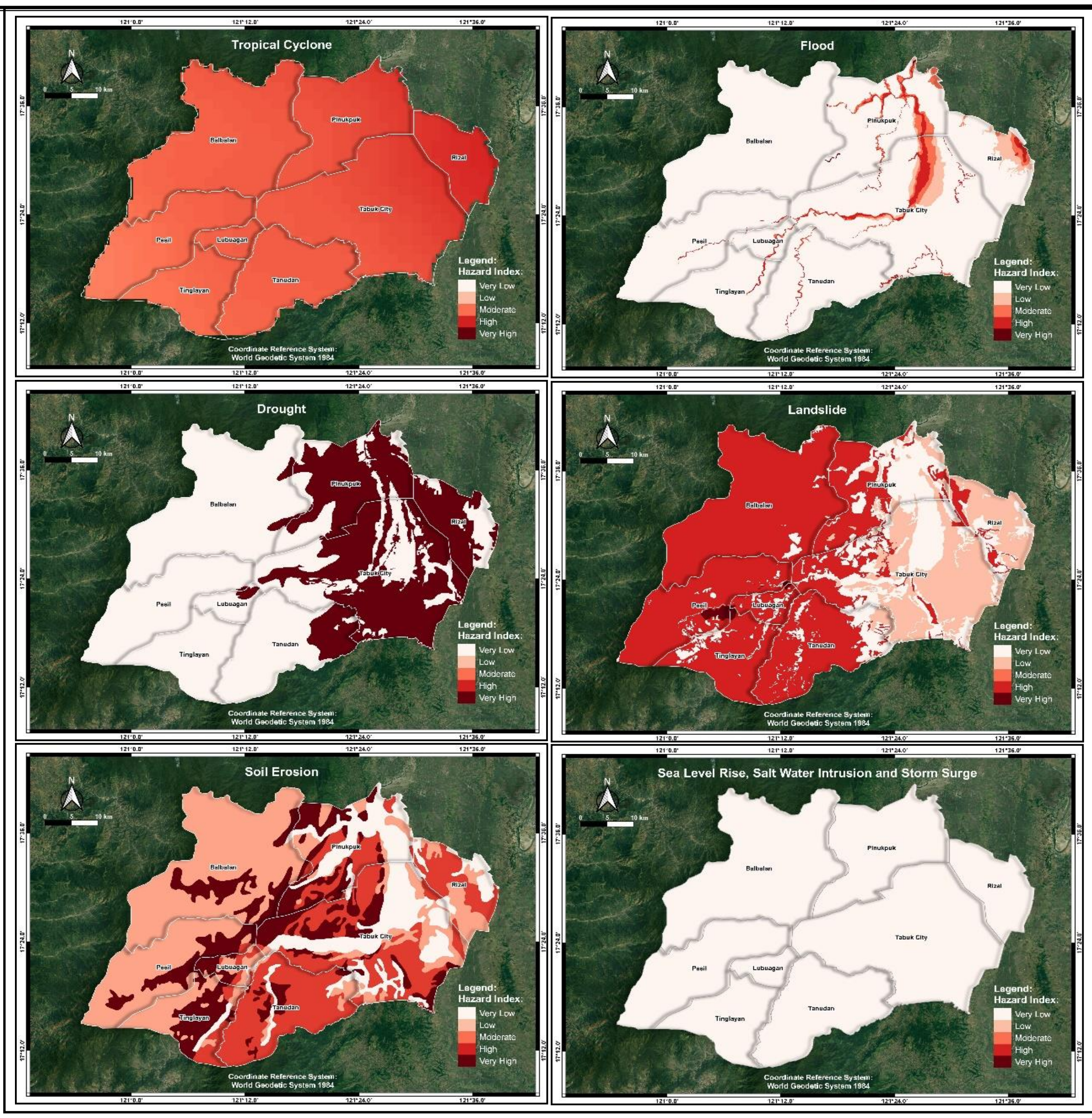

Figure 4. Various climate related hazards in Kalinga province.
Source: International Center for Tropical Agriculture

c. Adaptive Capacity Index

Adaptation, in the context of human dimensions of global change, refers to a process, action, or outcome in a system (household, community, group, sector, region, country) in order for the system to better cope with, manage or adjust to some changing condition, stress, hazard, risk or opportunity (Smit & Wandel, 2006). In climate change context, Smith *et. al.,* (2000) refer to adaptations as *"adjustments in ecological-socio-economic systems in response to actual or expected climatic stimuli, their effects or impacts".* The Philippines is one of the most vulnerable countries to climate risks because of its geographical location and level of economic development (Defiesta, 2014). The study aims to provide a high-resolution analysis at the municipal level, however, there are limited socio – economic variables available. Hence, Table 5 shows the list of capitals and the collected indicators that were used as bases for the adaptive capacity of the eight municipalities of Kalinga. These capitals include economic, human, physical, institutional and anticipatory. These indicators were derived from the available data (mainly from 2018) from the Cities and Municipalities Competitiveness Index (CMCI) of the Department of Trade and Industry (DTI) and CIAT. Each indicator was normalized and was summed up for each capital. Moreover, tabulated normalized values for each capital of the different municipalities were integrated in a spatial data or the Kalinga shapefile that contains municipal boundaries.

Table 5. List of capitals with their indicators.

Capital	Indicator
Economic	Classification
	Gross sales of registered firms
	Total capitalization of new business
	Number of approved business permits for new business applications
	Number of approved business renewals
	Number of occupancy permits approved
	Number of approved fire safety inspection
	Number of declared employees for new business applications
	Number of declared employees for business renewals
	Local inflation rate
	Cost of electricity - Commercial users and Industrial firms/customers
	Cost of water - Commercial users and Industrial firms/customers
	Price of diesel as of December 31 2018
	Regional daily minimum wage rate agricultural plantation and non-plantation (amount in Peso) 2015
	Daily minimum wage rate - non-agricultural (Establishments with more than 10 workers)
	Cost of land in a central business district
	Cost of rent
	Number of universal/commercial banks
	Number of thrift and savings banks
	Number of rural banks
	Number of finance cooperatives
	Number of savings and loans associations with quasi-banking functions
	Number of pawnshops
	Number of money changers/foreign exchange dealers
	Number of remittance centers
	Number of microfinance institutions
	Total number of LGU recognized / registered business groups
	Total number of other business groups
	Business tax collected by the LGU (in PhP)
	Real property tax collected by the LGU (in PhP)
	Total revenues of the LGU (in PhP)
	Total LGU budget
Human	Capacity of public and private health services – Doctors
	Capacity of public and private health services – Nurses
	Capacity of public and private health services – Midwives
	Public and private secondary education - Number of Teachers
	Public and private secondary education - Number of Students
	Number of local citizens with PhilHealth registration
Physical	Existing road network asphalt (in km.)
	Total land area
	Percentage of households with water and electricity service
	Number of public and private secondary and tertiary schools
	Number of public and private - Clinics
	Number of public and private – Clinic Beds
	Number of public and private – Diagnostic Centers
	Number of public and private - Hospitals
	Number of public and private – Hospital Beds
	Public and private – Infrastructure for Evacuation
	Presence of drainage systems in LGU Center
	Presence of water and power source
	Presence of a sanitary landfill
	Practice of Waste Segregation

Capital	Indicator
Institutional	Presence of comprehensive development plan
	Presence of the local investment incentives code
	Presence of the equivalent of an investment promotions unit
	Getting building and occupancy permits – Minutes
	Getting building and occupancy permits – Steps
	Getting Mayor's permit for new business applications – Minutes
	Getting Mayor's permit for new business applications – Steps
	Getting business renewal permits – Minutes
	Getting Business renewal permits – Steps
Anticipatory	Presence of the Comprehensive Land – Use Plan (CLUP) and Disaster Risk Reduction Management Plan (DRRMP)
	Presence of an office that implements the CLUP and DRRMP
	Presence of staff manning the office
	Presence of local E.O or ordinance that mandates the implementation of the CLUP and DRRMP
	Conduct of LGU-wide disaster drill
	Date of latest LGU-wide disaster drill
	Presence of early warning system that integrates professional responders and grassroots organization
	Total Budget for DRRMP
	Availability of local Geohazard Maps from DENR
	Availability of LGU Risk Profile from DSWD

Source: CMCI of DTI and CIAT.

d. Vulnerability Assessment

After the assessment of the three components of vulnerability – hazard index, adaptive capacity index and sensitivity index – of each crop for the different municipalities, the climate risk vulnerability can now be identified with the weights provided by the CIAT.

The vulnerability formula is shown below:

$$f\,(Haz, Sens, AC) = \sum_{n=1}^{n} \left((Haz_{\,(wh)} + Sens_{(ws)}) + 1 - AC_{\,Wa}\right)$$

where: Haz = hazard index, Sens = sensitivity index ($_i$=crop), and AC = adaptive capacity index. W_h=weight given for hazard, W_s=weight given for sensitivity, and W_a=weight given for adaptive capacity.

The weights used in this study was based from the previous CRVA projects of CIAT. These weights were determined during the consultations and workshops of local and national experts. The weight given for adaptive capacity was 70% and 15% for sensitivity and hazard. In addition, various scenarios were also created using different percentage (e.g. 33% for adaptive capacity, 33% for sensitivity and 33% for hazard) as shown in Table 6 since the analysis of weights for each component of vulnerability are highly subjective. These weights were based on literatures to explore the impact on different vulnerability classes. There are five (5) classifications for vulnerability (very low to very high vulnerability) for each municipality. The overall vulnerability was determined using the QGIS software.

Table 6. Weights used to assess vulnerability assessment.

Version	Sensitivity (%)	Hazard (%)	Adaptive Capacity (%)
Version 1	15	15	70
Version 2	33	33	33
Version 3	25	25	50
Version 4	20	20	60
Version 5	30	30	40

B. CLIMATE – RESILIENT AGRICULTURE

The studies used both primary and secondary data. Desk reviews were done to gather secondary data and information regarding the identification of target crops and study sites. Primary data were gathered through FGD and KIIs, field observation and photo documentation (Figure 5).

The crops chosen for the study were those identified as priority crops by the DA – RFO – CAR, and of which is based on the volume and area of production. The study sites were selected based on their crop production, gathered from the Philippine Statistics Authority (PSA), DA – RFO – CAR, and the provincial and municipal agricultural offices. During the field activities, the priority crops identified were verified in the study sites based on their crop production.

Figure 5. Activities done in Kalinga: (A) courtesy call of the AMIA Project staff with the different Local Government Units, (B) focus group discussions with farmers and stakeholders, (C) key informant interviews with farmers and stakeholders, and (D) field visitations around Kalinga.

The data collected through desk reviews, FGD and KII were on:

a) Agriculture context
   - People and livelihoods (gender – specific variables): demographics (current and trend; specific emphasis on rural populations); economic and social prosperity (poverty, access to basic needs – water and electricity, education, etc.); food security and nutrition
   - Agriculture activities: land use, farm size and title deeds; agriculture jobs and incomes; agricultural input use (water/irrigation, fertilizer, pesticides)
   - Key value chain commodities: identification and description of key value chain commodities relevant for food security and national and county economy
   - Challenges for the agriculture sector: outlining the key challenges for the agricultural sector in the county

b) Climate vulnerabilities
   - Past Climate Change and variability of the agricultural sector
   - Farmers´ perceptions of Climate Change and related risks
   - Future projected changes (with some discussion on uncertainty)
   - Climate vulnerabilities per commodity (across major value chain)

c) Adaptation options/interventions
   - Current interventions, programs and policies
   - Gaps in current adaptation options and needed interventions, programs and policies (conceptually mapped to specific vulnerabilities in the major commodities)

d) Institutional resources and capacity to implement adaptation strategies
   - Types of institutions engaged in facilitating the implementation of adaptation strategies
   - Resources and capacity to tackle climate change aspects, to deliver services (extension, insurance, financial services, etc.) and to execute (staffing, planning, implementation, financial management)
   - Intra- and inter-institutional coordination for effective management
   - Gaps in institutional management and governance to support the implementation of adaptation strategies

C. COST – BENEFIT ANALYSIS

a. Data and Sources

Both secondary and primary data were used to achieve the project objectives. Multi – stage stratified area probability sampling design was used where the primary sampling is in the municipality, and the secondary sampling was barangay and then finally the household.

Primary data were obtained through surveys and FGD and it included the costs and returns generated by the rice and corn farmers from their last cropping season (2020 wet season). It also included the adaptation strategies of the farmers and their perceived benefits and risks of availing crop insurance. Data on costs and returns of rice and corn production covers the area operated or managed by the sample farmer. Secondary data were also requested from the OPAG, OMAG and from PCIC particularly the number of farmers who availed crop insurance, the land area insured, and the number of farmers who claimed indemnity.

The data were gathered from a total of 67 corn producers, 36 of them are beneficiaries of crop insurance while 31 are non – beneficiaries and a total of 64 rice producers, 32 of them are beneficiaries of crop insurance and 32 are non-beneficiaries.

b. Data Analysis

For the prioritized adaptation technology cost and benefit analysis of enrolling in crop insurance considering financial benefits for rice and corn farmers enrolling, considering the various potential scenarios regarding the occurrence of typhoon hazards. For other selected adaptation, partial budget analysis was used.

c. Limitations of the Study

This project focused on financial cost and benefit analysis. It analyses only the costs and benefits from the point of view of the farmers. The costs included are the costs incurred by the farmer in his corn production and the benefits included are the benefits generated by the farmer such as his profit, if any.

V. RESULTS AND DISCUSSION

A. CLIMATE RISK VULNERABILITY ASSESSMENT

a. Sensitivity Index

Current Occurrences of Crops

Based from the result of the participatory mapping, maps regarding the existence of the selected crops were generated. As shown in Figure 6, areas who have red points were classified to have high production or yield, orange for moderate and yellow for low. The ranges of crop yield were identified by the local experts based on their existing reports.

For the conventional rice (A), crop production of less than 2.18 tons per hectare (t/ha) were classified as low yield, 2.18 – 3.34 t/ha for moderate yield and greater than 3.34 t/ha were classified as high yield. It was evident that in the map (Figure 6), that the city of Tabuk have high production of this crop, as well as in Pinukpuk and Rizal. The same ranges were applied for the crop yield classification of Heirloom rice (B). Since heirloom rice is suitable in mountainous areas, it is shown in the map that this particular crop is existing in the rolling areas of the province specifically in Balbalan, Pasil, Lubuguan Tinglayan and Tanudan. In Lubugan, Heirloom rice production was classified to be high while for the rest, production was classified to be low to moderate.

For hybrid corn (C), crop production of <3.11 t/ha were classified as low yield, 3.11 – 4.75 t/ha is considered to be of moderate yield and >4.47 tons/ha were classified as high yield. Corn is highly productive in warm areas and being one of the provinces' primary crop, it is grown mostly on the western part of the province specifically in Pinukpuk, Rizal, Tabuk city, Tanudan and Lubuagan. This crop. Therefore, based on the result, almost all parts of Pinukpuk had high production while some areas in Tabuk city, Rizal, Tanudan and Lubuagan varies from moderate to high yield.

Furthermore, for Robusta coffee (D), these ranges were followed. <1.29 t/ha were classified as low yield, 1.29 – 1.79 t/ha for moderate yield and >1.79 t/ha were classified as high yield. Since robusta coffee is one of the provinces' OTOP, almost all of the different municipalities of the province were planted with coffee except in some areas of Tabuk City and Rizal. Result showed that the production of coffee in the province ranges from low to moderate except for the municipalities of Lubuagan and Tanudan. As observed in the map, in most areas of Lubuagan, Robusta coffee production was classified as high, also, in some areas of Tanudan.

In addition, for banana (E), these were the ranges identified: <5 t/ha were classified as low yield, 5 – 10.44 t/ha for moderate yield and >10.44 t/ha were classified as high yield. According to the result, most of the municipalities have a low to moderate yield classification while Pinukpuk and some areas of Tabuk City were classified to have a high yield. During the conduct of the CRA, Aciga, Ammacian, Malagnat, Taggay and Wagud of Pinukpuk were barangays that considered banana as their secondary crop.

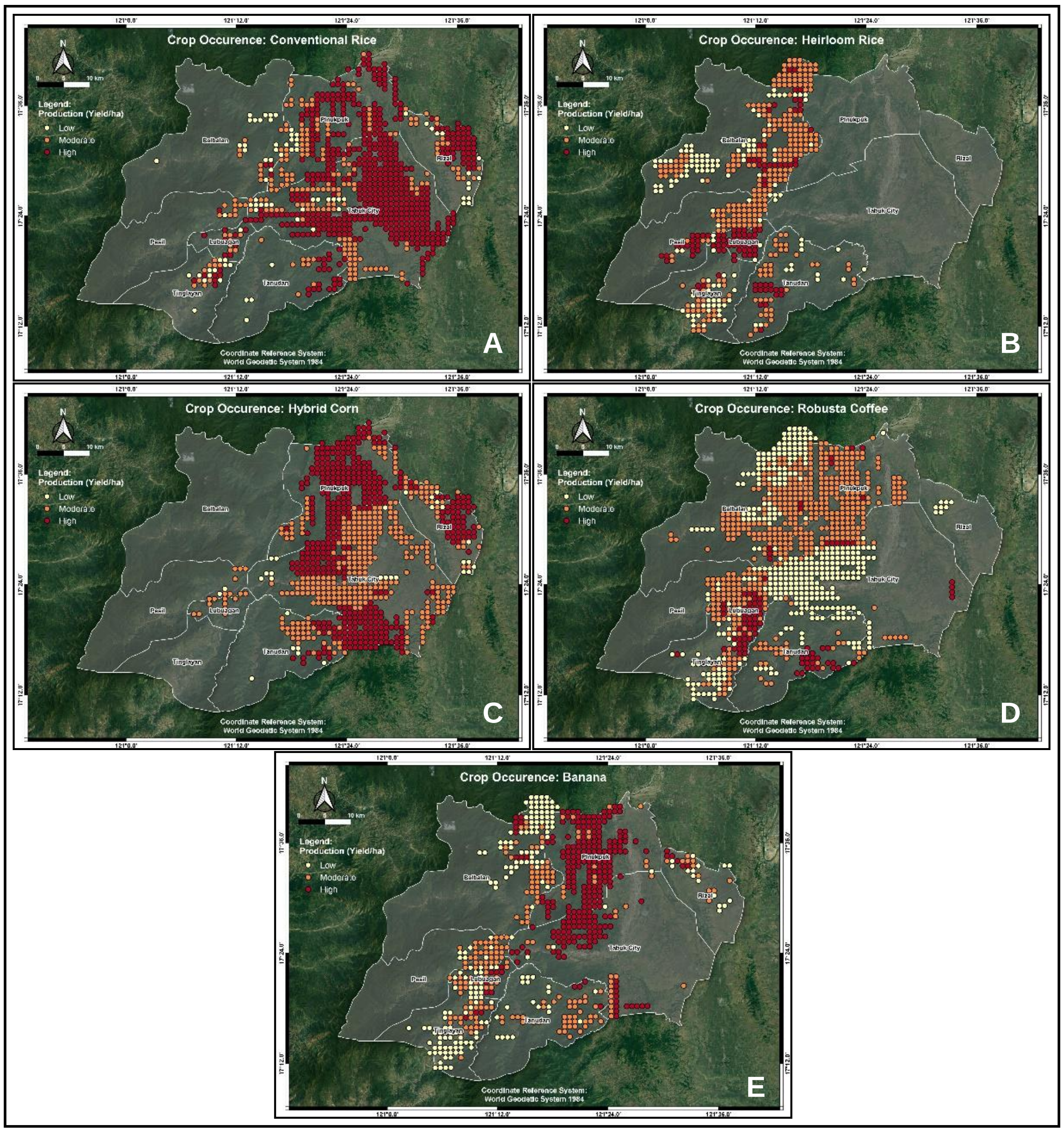

Figure 6. Crop occurrence points of the selected crops. A) Conventional rice B) Heirloom rice C) Hybrid corn D) Robusta coffee E) Banana

Crop Sensitivity

The sensitivity of each crop at the municipal level was assessed based on the suitability of the crops by the year 2050 in comparison to the current crop suitability using the MaxEnt model. The bioclimatic variables that contributed best to the model varied across the 5 crops. Figure 7 depicts the changes in climatic suitability of the selected crops by the year 2050. It was observed that losses are in the lowland areas of the province particularly in Pinukpuk, Rizal and Tabuk City. As observed, for conventional rice, hybrid corn, robusta coffee and banana, these municipalities will experience more pressure from climate change and are predicted to loss in climatic suitability. In contrast, the municipalities of Balbalan, Pasil, Tinglayan, and Tanudan are predicted to have gain for conventional rice and hybrid corn. For heirloom rice, as shown in the map, most of the municipalities are predicted to have gain except for Lubuagan with no change and Balbalan which will have a loss in suitability. In addition, for Robusta coffee, the province was predicted to have a loss since temperature highly affects the production of this crop. Areas that are predicted to experience more pressure from climate change is predicted to gain loss in climatic suitability of a crop does not necessary mean that the crops will not survive due to its topographical area but a decrease in terms of crop yield is expected in areas where agricultural management continues ‘business as usual’ approach.

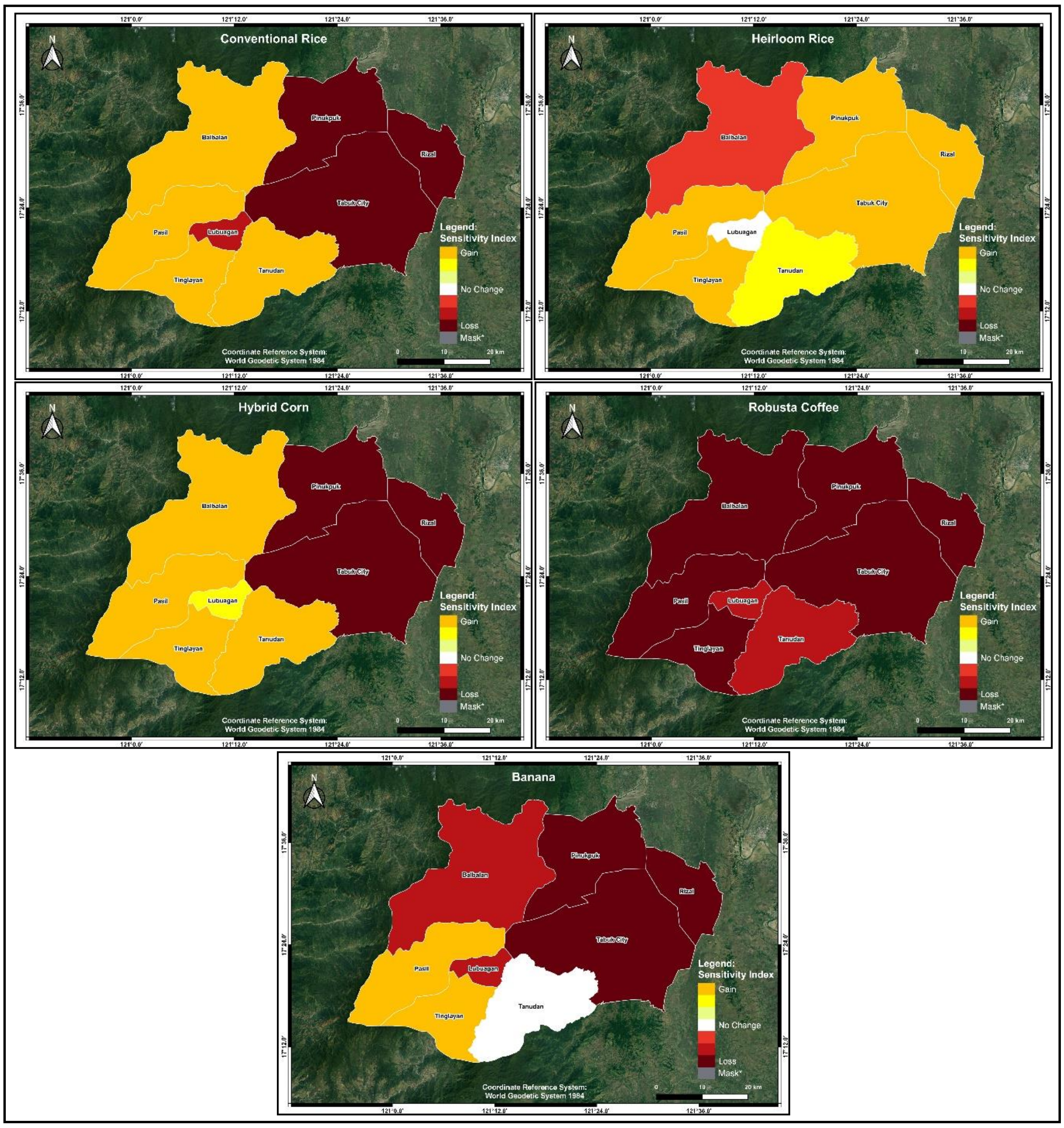

Figure 7. Sensitivity map of the selected crops in Kalinga.

b. Hazard Index

Tropical Cyclone

Globally, tropical cyclones are the deadliest and costliest of all "*natural*" disasters (Collet et al., 2017). Tropical cyclones are classified as tropical depressions, tropical storms, and typhoons. In the Philippines, Luzon had the highest occurrences of typhoons since 1989 to 2016 (Desquitado *et. al.,* 2020). From 2001 – 2010, the country had a total of 171 typhoons of which the highest occurrence of this hazard is in Luzon, particularly in the Cagayan Valley, Ilocos Region, CAR, Central Luzon and Bicol Region (Israel & Briones, 2018). According to Holden & Marshall (2018), Northern Luzon is one of the areas that is heavily affected by the risks of typhoon.

Based on the results, as shown in Figure 7, the municipalities of Pasil and Tinglayan are considered to have the least exposure to typhoon with normalized values of 0 and 0.05 while Tanudan, Lubuagan, and Balbalan are considered to have the low exposure to typhoon with normalized values of 0.21, 0.22 and 0.24, respectively. On the other hand, Tabuk City and Pinukpuk have moderate exposure with normalized values of 0.52 and 0.54, respectively; and Rizal (1.00) is highly exposed to tropical cyclones.

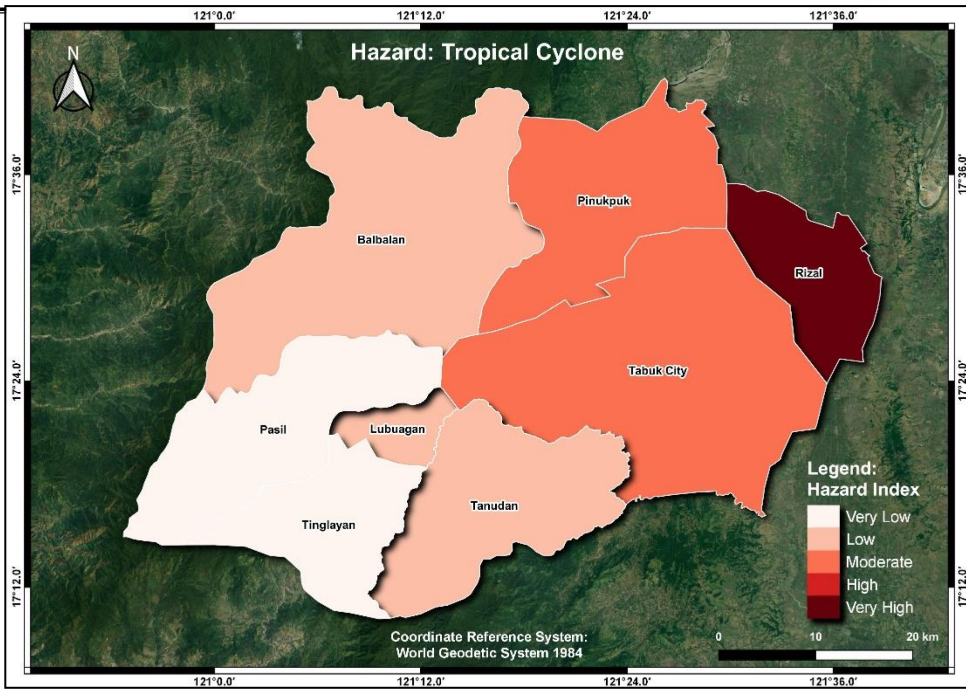

Figure 8. Normalized tropical cyclone index of the different municipalities in Kalinga.

Flood

Flooding is being triggered by tropical cyclones and heavy monsoon rains. This natural disaster is the leading cause of natural disaster deaths worldwide and is responsible for 6.8 million deaths in the 20th century (Doocy *et. al.,* 2013). According to the World Bank Group, (2011) over the time, heavy rainfall associated with typhoons and other weather systems may increase in both intensity and frequency under a changing climate and exacerbate the incidence of flooding in existing flood-prone areas and introduce a risk of flooding to new areas. From 2000 to 2010, the total value of agricultural damage, by commodity, affected by typhoons, floods and droughts in the Philippines amounted to a total of approximately USD 2,234.21 million (Israel & Briones, 2018).

Figure 9 shows that the municipalities that are most exposed to flooding are Pinukpuk (1.00), Rizal (0.98) and Tabuk City (0.94) followed by and Lubuagan (0.45), which was classified as moderately exposed to flood. Furthermore, Tanudan (0.15), Tinglayan (0.10), Pasil (0.06), and Balbalan (0) are classified as least exposed to this hazard.

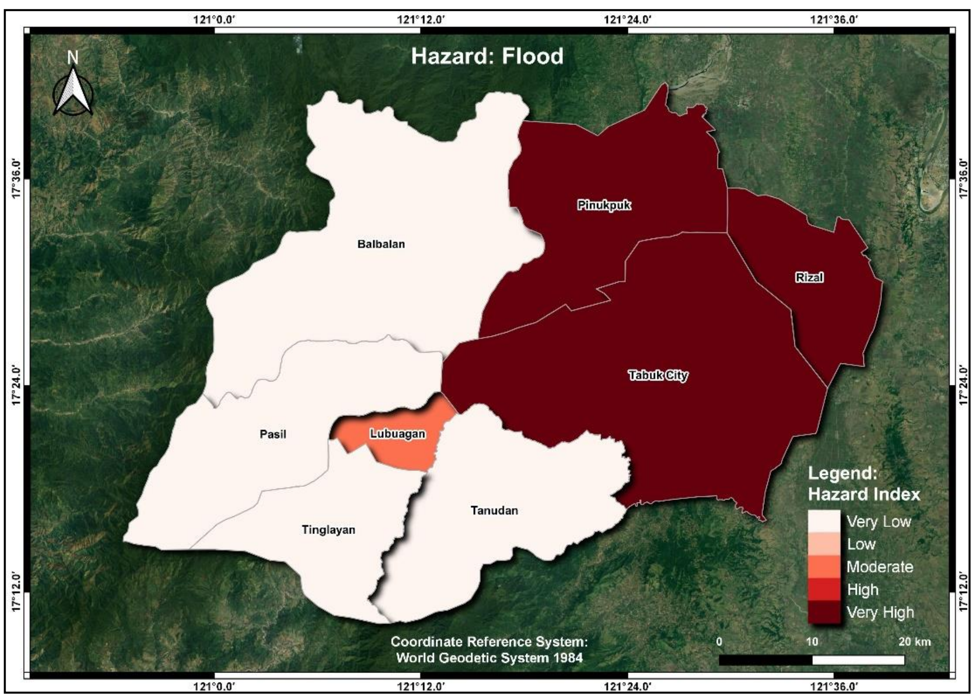

Figure 9. Normalized flood index of the different municipalities in Kalinga.

Landslide

The municipalities of Balbalan, Pasil, and Tinglayan, which are mostly mountainous have the highest exposure to landslide (Figure 10) with a normalized value of 1, 0.99 and 0.89, followed by Tanudan and Lubuagan (high), 0.7 and 0.8, respectively. Pinukpuk (low) with a normalized value of 0.28 followed by Rizal and Tabuk City (very low), 0.04 and 0.

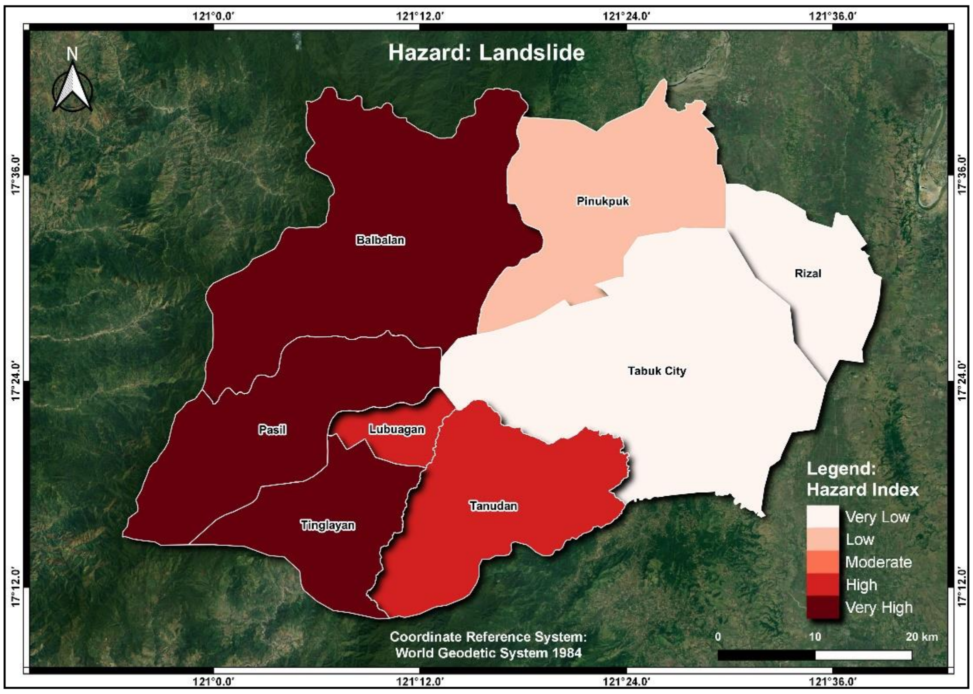

Figure 10. Normalized landslide index of the different municipalities in Kalinga.

Drought

The World Bank Group (2011) reported that prolonged droughts are associated with the El Niño phenomenon and these natural events will likely intensify in the future in the Philippines. The municipalities of Pasil and Tinglayan both having a normalized value of 0, were classified to have the least exposure to drought. Also, Lubuagan (0.02), Balbalan (0.03), and Tanudan (0.17) were also classified as very low in exposure to drought. They are followed by Rizal (low) with a value 0.29 followed by Pinukpuk (moderate), 0.59 and Tabuk City (very high), with a normalized value of 1, respectively (Figure 11).

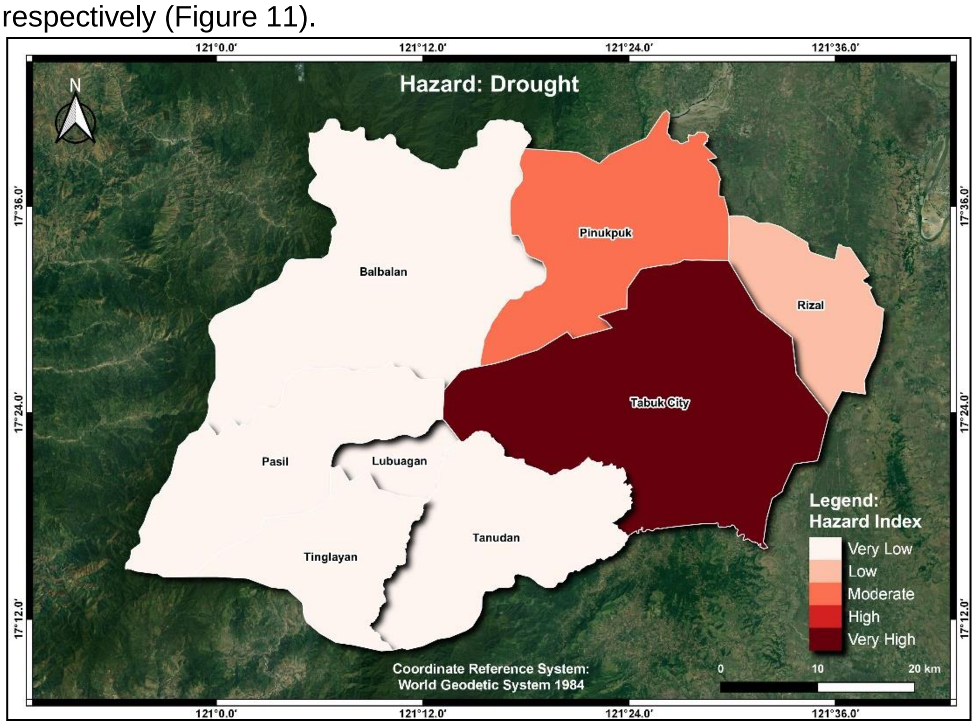

Figure 11. Normalized drought index of the different municipalities in Kalinga.

Soil Erosion

Human activities such as, land use conversion, deforestation and illegal logging, *kaingin* and other unsustainable farming practices, and poor land and water management have caused the quality of soil to decline, thus contributing to soil degradation. Considering the fact that these municipalities are in the mountainous areas of Kalinga, the municipalities of Lubuagan (0.93), Tanudan (0.99) and Tinglayan (1.00) have the highest exposure to soil erosion. On the otherhand, Tabuk City, Pinukpuk and Pasil were classified as low in exposure while Balbalan and Rizal, being situated on the lower area of the province are ranked to have the least exposure to this particular hazard (Figure 12).

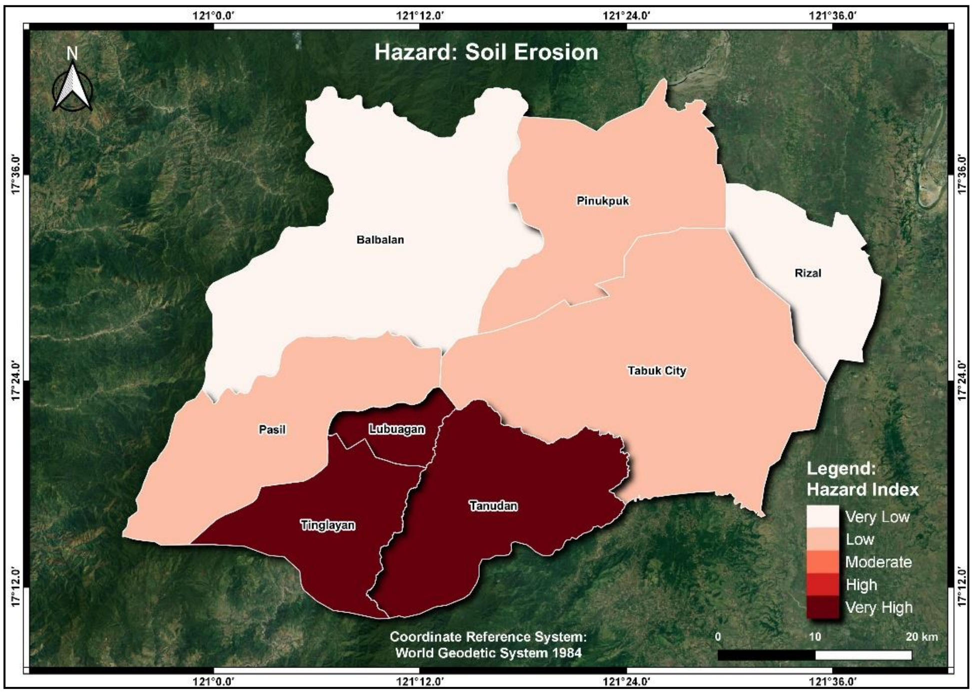

Figure 12. Normalized soil erosion index of the different municipalities in Kalinga.

Salt Water Intrusion, Sea Level Rise and Storm Surge

These hazards have no significant effect in Kalinga since it is a landlocked province as shown in Figure 13.

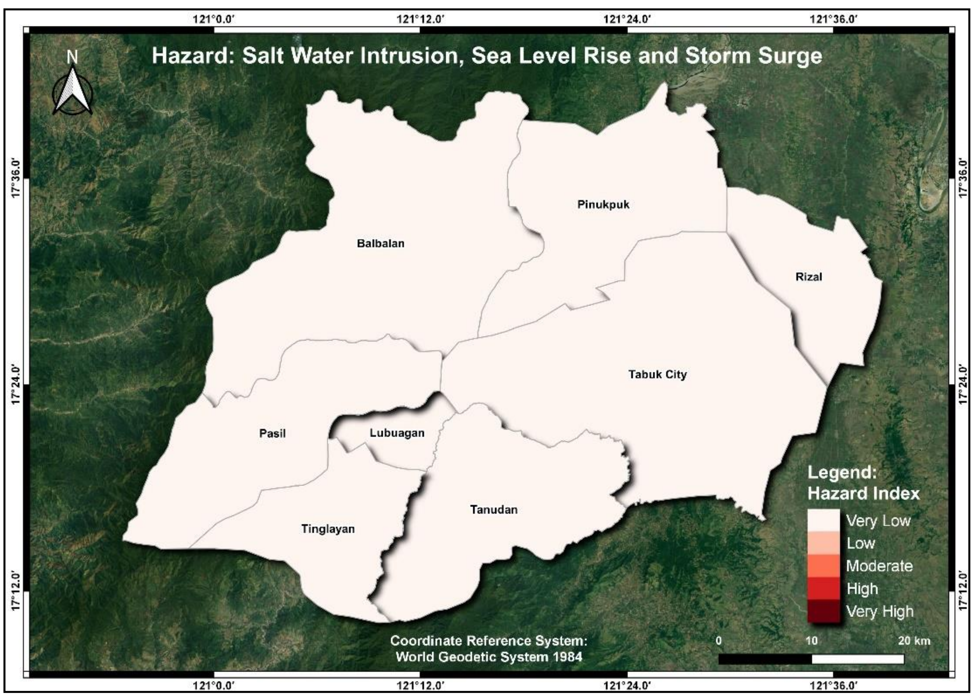

Figure 13. Normalized salt water intrusion, sea level rise and storm surge index of the different municipalities in Kalinga.

<u>Overall Hazard Index</u>

The normalized values for the eight (8) hazards were summed to come up with the overall hazard index map of Kalinga using the assigned hazard weights for Luzon. As shown in Figure 14, the municipalities of Pinukpuk (1.0) and Tabuk City (0.99) have the highest exposure to hazards as these municipalities are classified from moderate to very high exposure to typhoon, flood and drought which have the highest weights. These were followed by the municipality of Rizal with a normalized value of 0.72. Moreover, the municipalities that are moderately exposed to these hazards are Lubuagan (0.58) and Tanudan (0.44). The municipality of Tinglayan is classified to have a low exposure with a value of 0.27 and the municipalities that are least exposed to these hazards are Balbalan with a normalized value of 0.04 and Pasil with 0, respectively.

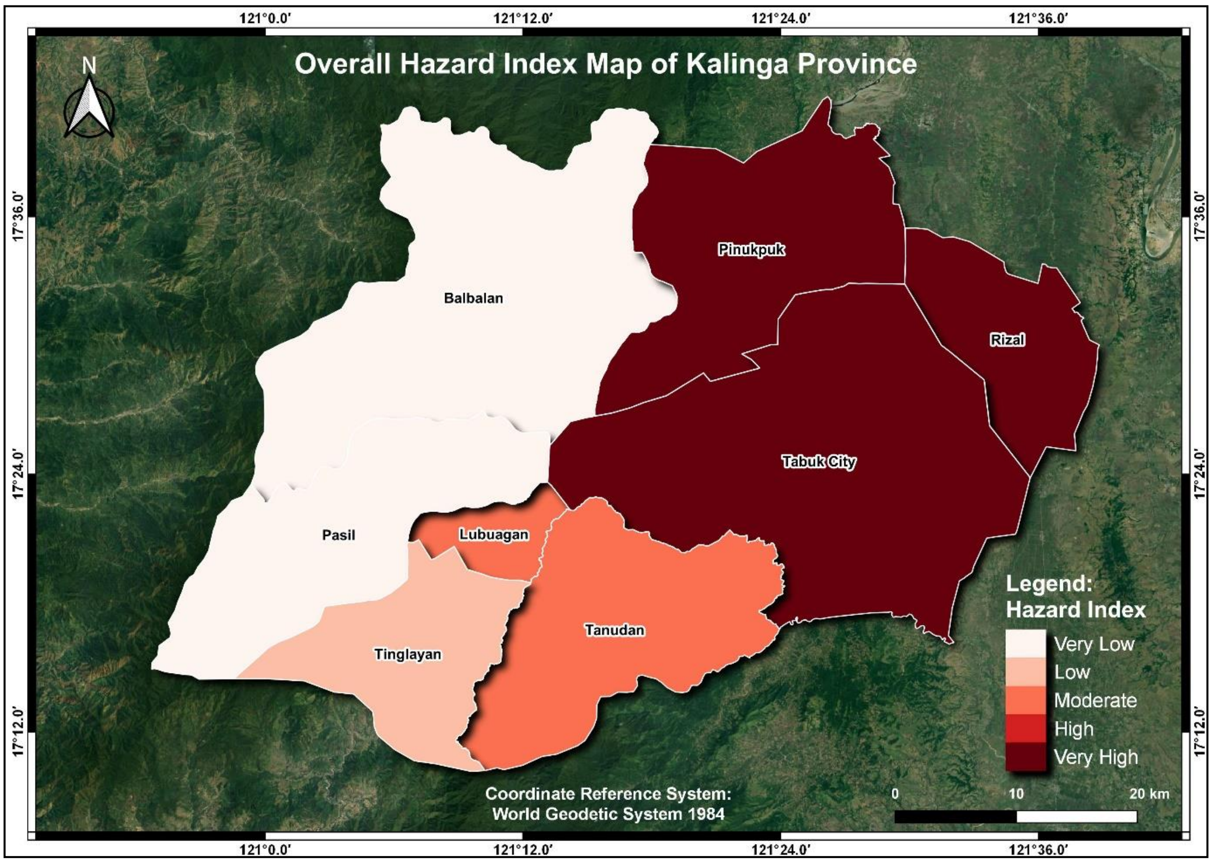

Figure 14. Overall Hazard Index Map of the different municipalities in Kalinga.

c. Adaptive Capacity Index

Each capital of adaptive capacity was classified into five (5) equal intervals through normalization. Normalization was done for easier comparison and analysis of data since the ranges of each indicator had a large difference. This is also done to avoid biases regarding the differences in socio-economic development between municipalities. The normalized data were classified as Very Low (0 – 0.20), Low (0.20 – 0.40), Moderate (0.40 – 0.60), High (0.60 – 0.80), and Very High (0.80 – 1.00). The value of 1 indicates that the adaptive capacity of a municipality is very high while 0 is very low. Figures 15 - 17 illustrate that the municipality of Tabuk had a very high adaptive capacity in terms of economic, physical and human capitals. Since it is a city, it is expected that there are high economic activities and better access to health and education. These are the driving factors on Tabuk's capacity to adapt.

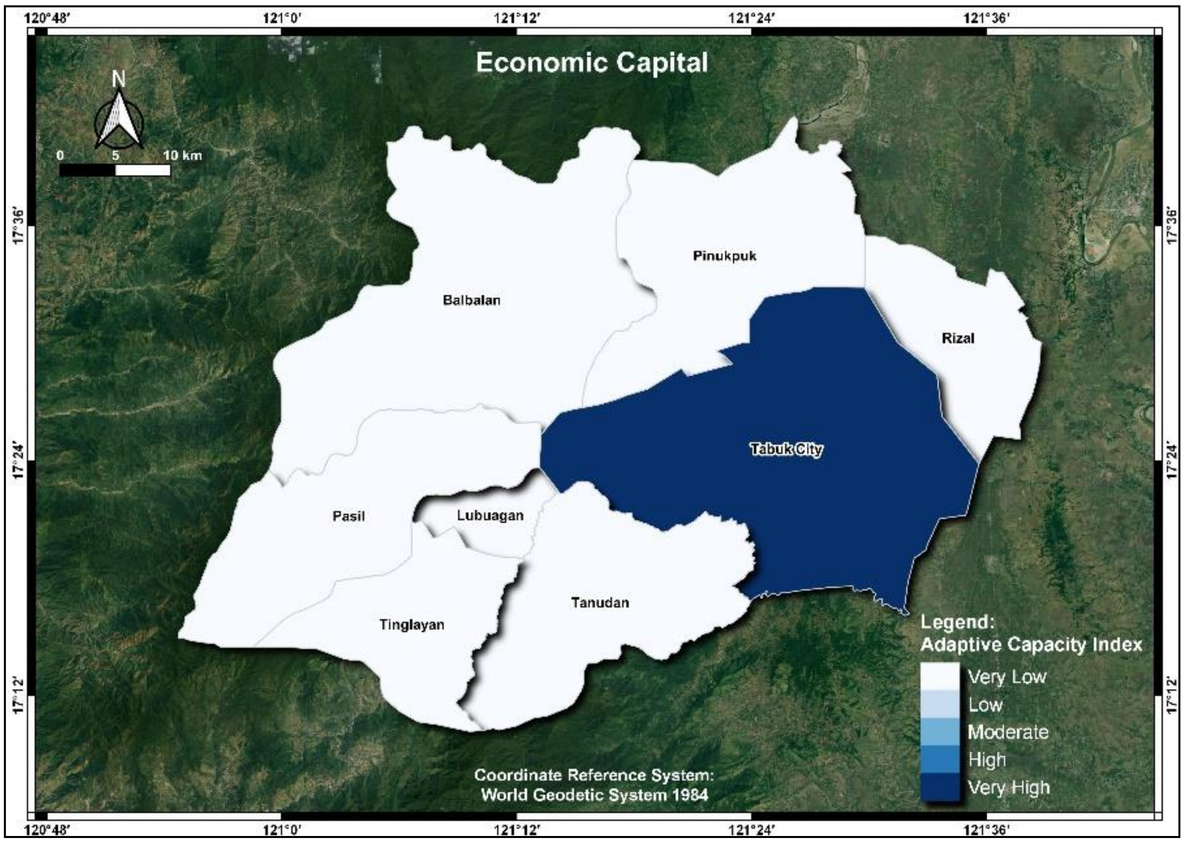

Figure 15. Economic capital map of Kalinga Province.

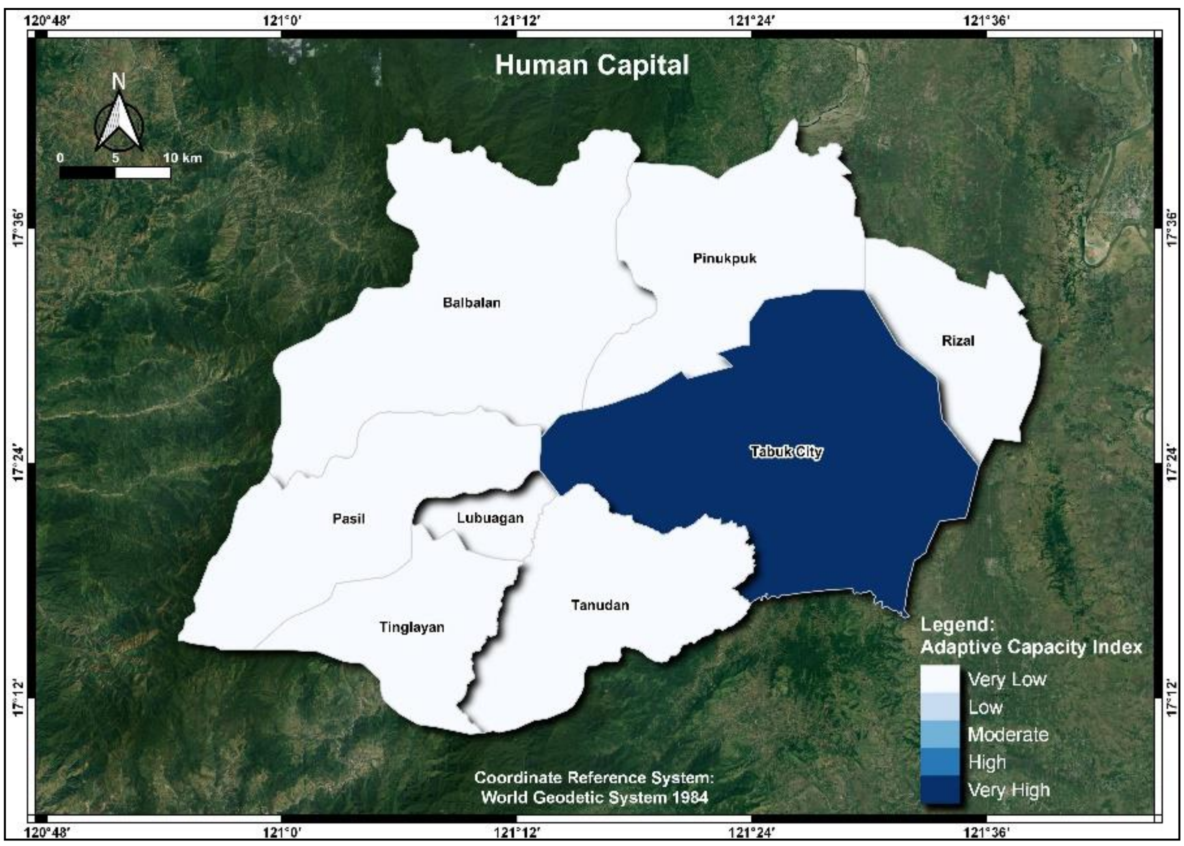

Figure 16. Human capital map of Kalinga Province.

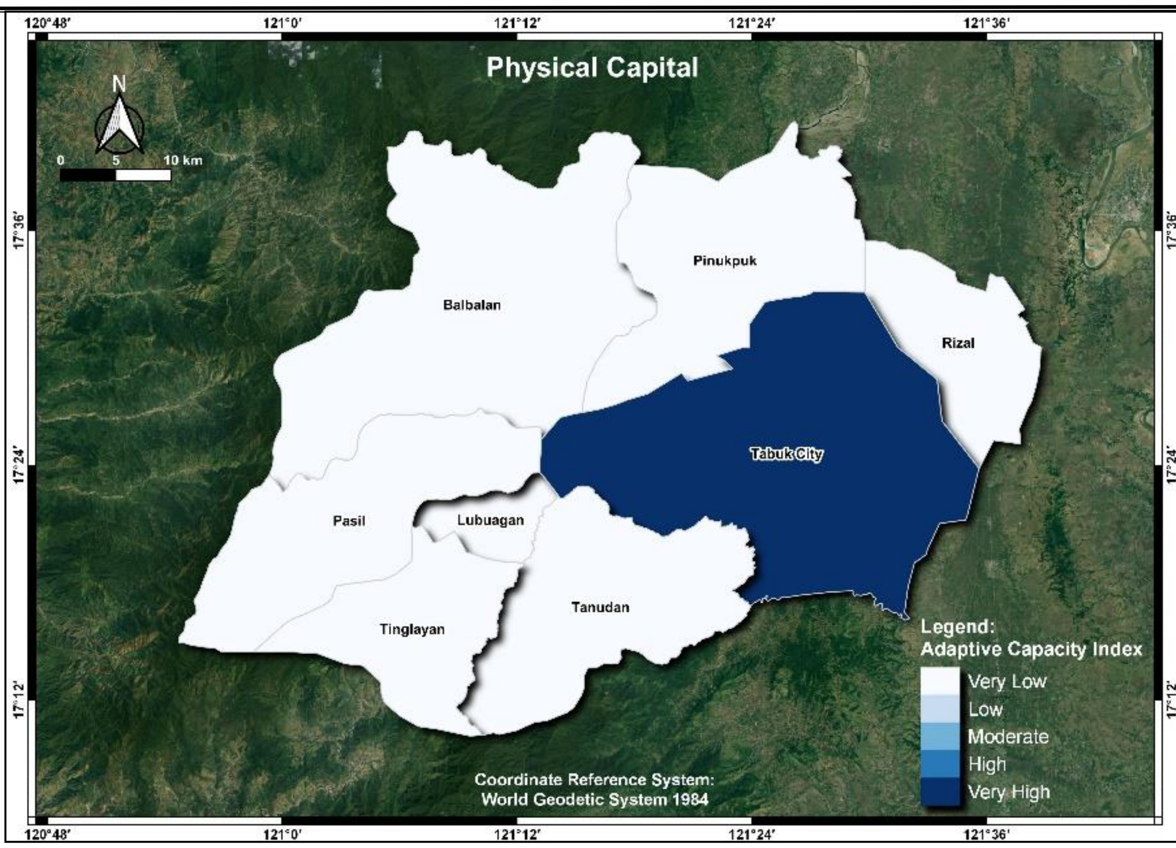

Figure 17. Physical capital map of Kalinga Province.

For the anticipatory capital, indicators related to plans such as presence of DRRMP, CLUP, disaster drills, availability of Geo – hazard maps and risk profiles are some factors that affected the result of this capital. Figure 18 shows that the municipalities of Tabuk and Tinglayan have the highest adaptive capacity. Among the eight (8) local government untis (LGUs) of Kalinga, Tinglayan had the most updated CLUP, DRRMP and LGU wide-disaster drill activity, while Tabuk had the highest total budget for DRRMP which made these municipalities adaptive in terms of anticipatory. Pinukpuk follows with a value of 0.74 then Lubuagan being the least adaptive. This result is due to the fact that these municipalities have the least budget allotted for DRRMP and have the least updates on the related indicators.

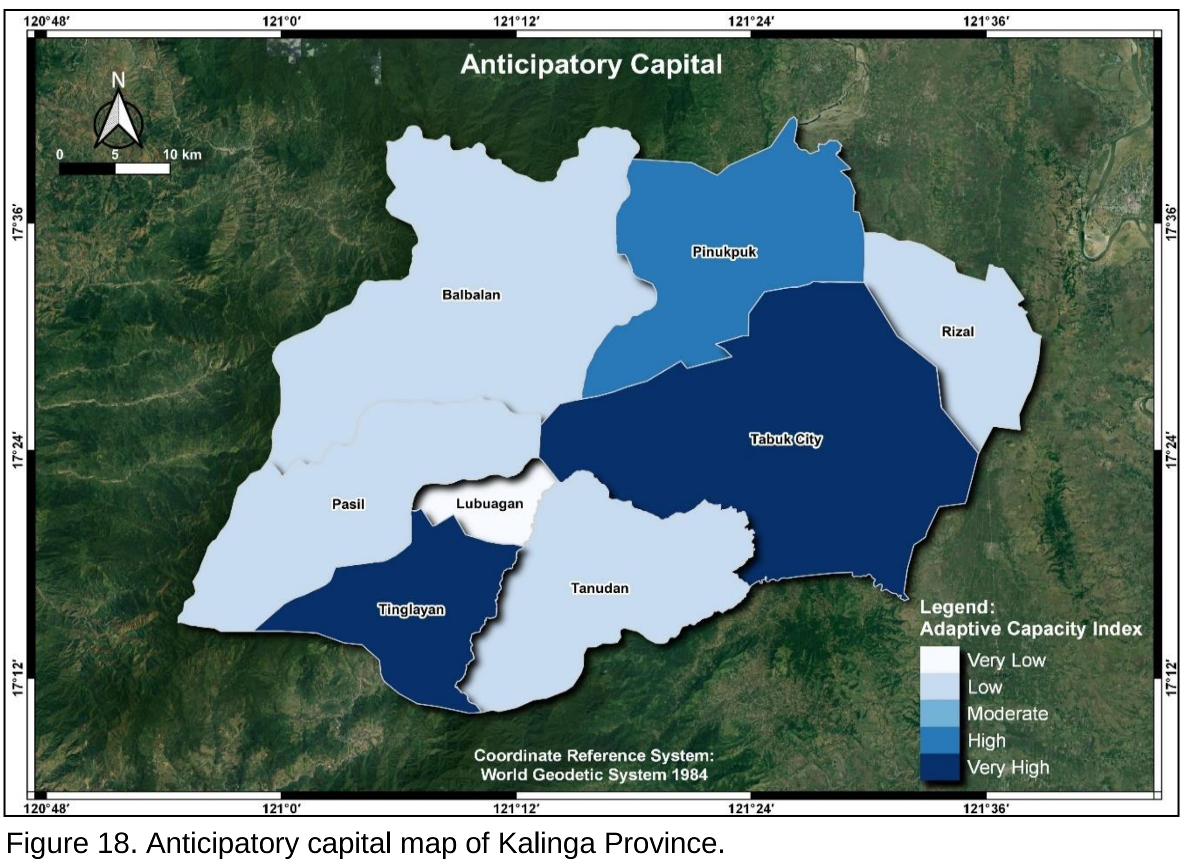

Figure 18. Anticipatory capital map of Kalinga Province.

On the other hand, indicators for the institutional capital are related to programs and projects that are supported by the government. The City of Tabuk is the most adaptive in terms of this capital, followed by Tinglayan with corresponding values of 0.75 and Rizal at 0.66 which were classified as high. Also, Pinukpuk (0.48) was categorized as moderate and Balbalan (0.25) as low. The rest of the municipalities have the least adaptive capacity in terms of institutional – Tanudan (0.15), Lubuagan (0.09) and Pasil (0.00) as shown in Figure 19.

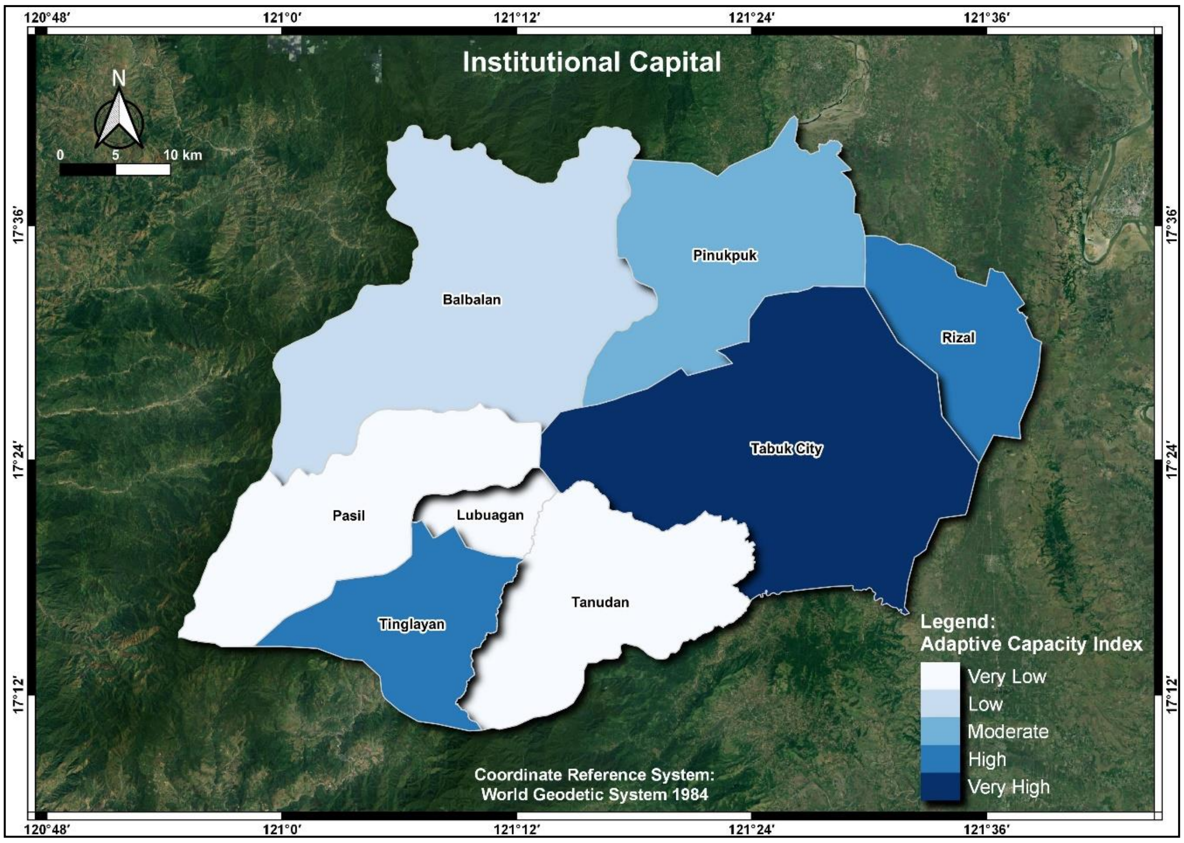

Figure 19. Institutional capital of Kalinga Province.

Overall Adaptive Capacity Index

The overall adaptive capacity index (Figure 20) of Kalinga is the aggregation of the five (5) capitals. The city of Tabuk (1.00) was classified to be the most adaptive since it has been consistent in having the highest adaptive capacity for all the capitals. Moreover, the municipalities of Pinukpuk (0.31), Tinglayan (0.29) and Rizal (0.25) have low adaptive capacity.

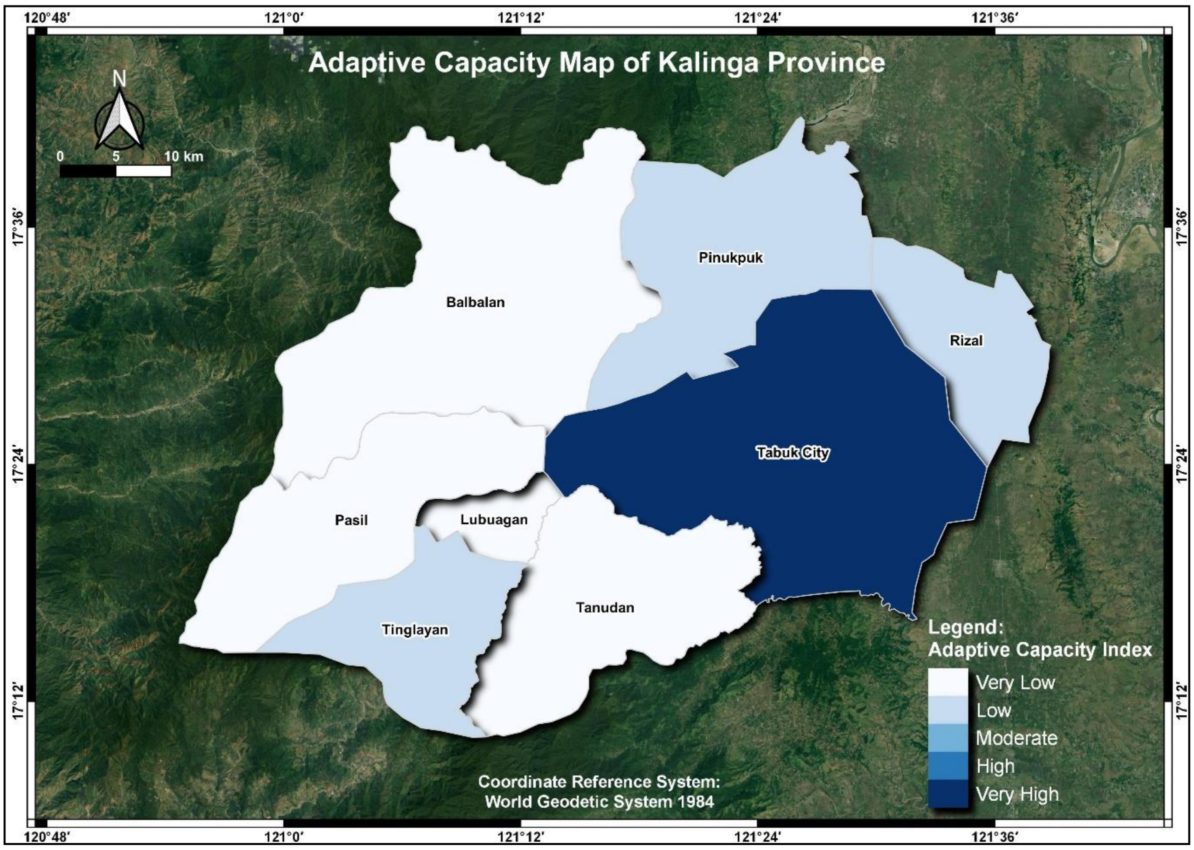

Figure 20. Overall Adaptive Capacity Index map of Kalinga Province.

However, since the study aims to assess vulnerable areas, inversion of the adaptive capacity was done. As shown in Figure 21, the lower the value, the higher the adaptive capacity, while the higher the given value, this indicates vulnerability. Areas are considered to be vulnerable if their adaptive capacity is low. Since Tabuk City had the highest adaptive capacity index, it is now classified as very low in terms of vulnerability. On the other hand, the municipalities of Pinukpuk, Rizal and Tingalyan were classified as highly vulnerable since they had low adaptive capacity. Furthermore, in comparison to the overall adaptive capacity, municipalities of Balbalan, Lubuagan, Pasil, and Tanudan were ranked as lowest in terms of adaptive capacity that is why in the inverted adaptive capacity index, they were classified as very highly vulnerable.

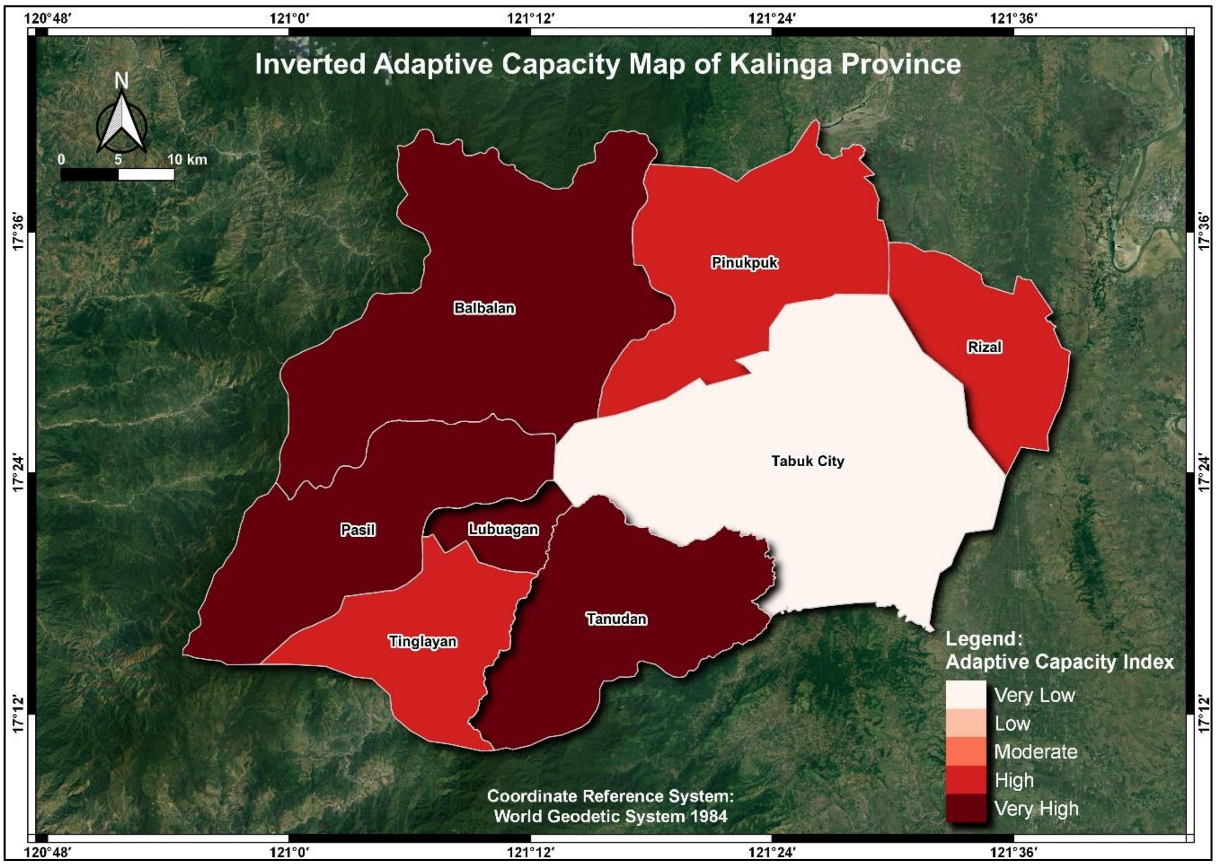

Figure 21. Inverted Adaptive Capacity Map of Kalinga Province.

d. Climate Risk Vulnerability

Although different weights were used in assessing the vulnerability of each crop, the results (Figures 22 – 31) showed consistency in detection of highly vulnerable municipalities. This shows that the characteristic of vulnerability, in terms of component and indicators are not too sensitive to varying weight proportions. However, Version 1 (15-15-70) will be used as a final basis in the prioritization, targeting and identification of areas that threaten the resilience of agri-fisheries communities.

In the identification of areas for prioritization, the municipality must be found to being highly vulnerable despite changes in the weights of the three dimensions (sensitivity, hazard, adaptive capacity) and at the same time must show high production of the selected crops.

<u>High Value Crops</u>

a. Banana

The municipalities of Pinukpuk, Rizal and Lubuagan were considered to have very high vulnerability in the production of banana (Figures 22) because they are characterized to have a moderate (Lubuagan) to very high (Pinukpuk and Rizal) incidence of hazards, high loss in banana suitability, and at the same time, have a very low (Lubuagan) to low (Pinukpuk and Rizal) adaptive capacity. Moreover, relating to the crop occurrence points gathered, Pinukpuk had the highest production of banana. Therefore, in terms of interventions, the municipality is recommended to be prioritized. In addition, in Figure 23, although different weight proportions were used, result showed consistency in detecting vulnerability of Banana in Pinukpuk, Rizal and Lubuagan.

b. Robusta Coffee

On the other hand, almost all of the municipalities in Kalinga except for Tabuk city were considered to have either a high (Tinglayan) to very high vulnerability (Pinukpuk, Rizal, Balbalan, Pasil, Lubuagan and Tanudan) in the production of Robusta coffee (Figure 24). Considering the underlying factors in the suitability of Robusta coffee, all of the municipalities of the province exhibited a negative change which greatly account for the result. In connection to the crop occurrence points gathered, Lubuagan had the highest production of Robusta coffee while moderate in Balbalan and Pinukpuk. Although Rizal and Pasil resulted to have high vulnerability, these municipalities have low Robusta coffee production. In addition, although Balbalan, Lubuagan, Tinglayan and Tanudan also have high vulnerability (70-15-15) and were recorded to have production that varies from moderate to high, the maps below show inconsistency in terms of vulnerability as the weights change. Thus, in terms of the implementation of interventions for Robusta coffee production, the municipality of Pinukpuk is recommended to be prioritized. In addition, in Figure 25, although different weight proportions were used, result showed consistency in detecting vulnerability of Robusta coffee in Pinukpuk and Rizal.

Rice

c. Conventional Rice

Figure 26 shows the vulnerability assessment of conventional rice. Based on the result, conventional rice production in the municipalities of Pinukpuk, Lubuagan and Rizal (even with varying weight as shown in Figure 27) are classified as highly vulnerable. Furthermore, as discussed in the result of participatory mapping of this crop, conventional rice was also mostly grown in Pinukpuk, Lubuagan and Rizal with high yield which means the production of this crop in these municipalities were >3.34t/ha.

d. Heirloom Rice

Heirloom rice, which is currently commonly produced in Balbalan and Lubuagan and were recorded to have a high production that is considered to be highly vulnerable in the municipalities of Balbalan, Lubuagan and Tanudan. As shown in Figure 28, Balbalan, Lubuagan and Tanudan were very high in vulnerability of heirloom rice. Also, although different weight proportions were used, result showed consistency in detecting vulnerability of Heirloom rice in the abovementioned municipalities.

Hybrid Corn

Hybrid corn, based on the crop occurrence mapping, is being produced in Pinukpuk, Rizal and Tabuk City, high yield was registered in Pinukpuk and Rizal and moderate yield for Tabuk City. This crop is projected to be highly vulnerable in Pinukpuk and Rizal based on the assessment as shown in Figures 30 – 31.

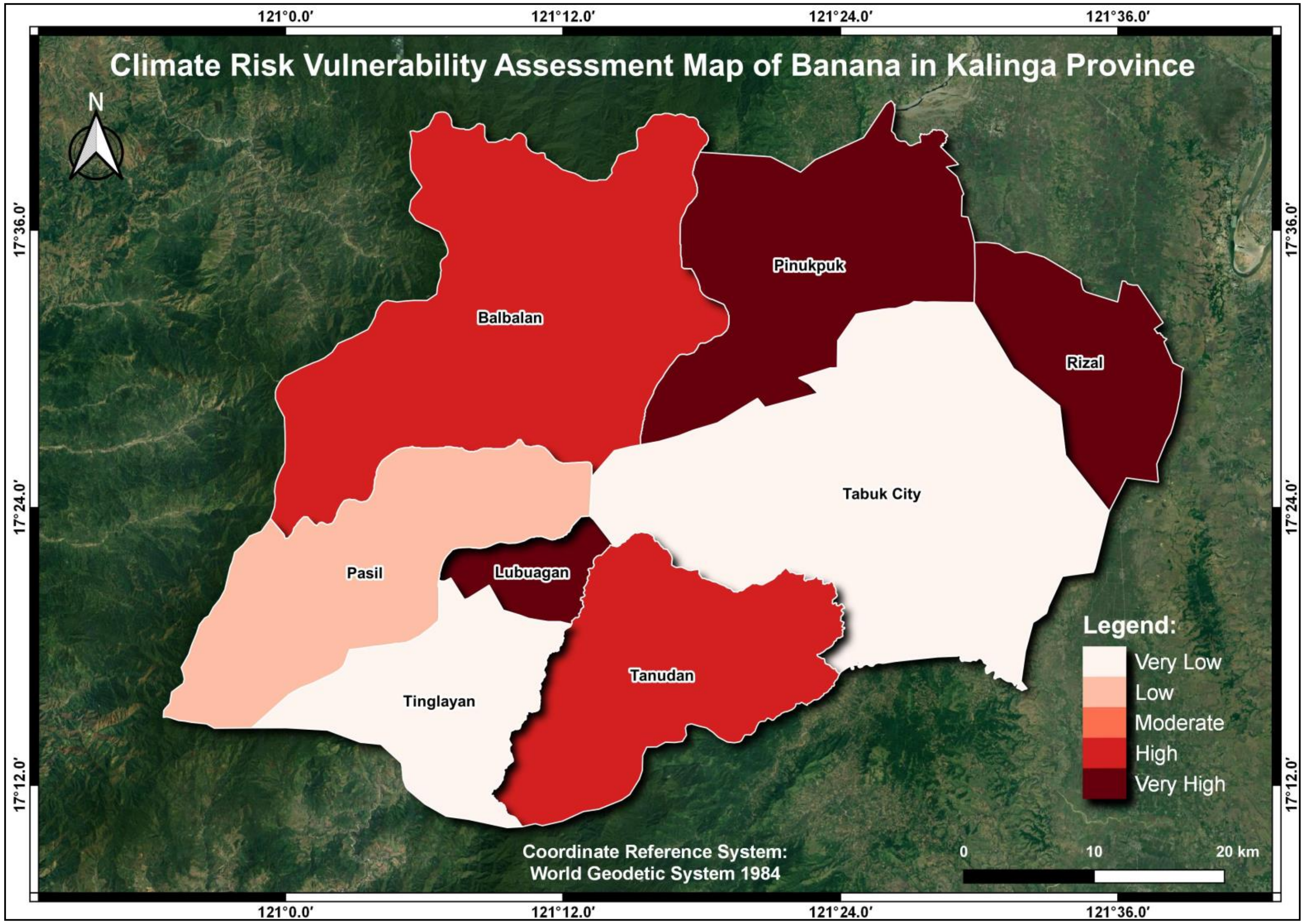

Figure 22. Climate risk vulnerability map of banana using the weights 70% for adaptive capacity, 15% hazard and 15% sensitivity.

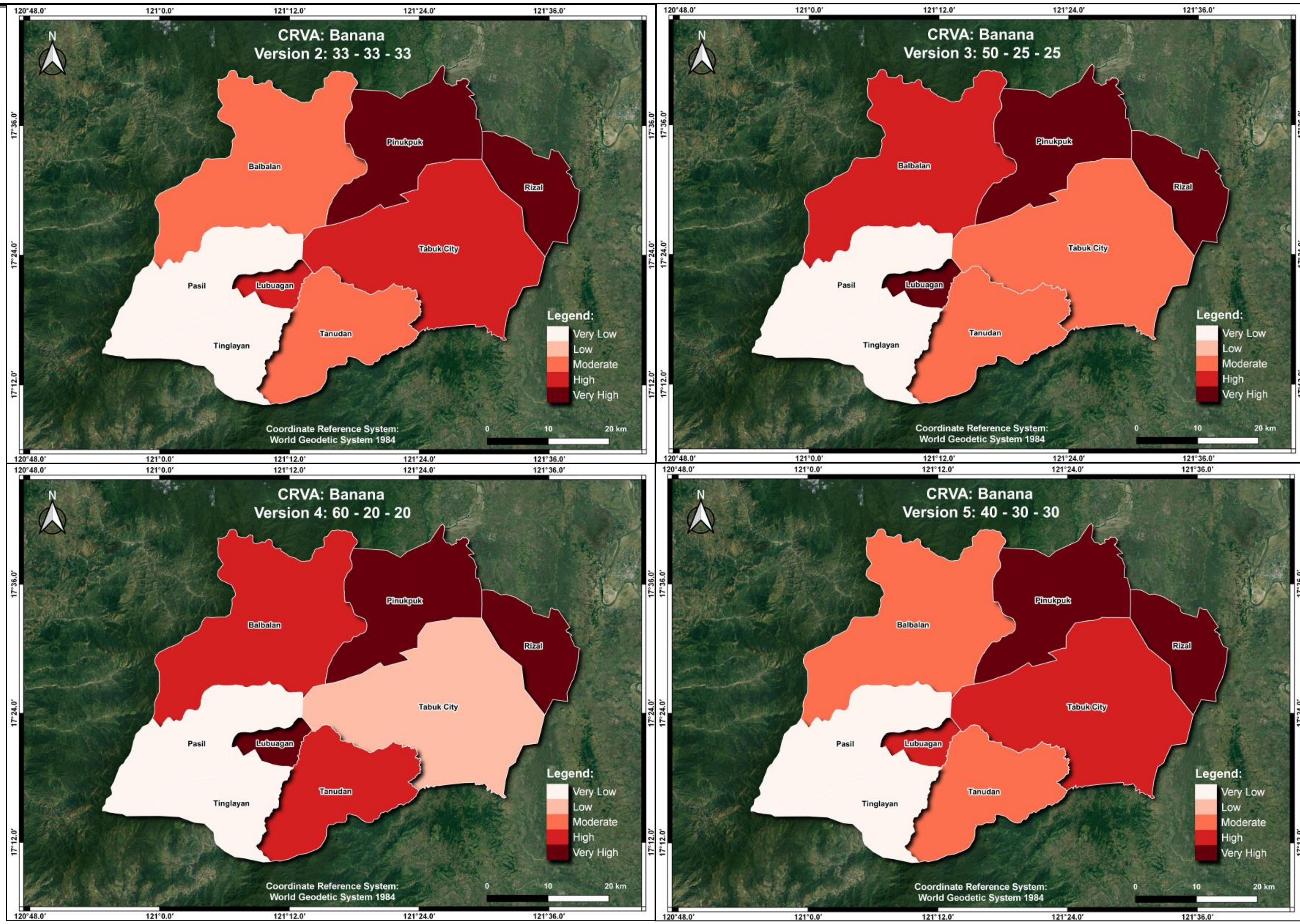

Figure 23. Vulnerability assessment of Banana using the four (4) different proportion of weights.

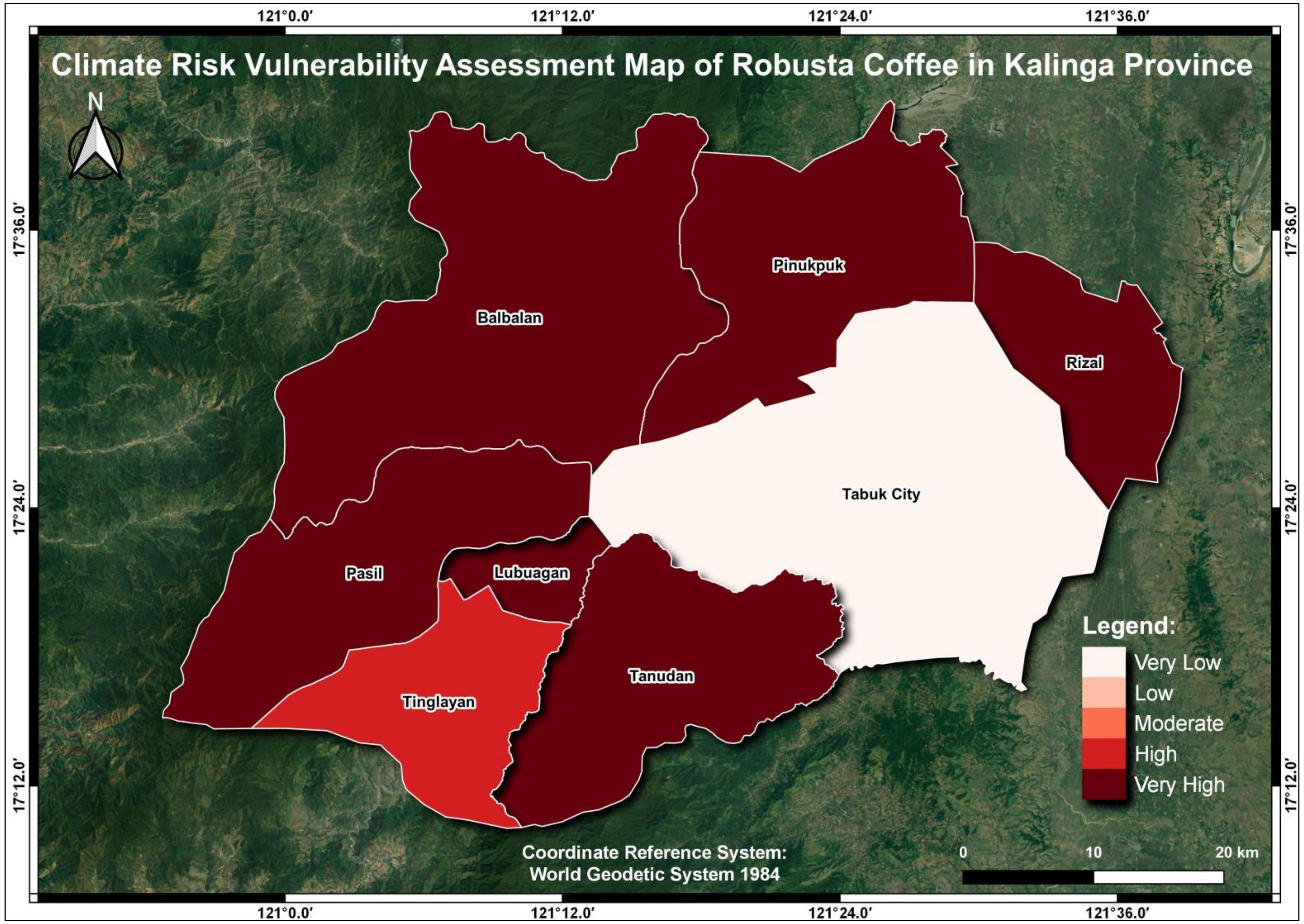

Figure 24. Climate risk vulnerability map of Robusta coffee using the weights 70% for adaptive capacity, 15% hazard and 15% sensitivity.

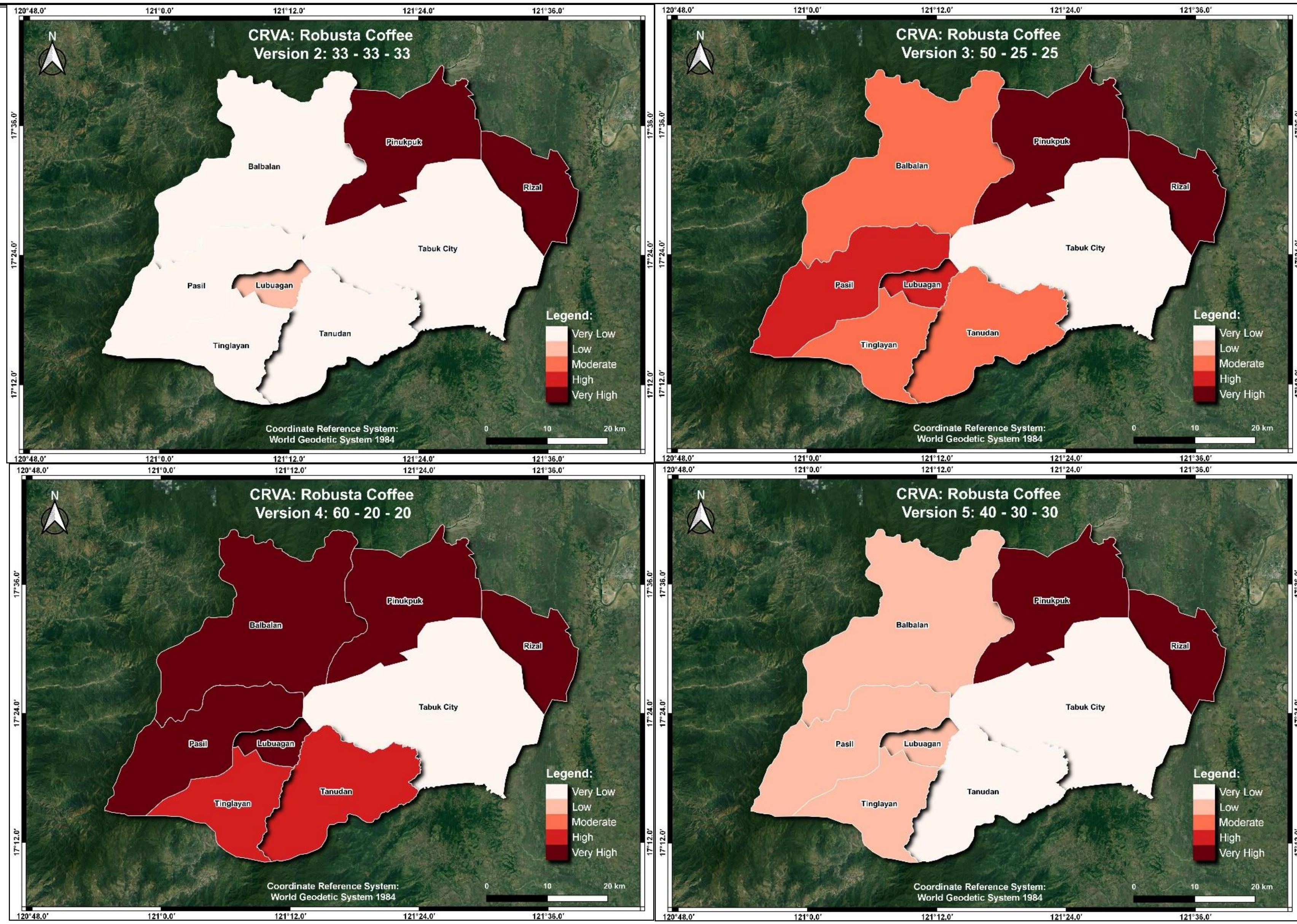

Figure 25. Vulnerability assessment of Robusta coffee using four (4) different proportions of weights.

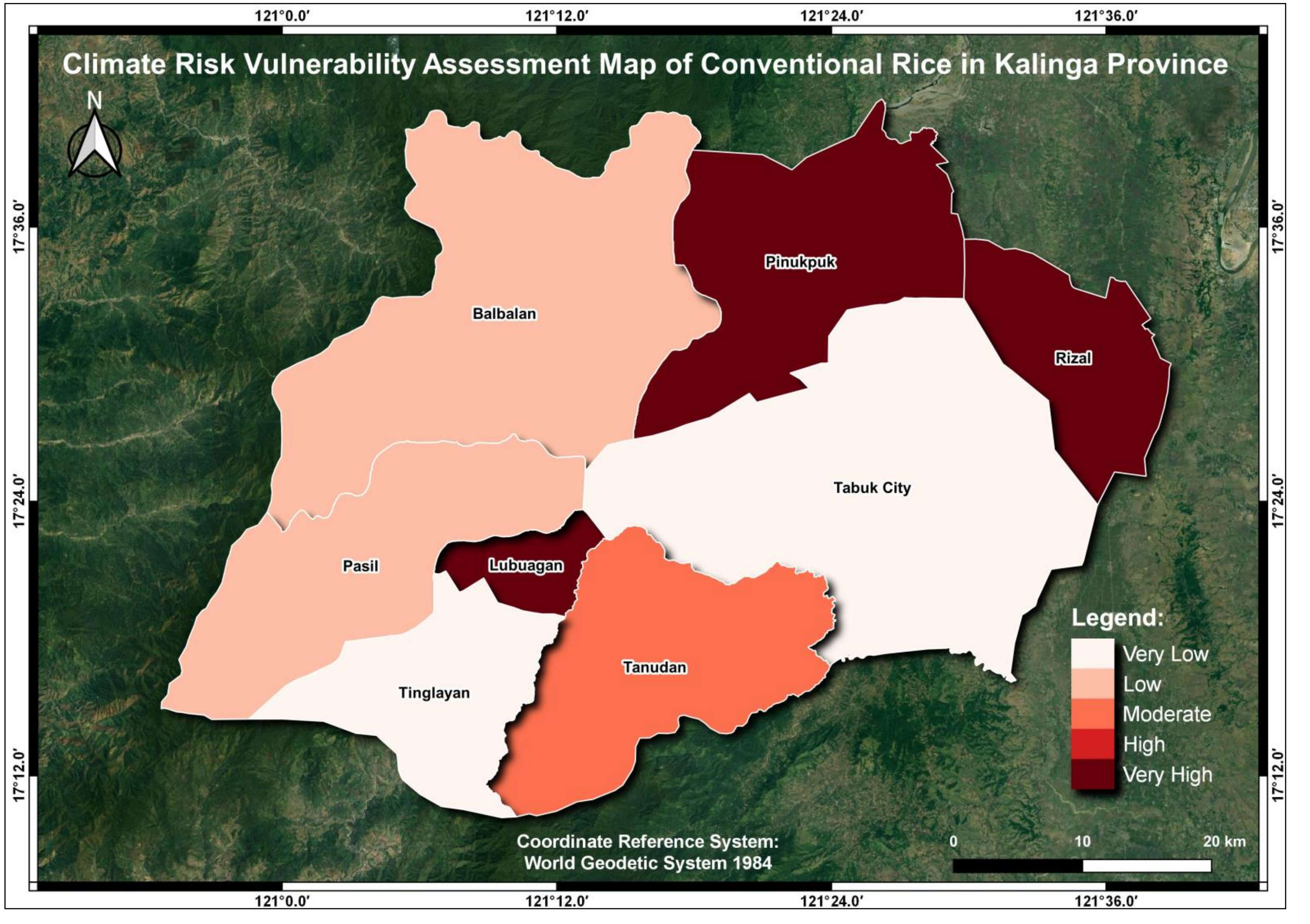

Figure 26. Climate risk vulnerability map of Conventional rice using the weights 70% for adaptive capacity, 15% hazard and 15% sensitivity.

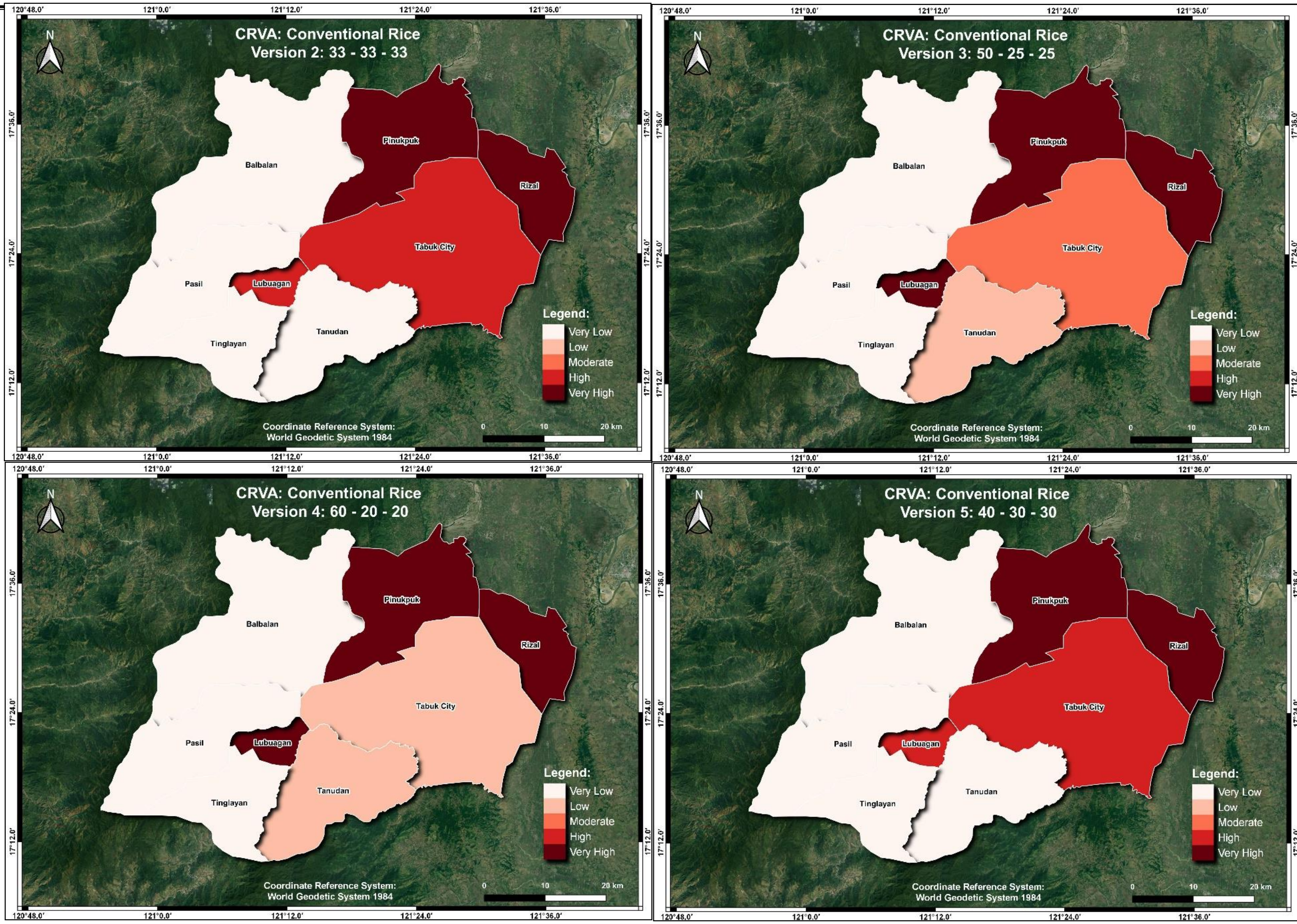

Figure 27. Vulnerability assessment of Conventional rice using four (4) different proportions of weights.

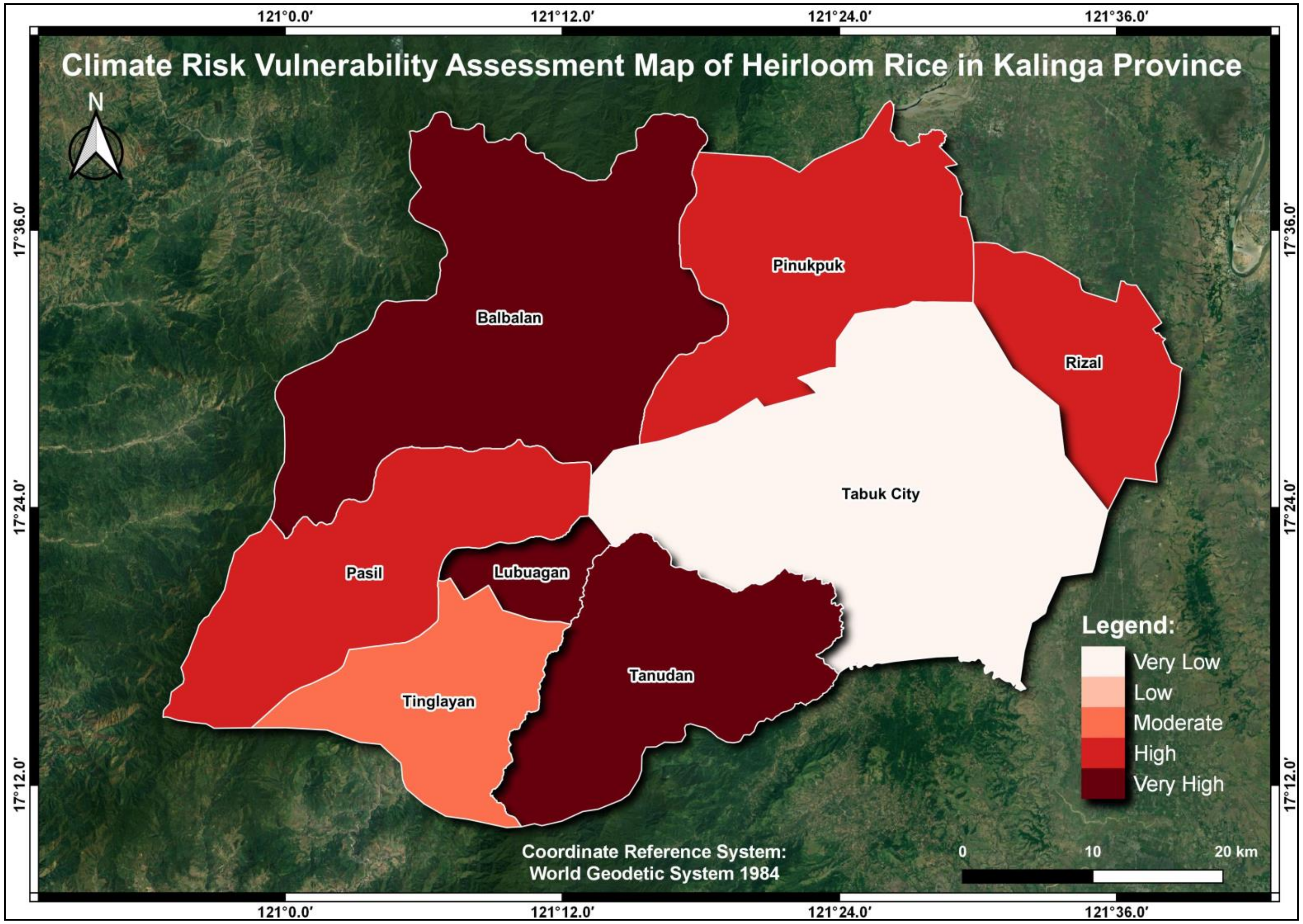

Figure 28. Climate risk vulnerability map of Heirloom rice using the weights 70% for adaptive capacity, 15% hazard and 15% sensitivity.

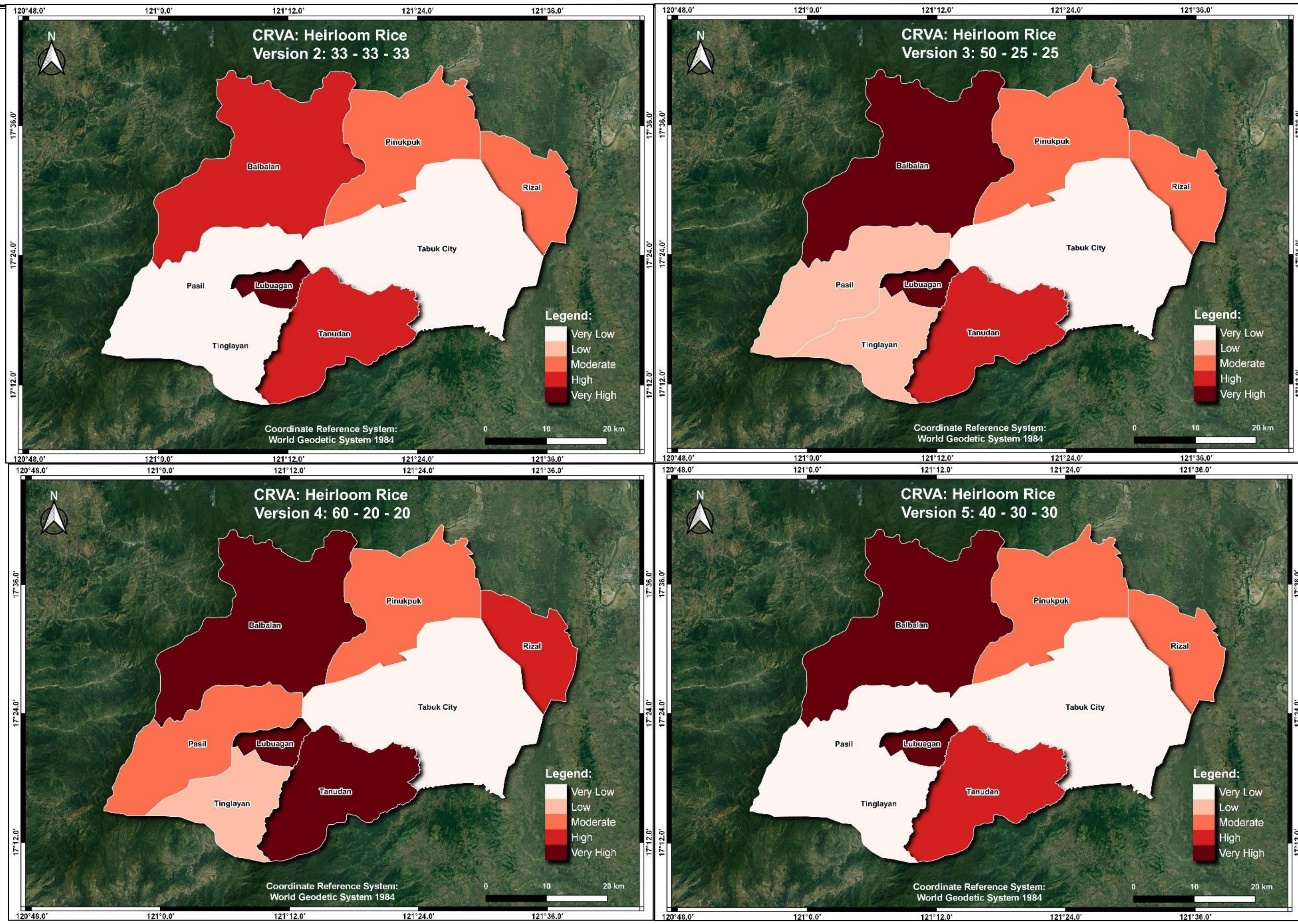

Figure 29. Vulnerability assessment of Heirloom rice using four (4) different proportions of weights.

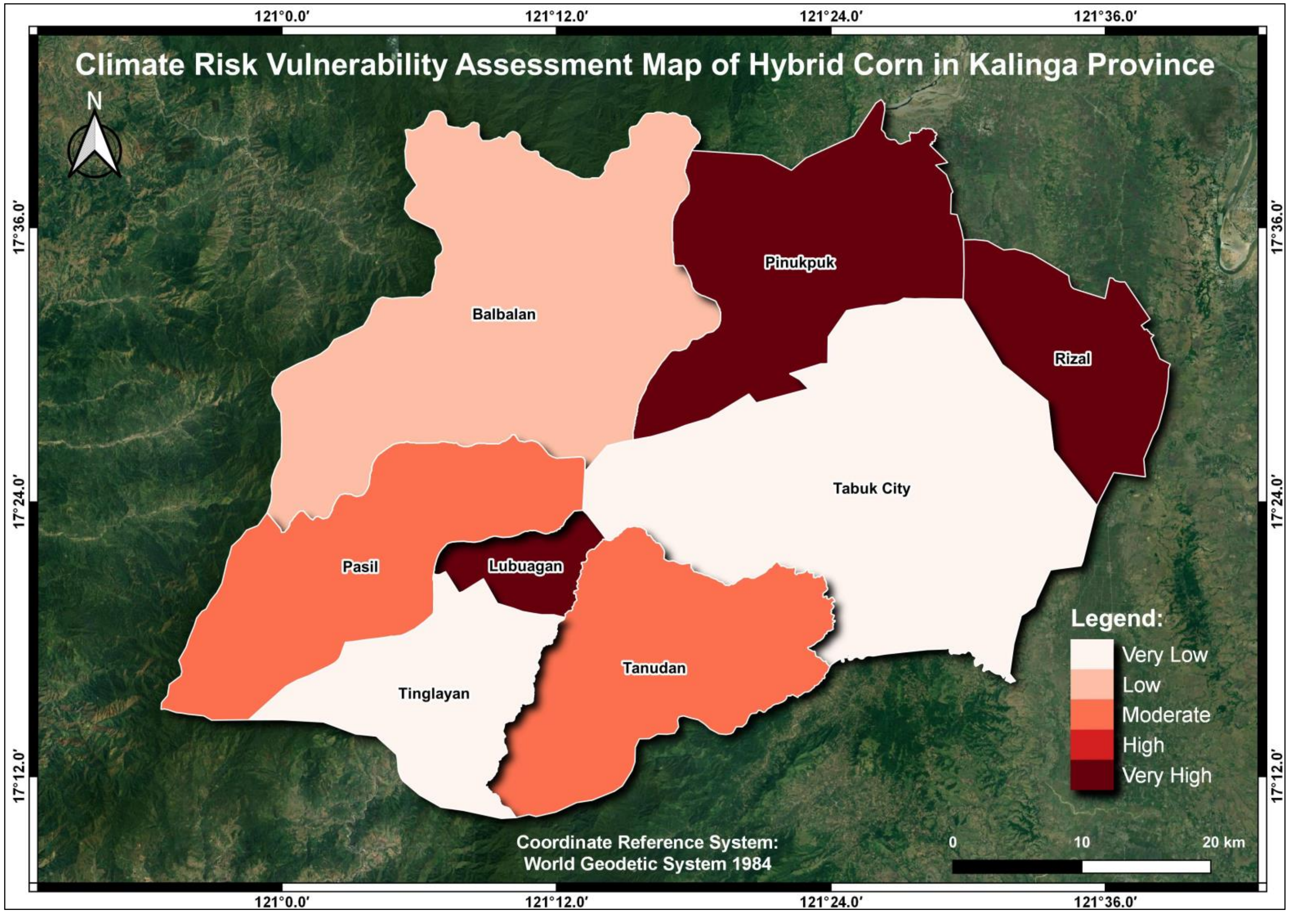

Figure 30. Climate risk vulnerability map of Hybrid corn using the weights 70% for adaptive capacity, 15% hazard and 15% sensitivity.

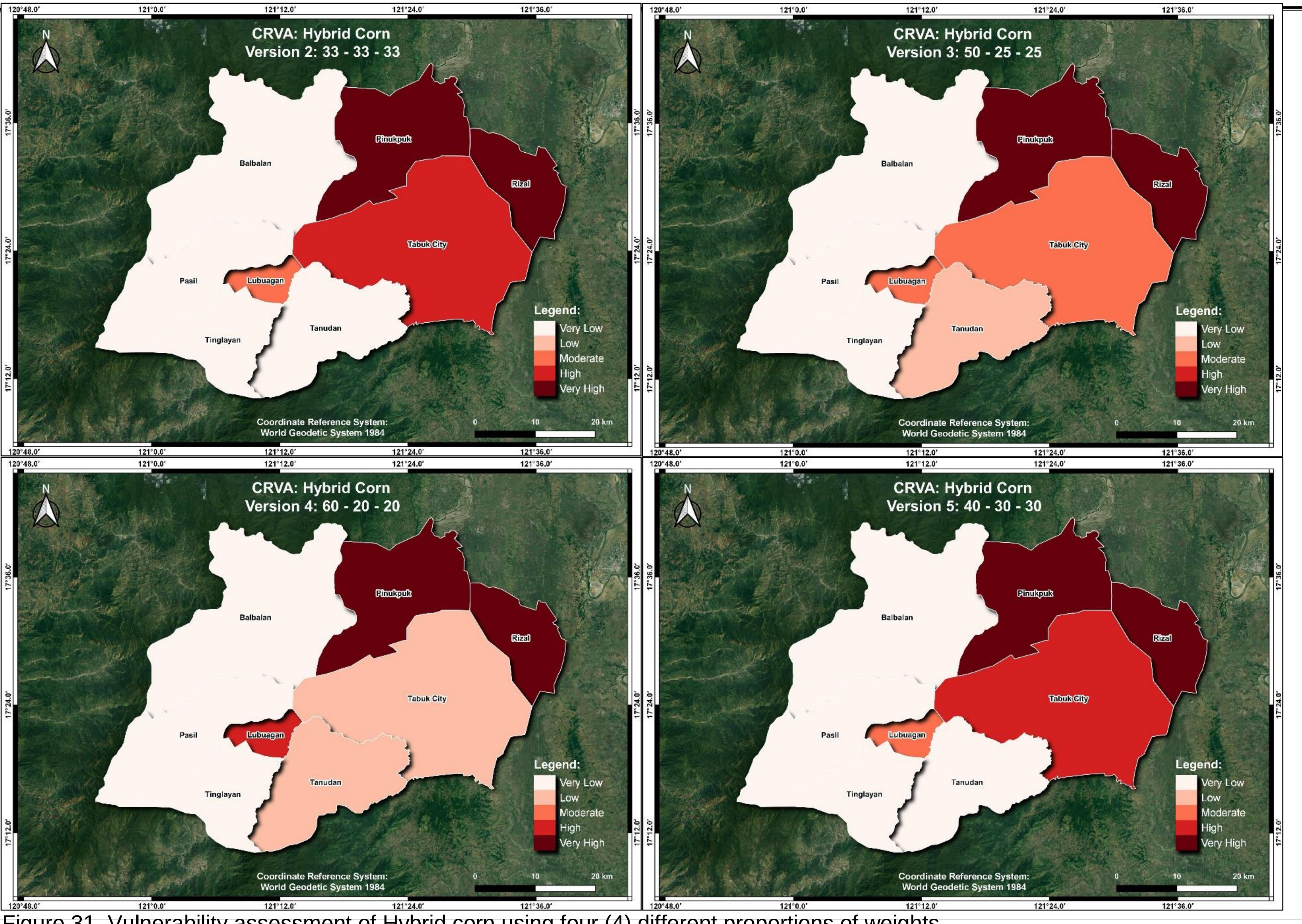

Figure 31. Vulnerability assessment of Hybrid corn using four (4) different proportions of weights.

B. CLIMATE – RESILIENT AGRICULTURE

Study 1. Sensitivity, Impact and Vulnerability Assessment of Rice Production

a. Rice production trend in Kalinga

As shown in Figure 32 the annual area planted to rice from 2011 to 2020 ranged from 25,485.00 to 37,044.00 ha with an annual production of 108,884.81 to 176,529.00 and an average yield of 4.17 to 4.83.

In 2016, rice production incurred damages and losses due to drought brought by El Niño phenomenon resulting to lesser area planted and eventually affecting the volume of production. In recent years, heavy and prolonged monsoon rains worsen the decrease in crop yields. The southwest monsoon in July 2018 enhanced by three typhoons ("Henry", "*Inday"* and "*Josie*") cost the rice production more losses (National Disaster Risk Reduction Management Council, 2018).

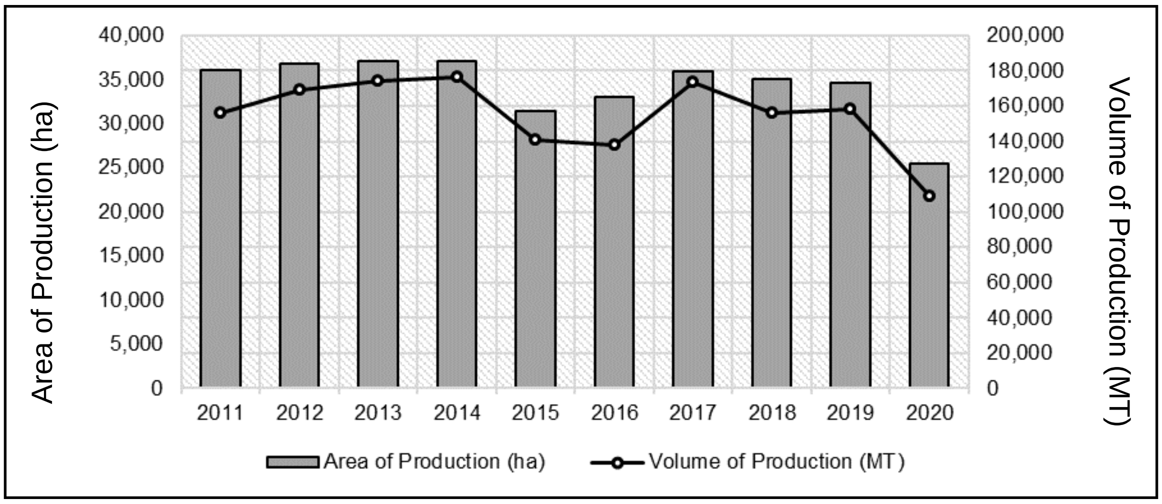

Figure 32. Kalinga rice production area and yield, 2011 – 2020.
Source: Philippine Statistics Authority (PSA)

b. Rice farming system in Kalinga

The major agricultural enterprise in Kalinga is crop production and rice is among the primary crops grown. Rice production in Kalinga has two cropping seasons. Majority of farmers grow rice as a monocrop every cropping season or twice a year (Table 7) and farm operation is both manual and mechanized. Majority of the farmers are engaged in conventional farming with the use of synthetic fertilizers and pesticides and few farmers also engage in organic farming with use of vermicomposting (Figure 33). Some farmers also plant corn, vegetables and fruit trees as relay crops or integrated crops. Some farmers also engage in fish, poultry and livestock production to augment their income. Animals commonly raised includes tilapia, pig and ducks.

Table 7. Kalinga rice farming system.

Farming System	Farm Components
Mono-cropping	Rice - rice
Relay cropping	Corn - rice - corn
Integrated farming	Rice - rice with fruit production with fish production with livestock/poultry raising
Organic farming	Rice - rice

Figure 33. Vermicomposting done by organic practitioners.

c. Rice cropping calendar in Kalinga

In Kalinga, planting season varies from every municipality and barangay (Table 8). Farmers in Pinukpuk plant their first crop around January/February and harvest on May and almost immediately plant the second crop around June/July. While farmers in Rizal plant their first crop around April/May and September/October for the second crop.

In Tabuk City, rice seedlings are grown and transplanted around February/March, two (2) months earlier compared to direct seeded crops. Immediately after harvesting the first crop the second crop is planted. Rice is planted around May/June and December/January in Tanudan, latest among the four municipalities.

Table 8. Kalinga general rice cropping calendar.

Municipality	Season	J	F	M	A	M	J	J	A	S	O	N	D
Pinukpuk	First	Sowing	Sowing	–	–	Harvesting							
	Second						Sowing	Sowing	–	–	Harvesting		
Rizal	First				Sowing	Sowing	–	–	–	Harvesting			
	Second	–	–	Harvesting							Sowing	Sowing	–
Tabuk City (Direct seeding)	First				Sowing	Sowing	–	–	Harvesting				
	Second								Sowing	Sowing	–	–	Harvesting
Tabuk City (Transplanting)	First		Sowing	Sowing	–	–	Harvesting						
	Second							Sowing	Sowing	–	–	Harvesting	
Tanudan	First					Sowing	Sowing	–	–	–	Harvesting		
	Second	Sowing	–	–	–	Harvesting							Sowing

Sowing   Harvesting

d. Rice production value chain characterization in Kalinga

I. <u>Value chain activities</u>

Table 9 shows the different activities that occur at each stage in the rice production value chain of Kalinga. In stage A (provision of seeds and other inputs) farmers acquire the needed seeds and other inputs within the province and near provinces like Isabela, Tuguegarao and Ifugao.

The stage B (on-farm production) and stage C (harvesting, storage and processing) activities are predominantly done by male farmers from land preparation to storage. Some farmers owned and use carabaos, plow and two-wheel tractors to work in their fields. In terms of labor, majority utilize man-animal labor during land preparation (plowing, rotavating and field leveling), man labor during transplanting and man-machine labor during harvesting.

Rice are being sold in dried weight during the stage D (product marketing). Straight buyers are also common where they directly buy rice produce right at the farmer's field. Other farmers sell their produce to different retailers.

II. Value chain actors

Different types of key actors in the Kalinga rice industry includes farmers, credit providers like the different farmer's association, cooperatives and/or federations, farm suppliers, farm laborers and machine operators, harvest and post-harvest machine operators, millers, traders (wholesalers and retailers), and support institutions (Table 10). These different types of key actors across the value chain varies from small scale to medium scale.

Table 9. Rice production value chain activities in Kalinga.

Value Chain Stages	Activities	Who carries it out	Where does it take place
Stage A 	Selection of seed variety and acquisition of seeds	Farmer (men and women)	*Farmers locality *Center town *Markets
	Acquisition of fertilizers and pesticides	Farmer (men and women)	*Farmers locality *Center town *Markets
Stage B 	Land preparation	*Farmer (mostly men) *Laborer	Farmer's locality
	Seed sowing	Farmer (men)	Farmer's locality
	Transplanting of rice seedlings	*Farmer (men and women) *Laborer	Farmer's locality
	Application of fertilizers	Farmer (men)	Farmer's locality
	Application of pesticides	Farmer (men)	Farmer's locality
	Irrigation	Farmer (men)	Farmer's locality
Stage C 	Harvesting and threshing	*Farmer (men) *Laborer *Machine renters/operators	Farmer's locality
	Drying	*Farmer (men) *Laborer	Farmers locality
	Milling/Packing	*Warehouse owner *Mechanical plant operators *Laborer	*Farmers locality *Center town *Markets
	Storage	Farmer (men and women)	Farmers locality
Stage D 	Selling of produce	*Farmer (men and women) *Local and outside buyer	*Farmers locality *Center town *Markets

Table 10. Types of actors involve in the rice production value chain in Kalinga.

VC Stage	Actors	Scale
Stage A	Seed and other inputs suppliers	Small
	Farmers Association/cooperatives	Small - medium
Stage B	Farmers	Small - medium
	Farmers association/cooperative	Small - medium
	Hired labourers	Medium
	Machine renters/operators	Small
Stage C	Farmers	Small - medium
	Farmers association/cooperative	Small - medium
	Hired labourers	Medium
	Machine renters/operators	Small
Stage D	Middlemen/trader	Small
	Buyers	Small - medium
	Retailers	Small - medium

*Small: < 10 workers Medium: 10-50 workers Large: > 50 worker

Figure 34 shows the participation and importance of men, women, youth (18-35) and children in the different value chain of rice production of Kalinga. Men has very high participation in all stages. Women's participation is within medium to high level. Their involvement includes being in charge in the marketing of the rice produce. Participation of youth ages 15-35 years old are low except during the harvesting, storage and processing stage. Children has very low participation at stage B and C.

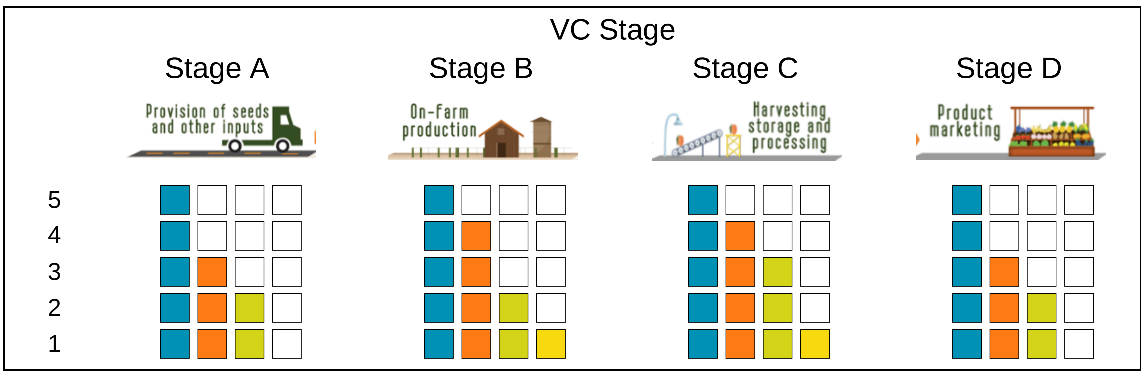

Figure 34. Importance of men, women, youth (18 - 35) and children across the different value chain of rice production in Kalinga.

*0: non-existent 1: very low 2: low 3: medium 4: high 5: very high

Men Women Youth Children

e. Assessment of Exposure and Sensitivity to Climatic Hazards of Rice Production in Kalinga

I. Climatic hazards and consequences

The identified climatic hazards during the FGD and KIIs with the farmers and local officials were mainly drought and prolong dry season, and typhoons which brought strong winds, flooding and landslides (Figure 35).

Drought and change in the usual pattern of dry and wet season are experienced in Kalinga. The dry season is usually from April to May but prolonged dry season was experienced and observed by the farmers. In the past, farmers can easily schedule their agricultural production activities because of the on-time rainy season. But in the recent years they have observed the changing patterns- dry season is prolonged and heat is more intense. Rice production is limited during such periods. The fluctuating dry and wet season have contributed to the decrease/shortage of water/irrigation, delayed planting and decrease in pollination activities of the flowers.

A number of strong typhoons with heavy rains and strong winds affects Kalinga. Landslides occur which frequently blocks farm-to-market roads and cause road closures. This result to farmer's late or delayed acquisition of seeds and other inputs and deliveries of harvested produce. Landslide/erosion also contributes to the reduction of production areas especially near the rivers.

The farmers identified strong winds brought by the typhoons to be damaging. Strong winds cause breakage/lodging of rice and corn plants. Strong winds occurring during the reproductive stage of the rice and corn plants results to the decrease in pollination activities of the flowers and increase unfilled grains.

Flooding is also another hazard experienced with the province. Rivers and other water ways overflows and affects standing crops at production areas. Some farmers experienced total loss during such event. Overall, this contributes to the reduction of yield and eventually farmer losses in income.

Figure 35. Effects of typhoon (climatic hazard) in rice production of Kalinga: (A and B) lodging of plants, and (C) rice field affected by erosion.

II. Underlying factors

The underlying factors that further contribute to the damages caused by drought and prolong dry season, and typhoons which brought strong winds, flooding and landslides are insufficient or poor irrigation systems, flood prone farm areas, poor road conditions, drying facilities not being utilized and the price regulation. Irrigation facilities are not being maintained and farmers do not pay their due. Most farm areas are also located in low lying areas and are near rivers. Farmers have difficulties on the procurement of farm inputs due to poor road conditions especially during the occurrence of typhoons. Transportation of farmers produce to the market are also limited.

f. Assessment of Adaptation and/or Mitigation Technologies to Climatic Hazards of Rice Production in Kalinga

Rice farmers in Kalinga employ several adaptations and/or mitigation strategies to address the effects of climatic hazards (Table 11) such as selection and acquisition of appropriate seed varieties, availing crop insurance, changing/adjusting the cropping calendar, use of water pump to irrigate and use of combine harvesters.

Farmers select and acquire appropriate seed varieties for dry and wet season cropping. Farmers select seed varieties that are resilient/tolerant to lodging and flooding during wet season cropping and drought tolerant during dry season cropping.

Some farmers avail crop insurance from PCIC every cropping season. With the assistance of the Municipal Agriculture Offices (MAOs) farmers can apply and avail crop insurance protection against losses arising from natural calamities and plant pest infestation.

Farmers change or adjust their cropping calendar. Farmers wait for the start of rain especially for rainfed – dependent. Installation and use of water pumps to supply water to the rice areas are being employed by the farmers. This help supplements the needed water of the crops during drought and prolong dry seasons.

For faster harvesting of rice produce, farmers use combine harvesters before the onset of typhoons. This minimizes the yield loss of the farmers.

Table 11. Adaptation/mitigation options of climatic hazards in Kalinga.

Climatic Hazard	Adaptation/Mitigation Options	Implementing Households (%)	Rank
Drought and prolong dry season	Use of water pump	40-50	1st
	Availing crop insurance	40-50	2nd
	Selection and acquisition of appropriate seeds (use of inbred/ hybrid seeds that are drought tolerant)	90-100	3rd
	Change/ adjusting cropping calendar	90-100	4th
Typhoon	Availing crop insurance	40-50	1st
	Selection and acquisition of appropriate seeds (use of inbred/ hybrid seeds that are drought tolerant)	90-100	2nd
	Use of combine harvester	45-55	3rd

Study 2. Sensitivity, Impact and Vulnerability Assessment of Corn Production

a. Corn production trend of Kalinga

Fluctuation occurred in corn production. As shown in Figure 36 the annual area planted to corn from 2011 to 2020 ranged from 11,394.00 to 14,890.00 ha with an annual production of 43,346.00 to 65,505.00 and an average yield of 3.37 to 4.58.

In 2016, rice production incurred damages and losses due to drought brought by El Niño phenomenon resulting to lesser area planted and eventually affecting the volume of production. In recent years, heavy and prolonged monsoon rains worsen the decrease in crop yields. The southwest monsoon in July 2018 enhanced by three typhoons ("Henry", "*Inday*" and "*Josie*") cost the corn production more losses (National Disaster Risk Reduction Management Council, 2018).

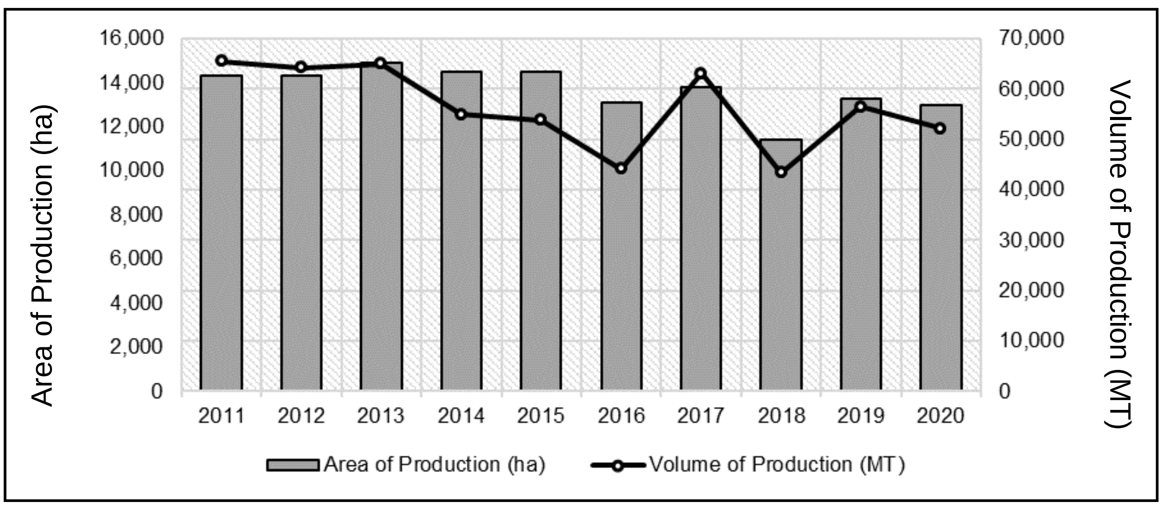

Figure 36. Kalinga corn production area and yield, 2011 – 2020.
Source: Philippine Statistics Authority (PSA)

b. Farm enterprise, crops and cropping patterns in Kalinga

The major agricultural enterprise in Kalinga is crop production and corn is among the primary crops grown. Corn production has two cropping seasons and majority of farmers grow corn twice a year. Majority of farmers practice mono-cropping but some farmers also practice relay cropping, planting rice between the first and second cropping of corn.

In Kalinga, planting season do not vary from every municipality. Farmers plant their first crop around April/May and harvest on August/September while for the second crop it is plated around October/November and harvested on February/March.

c. Corn production value chain characterization in Kalinga

I. Value chain activities

Table 12 shows the different activities that are involved at each stage in the corn production and marketing in Kalinga.

Stage A. Provision of seeds and other inputs

Corn farmers seek credit to purchase seeds and other inputs. This is done by some farmers who obtain less income from the previous harvest and with less capital. Farmers use quality and recommended seed varieties and acquire fertilizers and pesticides from agricultural farm supplies/stores located within the province and near provinces like Isabela, Tuguegarao and Ifugao. Farmers then transport the acquired seeds and other inputs to their locality/fields.

Stage B. On-farm production

Land preparation starts from site clearing. Site clearing is done upon reaping. Tilling and plowing are then employed with the use of machines for wide flat areas. Some farmers with much capital and who owned wide area hire laborers to do or help them in the activities. Rental of machines are also common.

Basal and top-dress application is done by the farmers. Pesticide application is widely used by the farmers. Mostly use are herbicides and insecticides since most farmers' plant roundup ready corn seeds. Foliar fertilizer is sprayed before tasseling (45 days after planting). Some farmers hire laborers to do or help them in the activities. Farmers mostly use herbicides and insecticides.

Stage C. Harvesting, storage and processing

Harvesting is done after 120 days after planting. Some farmers with much capital and who owned wide flat area harvest using harvester machine. Threshing is done at the same time by the harvester machine. Some rent thresher machines or pay per sack of threshed produce. Farmers then dry their corn produce on the road or near any multi – purpose drying pavements (MPDP) before selling (Figure 37).

Stage D. Product marketing

Farmers then transport their produce to the market for selling to retailers and other buyers. In some cases, products are directly bought from farmers right in the field. Selling of dried corn is done after the corn has 14% moisture content. Selling of dried corn is done at the market of which farmers bring the product to the buyers. After selling the produce, farmers usually pay their credits to their lenders or immediately deducted if they have a supply system.

Table 12. Value chain key activities of corn production in Kalinga.

Value Chain Stages	Activities	Who carries it out	Where does it take place
Stage A  	Access to credits	*Farmer (men and women) *Supplier/ Financier	Farmers locality, center town, markets
	Selection of seed variety and acquisition of seeds	Farmer (men and women)	Farmers locality, center town, markets
	Acquisition of fertilizers and pesticides	Farmer (men and women)	Farmers locality, center town, markets
	Hauling and transporting	*Farmer (mostly men) *Supplier/ Financier	Farmers locality, center town, markets
Stage B  	Land preparation	*Farmer (mostly men) *Laborers *Machine renters	Farmer's locality
	Planting	*Farmer (men and women) *Laborers *Machine renters	Farmer's locality
	Application of fertilizers	*Farmer (mostly men) *Laborers	Farmer's locality
	Application of pesticides	*Farmer (mostly men) *Laborers	Farmer's locality
	Application of foliar fertilizers	*Farmer (mostly men) *Laborers	Farmer's locality
Stage C  	Harvesting and threshing	*Farmer (mostly men) *Laborers *Machine renters	Farmer's locality
	Sun drying	*Farmer (mostly men) *Laborer	Farmers locality, center town
Stage D  	Hauling and transporting	*Farmer (men) *Local and outside buyers/retailers	Farmers locality
	Selling of products	*Farmer(men or women) *Local and outside buyers/retailers *Businessmen/entrepreneurs	Farmers locality
	Payment of credit	Farmer	Farmers locality, center town, markets

Figure 37. Drying of corn produce in various municipality of Kalinga.

II. <u>Value chain actors</u>

Different types of key actors in the Kalinga corn industry includes farmers, credit providers like the different farmer's association, cooperatives and/or federations, farm suppliers, farm laborers and machine operators, harvest and post – harvest machine operators, millers, traders (wholesalers and retailers), and support institutions (Table 13). These different types of key actors across the value chain varies. Farmers are small scale while the others are medium to large scale.

Table 13. Types of actors involve in the corn value chain in Kalinga.

VC Stage	Actors	Scale
Stage A 	Farmers	Small
	Farmers association/ cooperative/ federation	Medium - large
	Credit providers and lenders	Medium - large
	Seed and other inputs suppliers	Medium - large
Stage B 	Farmers	Small
	Farmer association/ cooperative/ federation	Medium - large
	Hired labourers	Medium - large
	Machine renters/operators	Medium - large
Stage C 	Farmers	Small
	Farmer association/ cooperative/ federation	Medium - large
	Hired labourers	Medium - large
	Machine renters/operators	Medium - large
Stage D 	Middlemen/trader	Medium - large
	Buyers	Medium - large
	Retailers	Medium - large

* Small: < 10 workers Medium: 10-50 workers Large: > 50 workers

Figure 38 shows the participation and importance of men, women, youth (18 – 35) and children in the different value chain of rice production of Kalinga. Men has very high participation in all stages. Women's participation is high except during stage A and their involvement includes being in charge in the marketing of the corn produce. Participation of youth ages 15 – 35 years old are medium during stage A, high during stages B and C, and very low during stage D. Children has no participation during stage A and D and very low participation at stage B and C.

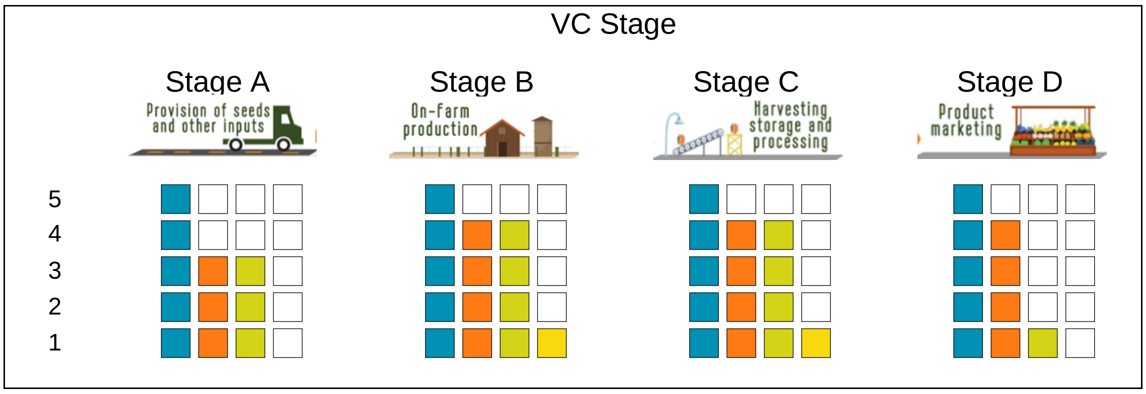

Figure 38. Importance of men, women, youth (18-35) and children across the different value chain of corn production in Kalinga

*0: non-existent 1: very low 2: low 3: medium 4: high 5: very high
Men Women Youth Children

d. Assessment of exposure and sensitivity to climatic hazards of corn production in Kalinga

I. Climatic hazards and consequences

The climatic hazards identified by the farmers and local officials were mainly drought and prolong dry season, and typhoons which brought strong winds, flooding and landslides.

Drought and change in the usual pattern of dry and wet season are experienced in Kalinga. The dry season is usually from April to May but prolonged dry season was experienced and observed by the farmers. In the past, farmers can easily schedule their agricultural production activities because of the on-time rainy season. But in the recent years they have observed the changing patterns- dry season is prolonged and heat is more intense. Corn production is limited during such periods. The fluctuating dry and wet season have contributed to the decrease/shortage of water/irrigation, delayed planting and decrease in pollination activities of the flowers.

A number of strong typhoons with heavy rains and strong winds affects Kalinga. Landslides occur which frequently blocks farm-to-market roads and cause road closures. This result to farmer’s late or delayed deliveries of harvested produce and acquisition of seeds and other inputs. Landslide also contributes to the reduction of production areas especially near the rivers.

The farmers identified strong winds brought by the typhoons to be damaging. Strong winds cause breakage/lodging corn plants. Strong winds occurring during the reproductive stage of corn plants results to the decrease in pollination activities of the flowers and increase unfilled kernel/cobs.

Flooding is also another hazard experienced within the province. Rivers and other water ways overflows and affects standing crops at production areas. Some farmers experienced total loss during such event. Overall, this contributes to the reduction of yield and eventually farmer losses in income.

II. Underlying factors

The underlying factors that further contribute to the damages caused by climatic hazards are on infrastructures, biophysical, socio economic, institutional and policy.
Farmers have difficulties on the procurement of farm inputs and transportation of produce to the market due to poor road conditions especially during the occurrence of typhoons. Some remote areas also have ragged roads. Farm areas are rolling or have a sloping terrain which contributes to poor road conditions and to the inevitability of soil erosion or landslides. Among the different actors in the value chain, farmers are the most vulnerable due to production loss. Corn production needed high capital and even with the presence of credit companies, some farmers do not take chances since interests are high.

e. Assessment of adaptation and/or mitigation technologies to climatic hazards of corn production in Kalinga

Corn farmers of Kalinga employ several adaptations and/or mitigation strategies to address the effects of climatic hazards (Table 14) such as selection and acquisition of appropriate seed varieties, availing crop insurance, changing/adjusting the cropping calendar and use of combine harvesters.

Farmers select and acquire appropriate seed varieties for dry and wet season cropping. Farmers select seed varieties that are resilient/tolerant to lodging and flooding during wet season cropping and drought tolerant during dry season cropping.

Some farmers avail crop insurance from PCIC every cropping season. With the assistance of the Municipal Agriculture Offices (MAOs) farmers can apply and avail crop insurance protection against losses arising from natural calamities and plant pest infestation.

Farmers change or adjust their cropping calendar. Farmers wait for the start of rain since corn production is rainfed-dependent.

For faster harvesting of rice produce, farmers use combine-harvesters before the onset of typhoons. This minimizes the yield loss of the farmers.

Table 14. Adaptation/mitigation options for climatic hazards in Kalinga.

Climatic Hazard	Adaptation/Mitigation Options	Implementing Households (%)	Rank
Drought and prolong dry season	Availing crop insurance	40-50	1st
	Proper selection of seed variety	90-100	2nd
	Change/ adjusting cropping calendar	90-100	3rd
Typhoon	Availing crop insurance	40-50	1st
	Use of combine harvester	45-55	2nd
	Proper selection of seed variety	90-100	3rd

Study 3. Sensitivity, Impact and Vulnerability Assessment of Coffee Production

a. Coffee production trend in Kalinga

Kalinga was ranked as the seventh-largest coffee producer in the country, with 3,698.50 MT 68% of Cordillera’s total coffee production as of 2013, according to the DA. Tanudan has the widest production area for Robusta beans planted on 3,954 ha of land, almost half of the province’s total production area.

Over the past 10 years the province coffee production areas continuously decreased (Figure 39). The volume of production slightly increased from the year 2011 to 2012 but by the year 2013 to 2017 there was a decrease from 3,699 MT to 311 MT.

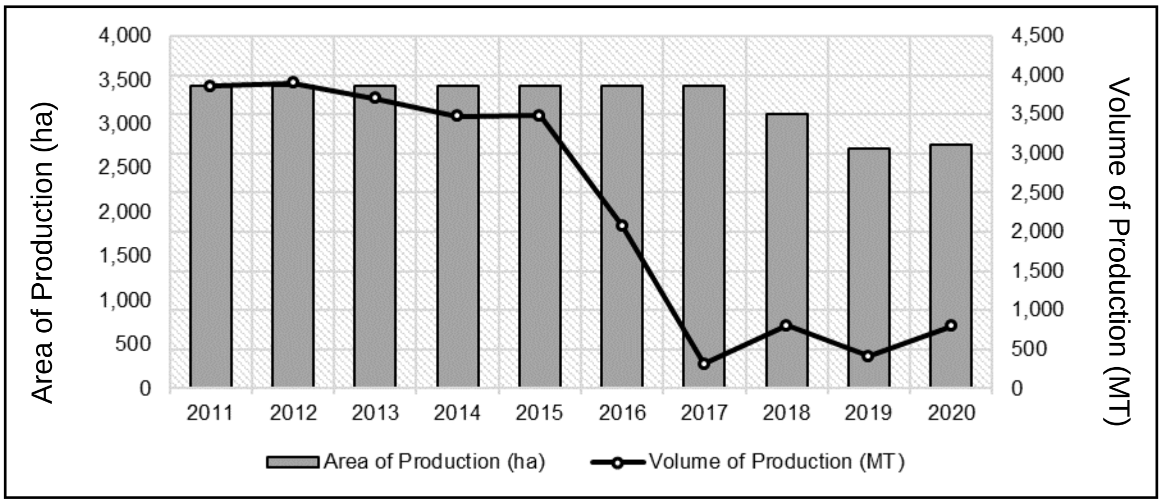

Figure 39. Coffee production in Kalinga
**Source: Philippine Statistics Authority (PSA)*

b. Coffee farming system in Kalinga

The coffee farming system of Kalinga include mix intercropping and multi – storey cropping system. Coffee trees were mix intercrop with Narra trees and Acacia trees which served as wind breakers and shades for the coffee trees. In multi – storey cropping system, fruit trees like cacao, lanzones, *bugnay*, *rambutan* were also planted with coffee trees, these acts as protection/shade and fruits can be harvested for home consumption or sold for additional income. Cash crops like pineapples and corn is also being planted with the coffee trees for income and consumption.

c. Coffee production value chain characterization in Kalinga

I. Value chain activities

Activities identified under stage A includes the acquisition of planting materials and other inputs like fertilizers. Majority of coffee farmers use wildlings acquired from their own coffee farms or nearby farms.

Activities during stage B starts from land preparation, hole preparation, transplanting, fertilizer application, weeding, pruning, rejuvenation of old trees. Land preparation include cleaning or site clearing, weeding, removal of stones and rocks. Some farmers hire laborers to help in land preparation. Farmers mix fertilizer or compost or farm residues with soil before transplanting wildlings or seedlings in a 1.5 to ft. the hole during wet season. Farmers do manual weeding and is done 1 or 2 times a year. Application of herbicide is also practiced by some farmers.

During harvesting farmers practice selective picking or strip picking. Cherries are then dried for 8 – 10 days depending on the weather if dry method is practiced. Cherries are pulped then fermented for 24 hours to remove the mucilage then dried is wet method is practiced. The green beans are then stored, roasted, grinded and then packed after being dehulled (Figure 40). Product marketing is last stage. Market outlets for coffee produced are at local markets, near municipalities and/or provinces. Some farmers also tried selling to Nestlé (2002 – 2013).

Figure 40. (A) some of the machines used to process the coffee beans and (B) drying method practiced by the producers.

II. Value chain actors

Table 15 shows the different types of key actors involved in the value chain of coffee production. Actors who are involve in the value chain were various government agencies like the DA and Bureau of Plant Industries (BPI), farmers, hired laborers, farmers' associations or cooperatives and buyers.

Table 15. Value chain characterization.

Types of Actors Engage in the VC	Scale
Government agencies	Large
Farmers	Small
Laborers	Small
Associations/ cooperatives	Small- Medium
Buyers	Small- Medium

* Small: < 10 workers Medium: 10-50 workers Large: > 50 workers

In Figure 41, men have medium participation during stage A, high participation during stages B, very high participation during stage C and low participation during stage D. Women are mostly in charge in marketing the coffee products that's why they have a high participation in stage D. For youth their involvement is medium level during stage B and C. Children has no involvement in coffee production since location is far, sloping and more dangerous.

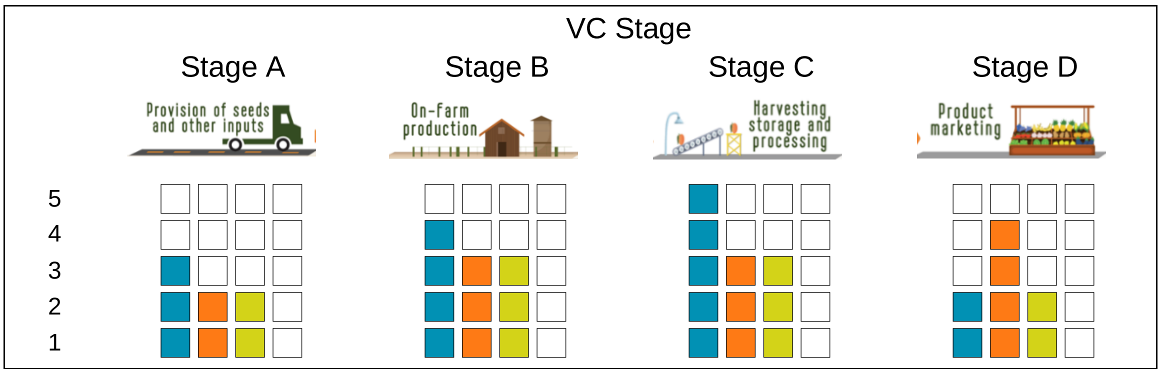

Figure 41. Importance of men, women, youth (18-35) and children across the different value chain of coffee production in Kalinga

*0: non-existent 1: very low 2: low 3: medium 4: high 5: very high

Men Women Youth Children

d. Assessment of exposure and sensitivity to climatic hazards of coffee production in Kalinga

I. <u>Climatic hazards and consequences</u>

The identified climatic hazards during the FGD and KIIs were drought and typhoon (Table 16). Typhoon is a great threat to coffee farmers. Typhoon cause the coffee trees to be uprooted, branches to be broken, shade trees to fell down which damages the coffee trees, and increase flower and fruit drop most especially when coffee trees are in their bearing and flowering stage. For young coffee, mortality increases. Typhoon also causes erosion and landslides that eventually destroys the farms, FRMs, foot paths and bridges. Farms are usually situated in mountainous, steep/slope areas of which are prone to landslides and soil erosion during typhoon.

Drought has a positive effect according to farmers because fruiting is better during drought but drought also has a negative effect most especially to young coffee trees because wilting is very common. Drought also results to stunted and weak coffee plant due to the lack of water.

Table 16. Consequences of climate hazards.

Climatic Hazards	Consequences	Severity
Typhoon	Causes damage to coffee trees and shade trees	Major
	Increase in flower and fruit drop	Major
	Causes soil erosion and land slide	Major
	Hauling difficulty due to muddy terrain	Moderate
	Postharvest drying difficulty	Minor- Major
Drought	Weak and stunted plants	Moderate
	Increase mortality for young coffee trees	Major
	Wilting of coffee trees	Moderate

II. Underlying factors

Farms are usually situated in mountainous, steep/slope areas of which are prone to landslides and soil erosion during typhoon. Farmers have difficulties on acquiring and collecting seedlings and wildling due to poor road conditions especially during the occurrence of typhoons. Transportation of farmers produce to the market are also affected due to poor road condition. Some remote areas have rough roads and no to limited source of water for irrigation. Prices are usually being dictated by buyers.

e. Assessment of adaptation and/or mitigation technologies to climatic hazards of coffee production in Kalinga

Unfortunately, there were no adaptation options/mitigation for the mentioned climatic hazards. All though there were practices mentioned but coffee farmers are doing them for the increase of production and for management only not in relation to climate hazards (typhoon and drought). Farmers insists that they don't do much because coffee trees have shade trees like Narra, Accasia and other fruit trees that during typhoon and drought shade trees acts as protection from high temperature also function as buffer trees from strong wind and rain.

Majority of farmers' produce are used for home consumption and if harvest is more then they sell it for additional income. According to the farmers, volume of harvest is very different from then because of climate change. Lesser harvest had caused some coffee farmers to shift/ convert their coffee farms into farming where they can earn much money.

Study 4. Sensitivity, Impact and Vulnerability Assessment of Banana Production

a. Banana production profile

Banana production is one of the sources of income of farmers in Kalinga. In fact, the harvested area for banana increased to 19.6% within 10 years from CY 2010 to 2020 (Figure 42). Banana production in Kalinga was also estimated to be 1,367.63 MT for the year 2020, which is a 43.3% increase from the previous year (Philippine Statistics Authority, 2021).

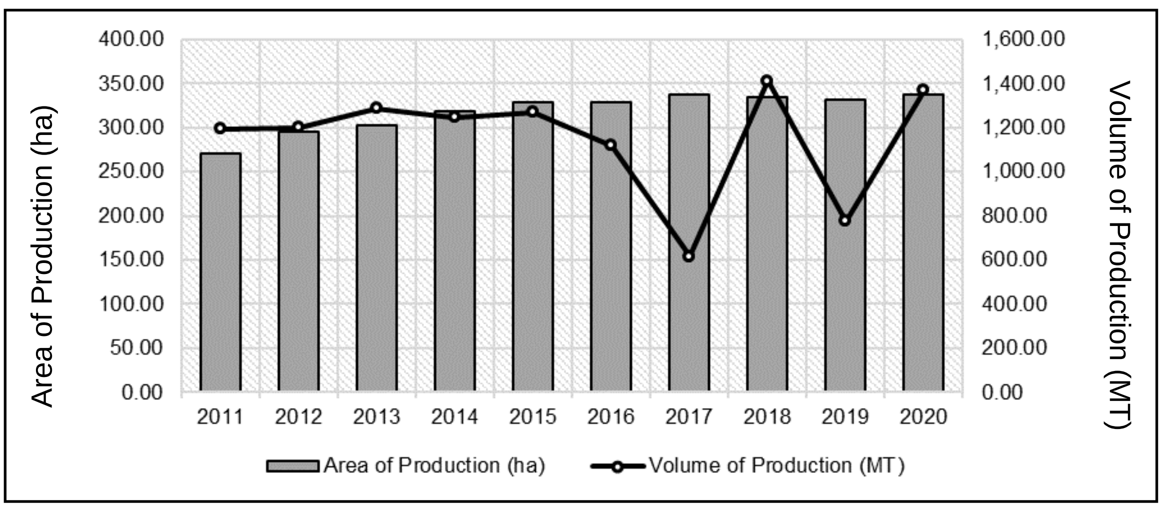

Figure 42. Annual production and harvested area of Banana in Kalinga province
**Source: Philippine Statistics Authority (PSA)*

b. Banana farming system

Banana is planted in more or less than 300 ha as a monocrop, border crop or a component of a mixed intercrop system in various municipalities of the province, namely Rizal, Tanudan and Tabuk City (Figure 43). As a border crop, banana is planted with corn in approximately 1:19 ratio and in a mixed intercropping system with other crops in a 4:1 ratio. The other crops mixed with banana are fruit trees such as lanzones, rambutan, mango, cacao, mandarin and others. Furthermore, some farms mix banana with annual crops such as pineapple.

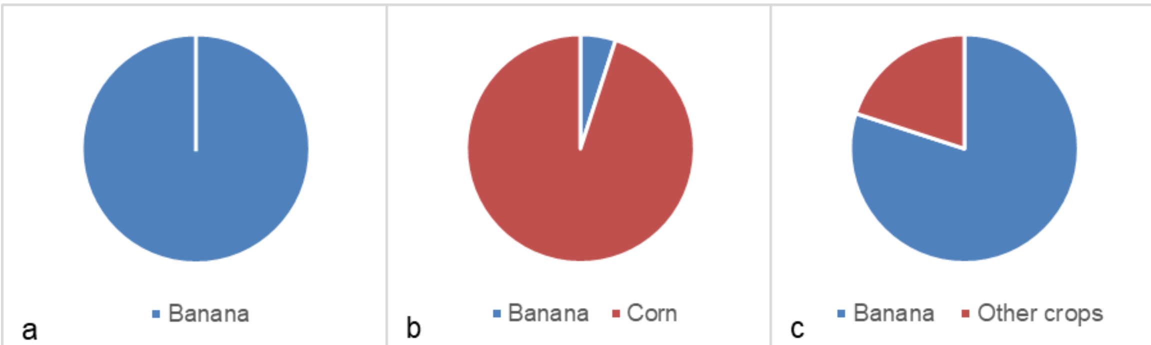

Figure 43. Proportion of banana in/as a (a) monocrop system; (b) border crop; and (c) mixed intercropping system

c. Value chain activities

The different activities involved in the production and marketing of banana in Kalinga are as follows (Figure 44):

a. Provision of seeds and other inputs

Healthy suckers are collected from their own or other established banana plantations within the province. Some farmers treat banana suckers with chemicals such as Cymbush in order to prevent the infection of bunchy top virus. Chemicals and other inputs are bought from nearby farm supplies.

b. On-farm production

Land preparation starts with land clearing and preparation of hills where the banana suckers are planted following uniform planting distances. Specifically, the variety *Dippig* is planted following a distance of 7.5 m^2 whereas varieties *Lakatan* and *Latundan* follow a 4.5 m^2 planting distance.

Manual weeding is done occasionally to limit competition with newly planted suckers. Surplus or unwanted suckers are also removed to maintain about 6 to 15 banana plants in each sub-area, thereby resulting to larger fruits. De-leafing is done usually in backyard farms prior to the occurrence of a typhoon in order to prevent lodging.

All these activities are done manually by the farmer, hired laborers or contract workers. The hired laborers or contract workers are farmers from neighboring farms.

c. Harvesting, storage and processing

Manual harvesting is done 6 months to 1 year from planting or 1.5 months from flowering depending on the variety used. Harvesting is done through a *Bayanihan* system where mutual help is provided among the community of farmers. on harvesting, fruits are packed in straw sacks or in bulk using a wooden wagon (*kariton*) and hauled manually to the storage area. Hauling is also sometimes done with the help of farm animals (e.g. carabao) (Figure 44).

Figure 44. Banana plantation in Pinukpuk and method of hauling produce

d. Product marketing

Fruits are marketed fresh and graded or classified as good, small or rr (reject) both by the farmer and the local buyer within a municipality. 'Good' bananas are large-sized, free from cracks, bruises and other disease symptoms. Such fruits also command the highest price. After price agreement between farmer and buyer, the fruits are loaded for transport. Specifically, the variety *Lakatan* is preferred and marketed at Tabuk city.

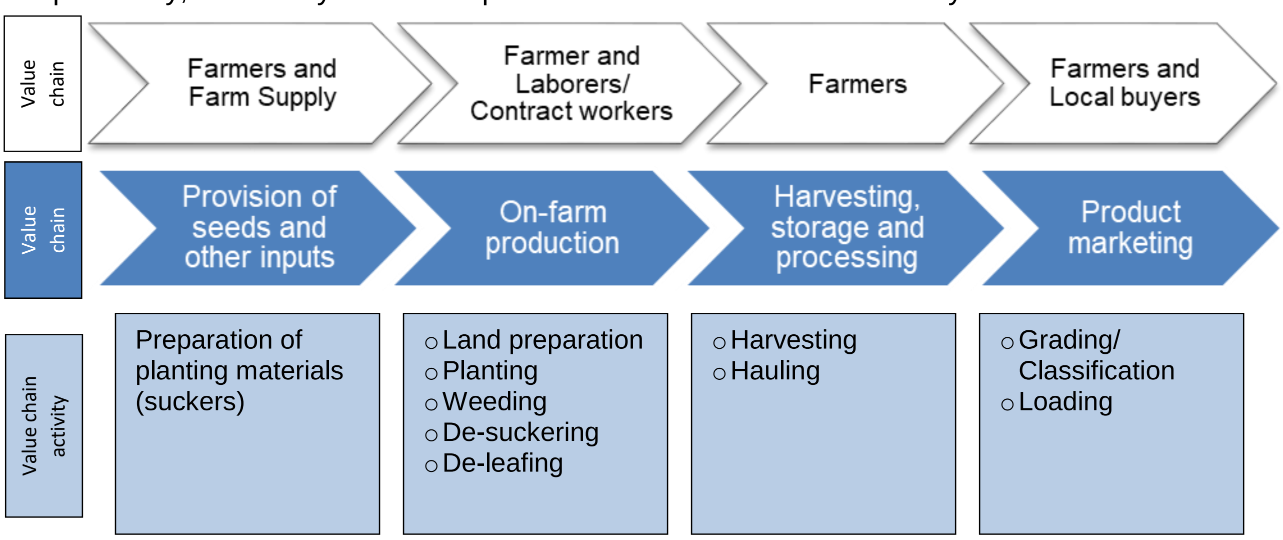

Figure 45. Value chain actors, stages and activities of banana production in Kalinga

d. Assessment of climate hazard

Banana farmers perceive that of all the climate hazards that occurred in their area, typhoons negatively impacted banana production. Most of the farmers disclosed that lodging of banana plants is a common occurrence during a typhoon. The other perceptions on climate hazard shared by farmers are described in Table 17.

Table 17. Perception of farmers on climate hazards and impact on banana production.

Climate hazard	Perception of farmer on climate hazards and its impacts
Typhoon	Occurrence of strong typhoons result in the lodging of banana plants. It also takes about 1.4 years for the suckers to grow and be ready for planting.
Typhoon	Lodged banana plants take a longer time to recover and bear fruits.
Typhoon	Weather is unpredictable and both rainy and dry seasons are noticeably prolonged.
Typhoon	Occurrence of pest and diseases, e.g. bunchy top virus, is exacerbated by strong rains. Harvested fruits are also observed to be smaller.
Typhoon	Buyers refuse to buy fruits with a high percentage of black spots.
Typhoon	Low production in wide areas is observed which was not the case in the past. In the past, high production was observed even in smaller areas. There are also new kinds of weeds observed in some banana farms.
Drought	Drought has minimal effect on banana production.

e. Assessment of climate change sensitivity

I. <u>Typhoon hazards and consequences</u>

The occurrence of typhoons has a minor to severe impact on banana production in Kalinga (Figure 46). The muddy terrain during and after a typhoon often delays the acquisition of planting materials (de-suckering) in the farm. Manual hauling and marketing of harvested fruits is also made difficult by the muddy terrain.

Furthermore, standing plants are damaged due to landslides and toppling of nearby trees or branches. Lodging of plants are also observed due to accompanying strong winds. Consequently, yield and economic loss is experienced by most farmers. However, the severity of the impact of typhoons is considered minor with the exception of the spread of pest and diseases. The spread of disease (banana bunchy top virus) and other pests, which is often exacerbated by the occurrence of typhoons, is severe.

The minor impact of typhoons is due to the fact that banana is considered a secondary crop by the farmers. Rice and corn are the main crops and sources of income for Kalinga farmers.

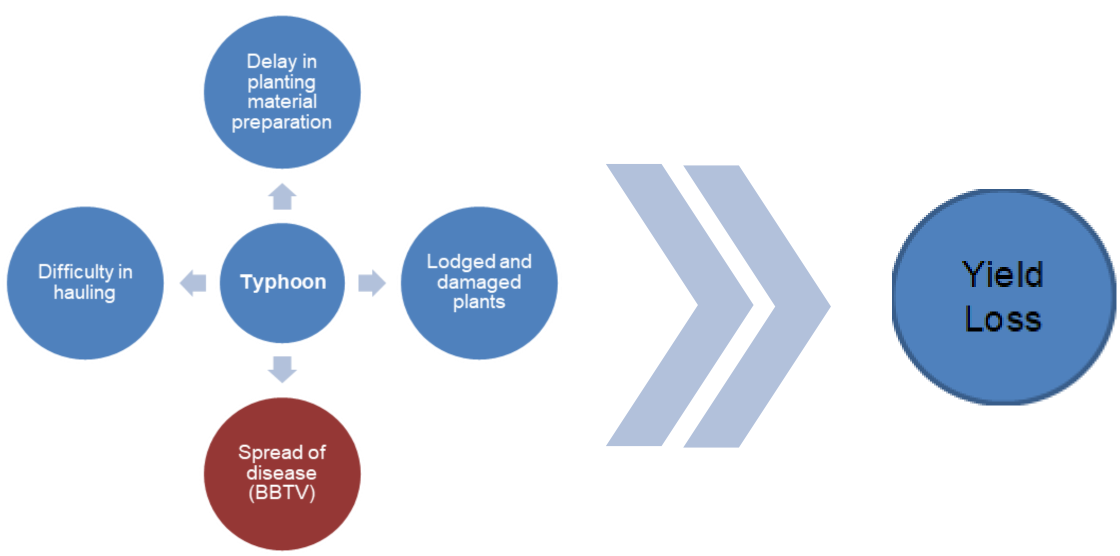

Figure 46. Consequences of typhoon on banana production in Kalinga. The severity of impact is rated as minor (blue) and severe (red).

II. Underlying factors

The underlying factors that may further contribute to the damages caused by typhoons are poor road conditions, vulnerability of the area to soil erosion or landslides and susceptibility of the banana varieties to pest and diseases (Table 18). Majority of the banana farms are located on mountainous or sloping areas which make it difficult for farmers to prepare their planting materials (de-suckering) during and after a typhoon. Farmers may also opt not to harvest mature fruits after a strong typhoon due to the muddy terrain. Such terrain contributes to poor road conditions in addition to the inevitability of soil erosion or landslides. Landslides may limit transport and marketing activities.

The occurrence of pest and diseases is worsened by the susceptibility of some banana varieties especially to bunchy top virus. The banana varieties susceptible to bunchy top virus are *Lakatan* and *Latundan*.

Table 18. Underlying factors and stage of value chain affected.

Underlying Factor	Type of Factor	Value Chain Stage Affected
Vulnerability of area to soil erosion/ landslides	Geographical	A, C, D
Susceptibility of banana varieties to pest and diseases	Biophysical	B

*A- Provision of seeds and other inputs; B- On-farm production; C- Harvesting, storage and processing; D- Product marketing

f. Climate impacts on gender

There is no negative impact of typhoons on both men and women on all stages of the value chain except on harvesting, storage and processing stage (stage C). In stage C, the men are more prone to hazard risks since they are responsible in repairing possible damages (e.g. landslides) to the farm. It is also unfortunate that these damages are difficult to prevent.

g. Assessment and identification of adaptation options and barriers to adoption

I. Adaptation options

Although the impact of typhoon on banana production is mostly minimal, farmers still practice adaptive mechanisms in order to further reduce the impact of typhoons. Harvesting early, which is done prior to the occurrence of a typhoon, has the highest degree of adoption (Figure 47). The harvested fruits are usually utilized for home consumption or animal feed. Mixed intercropping where banana plants are planted alongside fruit crops such as *lanzones*, *rambutan,* mango, etc. has a moderate degree of adoption (30 - 60%). This adaptation practice allows farmers to supplement their lost income from other crops which were not damaged by the typhoon. The other crops may also serve as wind breakers to protect the banana plants. De-leafing (Figure 48), staking and de-topping are also practiced by some farmers to reduce damage from typhoons. De-leafing is important in order to minimize bruising of fruits from flapping leaves due to strong rain and wind. De-topping and staking are done prior to the occurrence of typhoons to prevent lodging of banana plants in backyard farms.

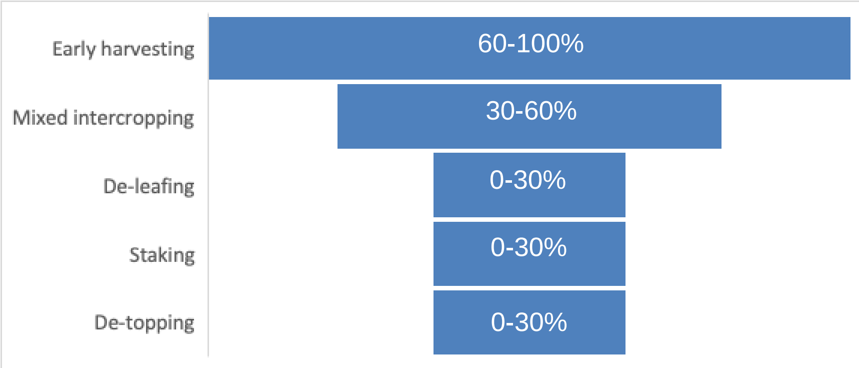

Figure 47. Adaptation options and degree of adoption by banana farmers.

Figure 48. De-leafing of the banana plants.

II. <u>Barriers to adoption</u>

The barriers to the adoption of the various adaptation practices discussed previously are cost of adoption and lack of financial benefits (Figure 49). Labor invested for de-leafing, de-topping and staking of banana plants is costly leading to the unwillingness of the farmer to adopt such practices. Another barrier to adoption is lack of financial benefits since farmers consider banana as a secondary crop. Farmers therefore do not prioritize adaptation practices that could reduce the impact of typhoons.

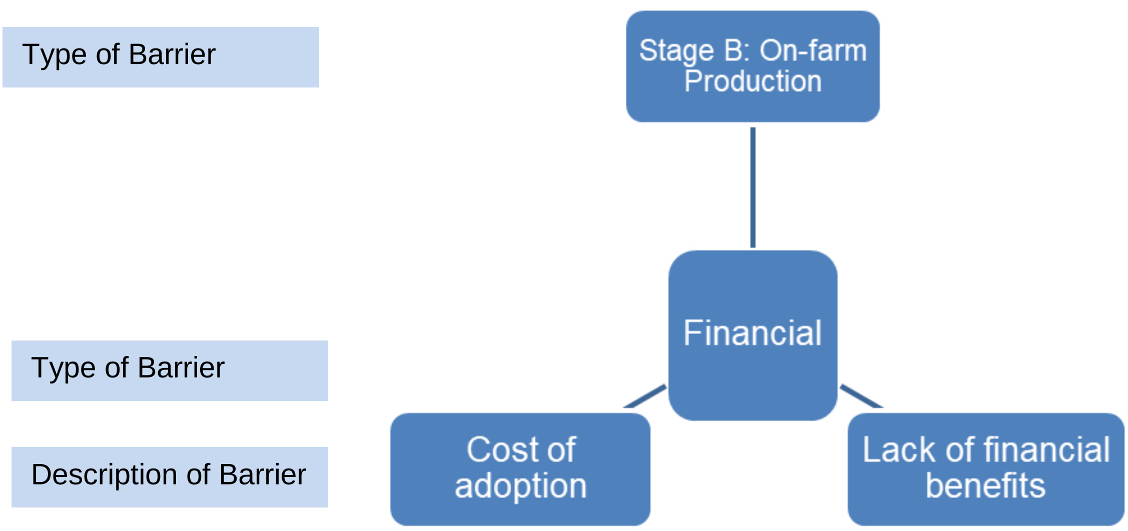

Figure 49. Barriers to adoption and stage of value chain affected

h. Agricultural sector challenges to banana production

The key challenges in the banana production of Kalinga province may be attributed to the fact that banana is considered a secondary crop by the farmers. The challenges for the farmer include inadequate cultural management, manual labor and lack of entrepreneurial skills (Table 19). Mechanical farming methods are impractical due to the sloping terrain and small farm sizes. The farm challenges include inadequate irrigation facilities and high cost of transportation. Irrigation facilities for rice and corn are prioritized since these crops are the farmers' main sources of income. The crop challenges include susceptibility of banana varieties to pest and diseases specifically bunchy top virus, which leads to costly pest control methods such as sanitation and quarantine. It is necessary to plant disease free planting materials or develop resistant banana varieties. Furthermore, challenges due to climate change include occurrence of strong typhoons which often leads to yield loss. Climate – smart technologies need to be applied to reduce the impact of climate hazards. However, if banana is considered a secondary crop, then technologies to improve its production and quality are largely ignored.

Table 19. Agriculture sector challenges of banana production in Kalinga.

Challenge	Description
A. Farmer	
Inadequate cultural management	Small holder farmers lack the technology and resources to practice the recommended cultural management practices for banana.
Manual labor	Small holder farmers practice manual labor due to high cost of labor-for-hire and small farm size. Mechanization is not economical due to farm size and terrain.
Inadequate entrepreneurial skills	Small holder farmers lack required skills to manage and negotiate with their markets. Moreover, price is dictated by the buyer.
B. Farm	
Inadequate irrigation facilities	Irrigation facilities are designed for priority crops in the area such as rice and corn.
High transport cost	Most farms are located in remote areas where farm to market road and transport facilities are inadequate.
C. Crop	
Susceptibility to pest and diseases	Bunchy top virus requires costly control measures and result to lower yield in monocropping systems.
D. Climate	
Occurrence of typhoons	Typhoons damage the banana plants leading to low production for approximately 2 years.

C. COST – BENEFIT ANALYSIS

Study 1. Cost-Benefit Analysis of Selected Adaptation Options for Rice in Kalinga

Based on Table 11, the top hazards for rice in Kalinga are drought, prolonged dry season, and typhoons. Availing crop insurance is the most preferred (rank 1) adaptation strategy for typhoons while similar strategy is preferred (rank 2) for drought. Hence, this study focused on the CBA for crop insurance. For other selected adaptation, partial budget analysis was used.

Crop Insurance as an Adaptation Strategy

Adoption and Extent of Crop Insurance as an Adaptation Strategy

PCIC is a state-owned agricultural insurer responsible for providing protection to the country's agricultural producers against loss of their crops and non-crop agricultural assets due to natural calamities, such as typhoons, floods, droughts, plant pests and diseases, and/or other perils. The Corporation offers two types of insurance programs: a) regular program wherein the premium is shared by the farmer, the lender, and the government, and b) special/subsidized program wherein the premium is fully subsidized by the sponsoring agency. There are six insurance products which include the following: rice and corn crop insurance, high-value crop insurance, livestock insurance, non-crop agricultural asset insurance, fisheries insurance, and credit and life term insurance.

Table 20 presents the number of rice farmers and area under crop insurance in Kalinga from 2018 to 2020. The percent of the area under crop insurance is only 16% to 18%. From 2018 to 2019, the total number of beneficiaries and area increased considering the damage caused by typhoon Rosita in 2018 and the damage resulting from the dry spell in 2019. Farmers were devastated and frustrated with the loss they incurred, which explains why more farmers were encouraged to apply for crop insurance in 2019 to minimize or cut losses if typhoons and drought occur and cause damage. The relative decrease in 2020 can be associated with the perceived constraints of farmers wherein some of them said that their application and claims were denied, and there was late validation of their damaged crops. In an interview with the representative of PCIC in their Sub-Office in Kalinga, he claimed that there are denied applications and claims because some farmers are late in processing their applications, and claims are based on the time frame required by the agency. In a study of rice farmers in Region 6 in 2017, Reyes *et. al.,* (2017) reported that 50% of the rice farmer respondents availed themselves of crop insurance. Bordey and Lapurga (2013), on the other hand, reported that only 33% of rice farmers in Nueva Ecija, Iloilo, and Leyte availed of agricultural crop insurance from 2007 to 2011, primarily because of limited understanding of crop insurance, lack of funds and added cost.

Table 20 below presents the total area devoted to rice farming and the number of farmers who availed crop insurance from 2018 to 2020. The same area and number of farmers were recorded in 2018 and 2019; however, the number of beneficiaries and areas with crop insurance significantly increased from 2018 to 2019. These numbers and area then decreased in 2020. The decrease is associated with the Covid – 19 Pandemic, which caused travel restrictions and limited transportation that limited the mobility of farmers to insure their crops. Other reasons raised by the farmers during the validation were the limited fund allotted to the province because when the allotted fund for the province is already exhausted, the office can no longer accommodate other applications. Another reason was that farmers are filtered through the RSBSA registration system. Individuals who are not farming have difficulty showing proof documents such as receipts, land titles, and other important documents.

Table 20. Area and number of rice farmers with crop insurance in Kalinga from 2018 - 2020.

Year	Total area (ha)	Total area with insurance (ha)	% of the area under crop insurance	Total no. of farmer-beneficiaries
2018	35,062.00	5,652.41	16.12	4,590
2019	34,579.00	6,153.43	17.80	4,884
2020	25,485.00	4,157.80	16.31	3,781

Source of basic data: Philippine Rice Information System, 2021

Farmers' Understanding of Crop Insurance

Table 21 summarizes the understanding of rice farmer-beneficiaries about crop insurance. The majority of the farmers claimed that crop insurance is about receiving payment to replace the expenses incurred when calamity damages their crop. Other farmers' understanding of crop insurance is that it helps the farmers ensure their crops.

Table 21. Understanding of crop insurance, rice farmer-beneficiaries (n=29).

Items	Frequency	%
When the crop is damaged by calamity, you can receive payment to replace expenses or capital	17	58.62
If your crop is damaged, insurance will help you	2	6.90
It can help farmers	2	6.90
It's where you insure crops	2	6.90
If we report damage, we just wait for them to call us when the cheque is ready	1	3.45
Ensure yield so that they change it when it's damaged	1	3.45
It's good, but their rules and regulations are not that good, some farmers are lazy to apply	1	3.45
It's good when its implemented wisely and properly so that it will be helpful	1	3.45
Stemborer and typhoon damage are the only covered by the PCIC, but other said that even those damaged by the rainy season are covered	1	3.45
When a crop gets damaged, you need to report it because you won't receive a payment if you don't report	1	3.45

Table 22 describes how the rice farmers who are non-beneficiaries of crop insurance understand crop insurance. Although they did not avail insurance, the majority of rice farmers have a good understanding of what crop insurance is all about. Some of them are not aware of crop insurance.

Table 22. Understanding of crop insurance, rice farmer-non-beneficiaries (n=21).

Items	Frequency	%
You can wait for some assistance if calamities, including pests, damage your crop	9	42.86
Not aware	5	23.81
It helps farmers during calamities	4	19.05
Crop is insured	2	9.52
They give insurance	1	4.76

Number of Farmer – Beneficiaries by Type of Insurance Scheme

Table 23 shows that most of the farmers in Kalinga availing of the government's crop insurance program are availing of the free and subsidized insurance program. This free crop insurance program started in 2014. The government premium subsidy is for the full (100%) cost of insurance premiums of subsistence farmers and fisherfolk registered in the RSBSA for crops (rice, corn, high-value crops), livestock, fisheries/aquaculture, and non-crop agricultural assets (Philippine Crop Insurance Corporation, 2021). Only 4% to 6% are paying premium fees. During the data validation, farmers claimed that there is no difference in the amount of indemnity payment whether you are under free, subsidized, or you are paying your premium. The amount of indemnity payment varies only depending on the percentage of damage. "Paying" farmers choose to pay for a premium payment for their farm area that exceeds the qualified area covered by the free, subsidized insurance. (Free subsidized area varies per season depending on fund availability). There is also a considerable increase of farmers availing crop insurance from 2018 to 2019, considering that the DA and DAR is working double – time to expedite the enrolment of agrarian reform beneficiaries (ARBs) to the RSBSA (Department of Agrarian Reform, 2020). The decrease in ensured farmers from 2019 to 2020 can be associated with the frustration of some farmers with the perceived constraints as discussed in the Perceived Constraints and Benefits in Availing Crop Insurance.

Table 23. Number of beneficiaries, by type of rice crop insurance scheme.

	2018		2019		2020	
	Free	Paying	Free	Paying	Free	Paying
Pinukpuk	277	-	190	2	155	7
Rizal	790	12	1,377	38	896	64
Tabuk	3,066	273	2,994	214	2,495	89
Tanudan	171	-	45	3	75	-
Pasil	-	-	8	-	-	-
Balbalan	1	-	2	-	-	-
Tinglayan	-	-	11	-	-	-
Total	4,305	285	4,627	257	3,621	160

Reasons for Not Availing of Crop Insurance

Table 24 showed that out of 21 rice farmers, 38.10% of them said they are not availing crop insurance because they are not aware of it and just know about it during our interview with them. This result is similar to Anzano & Alvarez (2016), as cited by Reyes *et. al.,* (2019), where around one – third of rice farmers surveyed in Western Visayas cited lack of awareness on applying for crop insurance products as the main reason for having no insurance at all. Similarly, Yorobe *et. al.,* (2017) citing PhilRice 2011 – 2012 data indicated that a quarter of rice farmers in Nueva Ecija, Iloilo and Leyte also mentioned lack awareness as their reason for not enrolling in the rice crop insurance. Other top reasons are as follows: they are busy in farm operations so they tend to forget to process their insurance (14.3%), late in processing their application (9.52%), and difficulty in visiting the PCIC office. The reasons mentioned imply that aside from not being aware of crop insurance, there appears no sufficient motivation on the part of the farmers to apply for crop insurance. For example, one respondent explicitly mentioned that his reason for not availing of crop insurance (despite its being free) is that based on experience, he thinks he will not receive indemnity payment anyway. Yorobe *et. al.,* (2017) also identified transaction issues, including bad experience with insurance, very tedious requirements, not fair, not qualified farm area, and discontentment as reasons of rice farmers for not enrolling in the rice crop insurance.

Table 24. Reasons for not availing of crop insurance, rice farmers, 2020.

Items	Frequency	%
Not aware (they just know during the interview)	8	38.10
Busy in farm operations; no time for processing application	3	14.29
Cannot visit PCIC office due to covid/lockdown	2	9.52
Late application	2	9.52
Forgot to insure	1	4.76
I assumed I would not receive indemnity payment due to past experiences	1	4.76
No forms available, lazy to get at PCIC office	1	4.76
Not informed	1	4.76
Not registered to RSBSA, they said it is not allowed, their explanation is not the same	1	4.76
Farm location is sloping	1	4.76
	21	100

Year Farmers Started Availing Crop Insurance

Table 25 details the year when rice farmers started availing crop insurance. One farmer claimed that he started to insure his crop in 2004. Many of the respondents indicated 2018 as the year when they began availing of crop insurance. This year they used the RSBSA list to enroll farmers with the PCIC. The government appropriated PhP 2.5 billion pesos in 2017 to be used as government premium subsidy to the PCIC. Accordingly, based on the RSBSA, which is a list of all farmers, fisherfolks, and agricultural laborers spearheaded by the Department of Budget and Management (DBM) and validated using the PCIC Automated Business Systems, the number of farmers, fisherfolks and laborers in the country is 10,915,180. Since the budget is limited, PCIC prioritized recipients of insurance coverage for farmers based on the size of landholdings, inclusion in the Special Area for Agricultural Development (SAAD), and crops planted (Philippine Crop Insurance Corporation, 2021).

Table 25.Year when rice farmers started availing crop insurance.

Year	Frequency	Percentage
1996	1	3.23
2004	-	-
2010	2	6.45
2011	2	6.45
2013	1	3.23
2014	1	3.23
2015	3	9.68
2016	3	9.68
2017	3	9.68
2018	12	38.71
2019	1	3.23
2020	2	6.45
	31	100

Number of Farmers who Received Indemnity

Table 26 below shows that almost half of the rice farmers who availed crop insurance in 2019 were paid indemnity. On the other hand, more than one-tenth of those who availed of crop insurance in 2018 and 2020 were able to claim indemnity. The percentage of farmers who were paid indemnity explains the number of farmers who have incurred losses and how many of them were actually paid. Generally speaking, the lower the percentage means, the fewer farmers were affected. However, some of the farmers cited that although they were affected by the typhoon and incurred losses, they were not paid indemnity. Farmers claimed that in the year 2018 and 2020, few farmers received indemnity payments because there was minimal damage caused by natural calamities, either drought or typhoon. Still, in 2019, farmers were much affected by the occurrence of drought during the wet season. Farmers claimed during the data validation that those who were not paid indemnity were denied claims due to reasons such as wrong information written, late application, and some farmers were not able to attend the postharvest interview. These results imply that evaluation of the loss of harvest or damage caused by the event (drought, typhoon etc.), which a PCIC adjuster does, is a crucial stage in the government's crop insurance program. Those farmers have difficulty claiming and receiving indemnity can adversely affect their desire to enroll in crop insurance. Gunnsteinsson (2020) mentioned that when payouts are based on the percent of harvest lost rather than an evaluation of the absolute loss, the payouts are unrelated to underlying productivity or marginal investment of a farmer on his crops (such as fertilizer) and has potential adverse effects on investment and demand for insurance.

Table 26. Number of rice farmers who received indemnity from 2018 - 2020.

Municipality	2018 Availed	2018 Received Indemnity	2018 %	2019 Availed	2019 Received Indemnity	2019 %	2020 Availed	2020 Received Indemnity	2020 %
Pinukpuk	277	1	0.36	192	62	32.29	162	3	1.85
Rizal	802	99	12.34	1,415	331	23.39	960	62	6.45
Tabuk	3,339	483	14.47	3,208	1,799	56.08	2,584	415	16.00
Tanudan	171	2	1.17	48	35	79.92	75	1	1.33
Tinglayan	-	-	-	11	3	27.27	-	-	
Total	**4,589**	**585**	**12.75**	**4,874**	**2,230**	**45.75**	**3,781**	**481**	**12.72**

Perceived Benefits and Constraints in Availing Crop Insurance

Table 27 presents the perceptions of farmers on the benefits of availing of crop insurance. The responses were coded and recoded, and frequency counts of similar codes were used to derive the common farmer perceptions. Many of them indicated that the primary benefit of availing of crop insurance is that farmers can expect future financial benefits or assistance in indemnity. In a more definitive way, some mentioned that crop insurance provides financial support when the crop is damaged due to calamities or when pests and diseases and financial support infest the crop to recoup some of the losses and/or expenses incurred. Farmers mentioned that although minimal, the indemnity provides the farmers additional finances to replace some of the losses incurred during calamities or buy some inputs to replace the damaged crops. Some use the indemnity to help them pay for the interest of their loans. Yorobe *et. al.,* (2017) also reported in 2012 that one reason farmers in Nueva Ecija and Ilo-Ilo enroll in rice crop insurance is access to credit.

Table 27. Perceived benefits of crop insurance, rice farmers, Kalinga, 2020.

Perceived Benefits	Frequency	%
Expectation of future financial benefits/assistance	8	36.36
Provide financial support when crop is damaged due to calamities or when the crop is infested by pests and diseases	4	18.18
Provide financial support to recoup some of the losses and/or expenses incurred	4	18.18
It helps farmers when there is less harvest	3	13.64
Provide financial assistance to pay for interests of loans	1	4.50
Crops are insured	1	4.50
Indemnity payment, use to purchase seeds and others	1	4.50
TOTAL	**22**	**100.00**

On the other hand, Table 28 below enumerates the various constraints perceived by the farmers. The top constraint mentioned by 40% of the farmers interviewed is the lack of transparency. For example, farmers claim that PCIC does not explain why their applications for claims are denied. Some farmers do not even know if their application for a claim is accepted or not. Some farmers interviewed (20%) claim that validation is not uniformly done because some adjusters just validate through a phone call and do not visit the field. Some just stand on the road, thus misjudging the extent of the damage. Other farmers mentioned the minimal or insufficient indemnity paid to them, including delayed payments. Some also said that the insurance policies and terms and conditions are inconsistent and unclear. They cited that some farmers who are not supposed to receive indemnity payment were paid or received indemnity payment.

Despite the constraints raised, 15% of the farmers interviewed claimed that there are no constraints or problems with crop insurance since it is free. Some mentioned that the PCIC office personnel in Tabuk is approachable. Despite the several issues raised by the farmers, some farmers are still thankful for the government support, especially the PCIC, with the help of the OMAG of different municipalities for assisting them and encouraging them to apply for crop insurance, given that it is free and very helpful.

Table 28. Perceived constraints of crop insurance, rice farmers, Kalinga, 2020.

Perceived Constraints	Frequency	%
Lack of transparency, e.g denied application and non-payment of indemnity	8	40
Validation is not done uniformly-some do not actually check/visit the field, some validate through phone call	4	20
None (because its free subsidize and PCIC office in Tabuk is approachable)	3	15
Terms and conditions are not clear	2	10
Some farmers who are not supposed to received payment were paid indemnity	1	5
Amount of indemnity payment is minimal/insufficient	1	5
Misjudgment of the extent of damage	1	5
	20	100

Production Costs and Returns of Rice Farming in Kalinga

Table 29 presents the detailed cost and return analysis of an average rice farmer in Kalinga per ha and per kg. Rice farming during the wet season in Kalinga in 2020 appears to be not economically profitable when considering all non – cash and imputed costs. However, considering the cost of family labor and returns to own land as income results in positive returns to own labor and land. The net profit-cost ratio, which determines the amount earned by the farmer for every peso invested, shows that farmers are almost just breakeven during the wet season. Labor has the most significant cost share with a total of 40.5%. Fertilizer also is a major cost comprising 15% of the total production cost.

Table 29. Detailed Costs and Returns Analysis of Rice Farming, 2020 Wet Season (n=64).

Items	**Per hectare**	**Per kg**	**Production Cost-share (%)**
n	64		
Average Area Cultivated (ha)	1.78		
RETURNS (Php/ha)			
Total harvest (kg ha-1)	4521.36		
Fresh Price (P kg^{-1})	13.00		
Gross Returns (P/ha)	**58777.72**		
COSTS (Php/ha)	**COST/HA**		
CASH COSTS			
Seed/Planting Material	2584.14	0.57	4.2
Fertilizer	9022.73	2.00	14.8
Herbicides	1909.73	0.42	3.1
Pesticide	1983.90	0.44	3.3
Pre-harvest labor	8345.58	1.85	13.7
Harvesting labor	2431.00	0.54	4.0
Land rental	390.63	0.09	0.6
Food Cost	5509.68	1.22	9.1
Fuel Cost	1042.25	0.23	1.7
Transportation cost	471.72	0.10	0.8
Irrigation Cost	1352.13	0.30	2.2
Other Costs	4715.95	1.04	7.7
Total Cash Costs	39759.42	8.79	65.3
NON-CASH COSTS			
Seed/Planting Material	637.17	0.14	1.0
Pre-harvest labor	3741.21	0.83	6.1
Harvesting/threshing labor	10125.65	2.24	16.6
Depreciation cost	2079.73	0.46	3.4

Land rental	4511.20	1.00	7.4
Total Non-Cash Costs	21094.96	4.67	34.7
Total Production Cost	**60854.38**	13.46	
Net Profit (P/ha)	**-2076.67**	-0.46	
Net Profit-Cost Ratio	**-0.03**		

Cost-Benefit Analysis of Enrolling in Rice Crop Insurance

Table 30 presents the summary of the cost-benefit analysis of enrolling in crop insurance considering the financial benefits to a rice farmer of enrolling considering the various potential scenarios regarding the occurrence of typhoon hazards. The typhoon – damage years based on data from PAG-ASA and the Department of the Interior and Local Government (DILG) office show that there were four (4) damaging typhoons out of the assumed 5 – year period from 2016 to 2020. Given these disaster years and assuming that the indemnity benefit is PhP 4,293.06/ha and a premium fee of PhP 554.76, then the NPV is positive at PhP 2,750.92 with a BCR greater than one meaning it pays for the farmer to enroll in crop insurance. Under the scenario of damages yearly due to typhoon, the NPV is much higher at PhP 6,298.88/ha. For an uninsured farmer, the NPV is negative PhP 7,872.20/ha or a difference of PhP 14,171.07. However, under the scenario of no damaging typhoons within five (5) years, the NPV of enrolling in crop insurance is also negative. These results imply that investing in crop insurance is beneficial to a rice farmer in Kalinga, where typhoons causing damage occur almost every year. According to Pulhin *et. al.,* (2017), taking the case of Laguna, similarly concluded that investment in crop insurance is useful when catastrophic climate events are known with certainty. These benefit – cost estimates are limited to the indemnity benefits. They do not factor in other potential benefits such as reduced farms' reliance on short – term debt after a calamity and the production impacts of subsidized agricultural insurance in developing countries (Cai, 2016; Cole *et. al.,* 2017).

Table 30. Summary Results of Cost-Benefit Analysis of Rice Farmers Enrolling in Crop Insurance, 5 – year period, 10% discount rate

Parameters	Crop Insured Farmer			Uninsured Farmer
	Actual damaging typhoon occurrence	With yearly damage	Without typhoon damage	
Net Present Value (NPV)	2,750.92	6,298.88	-9,975.17	-7,872.20
PV of Benefits	235,539.88	239,087.85	222,813.79	222,813.79
PV of Costs	232,788.96	232,788.97	232,788.96	230,685.99
Benefit-Cost Ratio	1.01	1.03	0.96	0.97

Use of Combine Harvester as an Adaptation Strategy

The use of a combined harvester ranked third as a preferred adaptation strategy for climate change. A modern combine harvester is a versatile machine designed to harvest various grain crops efficiently. The name derives from combining three separate harvesting operations such as reaping, threshing, and winnowing into a single process. Thus, a combine harvester is a time – saving technology (Tiwari *et. al.,* 2017). Based on the 64 rice farmers interviewed, 95% used combine harvesters during the 2020 wet season.

The identified benefits of using a combined harvester based on the FGD and data validation activity includes: saving labor in harvesting and threshing, including reduced expenses on food cost; faster operation, especially during the rainy season; better quality of produce, and reduced losses compared to manual harvesting and use of axial threshing. These benefits are similar to the major benefits of mechanical harvesting as identified by Hasan *et. al.,* 2020, namely: i) saving rice harvesting time, ii) saving labor involvement, iii) saving harvesting cost, iv) saving grain and yield losses, v) to reduce human drudgery, vi) to enhance income through custom hire services (CHS), and vii) to create new employment opportunities.

On the cost side, farmer leaders and agricultural technicians mentioned that using a combine harvester during the wet season entails an additional labor cost for fixing the paddy field bunds or dikes, which are flattened during combine harvester operation.

<u>Profitability of Using Rice Combine Harvester in Kalinga</u>

Table 31 presents the detailed costs and returns analysis of average rice farming in Kalinga adjusted based on perceived benefits when using rice combine harvester, as mentioned in a focus group discussion with farmers and stakeholders. Manual harvesting and threshing using an axial thresher require a combined total of 15 – 20 persons/ha^{-1}. On the other hand, a combined harvester can mechanically harvest and thresh paddy in a single pass through the field with only 3 – 5 persons/ha^{-1}. The farmers added that sometimes it takes three (3) days from harvesting, hauling, and threshing during the wet season. With a combined harvester, harvesting and threshing can be finished in four hours or half – day. This corroborates the results of Bordey *et. al.,* 2016, who mentioned that harvesting in the Philippines is mostly done manually while threshing is mechanized using an axial – flow thresher, needing a combined total of 21 man – day (md)/ha^{-1}. On the other hand, a combined harvester can mechanically harvest and thresh paddy in a single pass through the field, needing less than 2 md/ha-^{1}.

The estimated net profit – cost ratio in rice farming using a combine harvester is 0.16, which means for every peso invested in rice farming, the farmer gets 0.16 centavos profit. This is much higher than the average profitability of rice farming during the wet season in Kalinga, which is negative when considering imputed and non – cash costs. Similarly, Bordey *et. al.,* 2016 found that the cost of using a combined harvester was about 8% of output, which is PhP 1.56/kg^{-1} lower compared to manual harvesting, which is 10% of the harvest, and manual threshing, which is 7% of the harvest. They further mentioned that this benefit of using a combined harvester does not include the potential cost-saving implications on packaging/handling costs in rice marketing.

Table 31. Estimated Cost and Returns Analysis of Rice Farming Using Manual and Combine Harvester.

Items	Average Farmer	Using Combine Harvester
RETURNS (Php/ha)		
Total harvest (kg ha-1)	3,884.57	<u>4,534.57</u>
Fresh Price (P kg^{-1})	13.00	13.00
Gross Returns (P/ha)	**50,499.35**	**58,949.35**
COSTS (Php/ha)		
CASH COSTS		
Seed/Planting Material	2,397.41	2,397.41
Fertilizer	9,079.40	9,079.40
Herbicides	1,855.29	1,855.29
Pesticide	1,922.10	1,922.10
Pre-harvest labor	8,169.37	8,169.37
Harvesting	168.03	168.03
Land rental	655.74	655.74
Food Cost	5,345.70	5,090.95
Fuel Cost	936.83	936.83
Transportation cost	453.94	453.94
Irrigation Cost	1,418.63	1,418.63
Other Costs	8,402.21	8,402.21

Total Cash Costs	40,804.63	40,549.88
NON-CASH COSTS		
Seed/Planting Material	668.51	668.51
Pre-harvest labor	2,786.31	2,786.31
Harvesting/Threshing	11,121.11	5,921.11
Other activities cost	979.52	979.52
Land rental	4,733.06	4,733.06
Total Non-Cash Costs	20,288.51	15,088.51
Total Production Cost	**61,093.14**	**55,638.39**
Net Profit (P/ha)	**-10,593.79**	**3,310.96**
Net Profit-Cost Ratio	**-0.17**	**0.06**
Net returns to land & management	**4,293.14**	**12,997.89**

Study 2. Cost-Benefit Analysis of Selected Adaptation Options for Corn in Kalinga

Based on Table 14, the top hazards for corn in Kalinga are drought, prolonged dry season, and typhoons. The preferred (rank 1) adaptation strategy for typhoons and drought is availing of crop insurance. Hence, this study focused on the CBA for crop insurance. For other selected adaptations, partial budget analysis was used.

Adoption and Extent of Crop Insurance as an Adaptation Strategy

Table 32 below presents the total area devoted to corn farming and the number of farmers who availed of crop insurance from 2018 to 2020. The periods of 2018 and 2019 recorded the same area and number of farmers. However, a significant increase from 2018 to 2019 was observed in the number of beneficiaries and area with crop insurance, which eventually decreased in 2020. The decrease is associated with the constraints perceived by the farmers when availing of crop insurance, including applications that were denied and the late conduct of evaluation during the covered cropping season. The decrease is associated with the pandemic brought by the Covid – 19 that caused travel restrictions and limited transportation, limiting farmers' mobility to insure their crops. Other reasons raised by the farmers during the validation were the little fund allotted to the province because when the allotted fund for the province is already consumed, the office can no longer accommodate other applications. Another reason was that farmers are filtered through the RSBSA registration system, where individuals who are not really farming have a hard time showing proof documents such as receipts, land titles, and other important documents.

Table 32.Area and number of corn farmers with crop insurance in Kalinga from 2018-2020.

Year	Total Area (ha)	Total no. of farmers	Total beneficiaries	% of farmers with crop insurance	Total area with insurance (ha)	% under crop insurance
2018	12,249.5	9,337	3,258	34.89	5,173.35	45.04
2019	12,249.5	9,337	6,261	67.06	7, 960.85	60.05
2020	12,276.3	9,453	3,763	39.81	3, 585.42	27.60

Source: DA – CAR Corn Program

Table 33 enumerates the total area and number of corn farmers with crop insurance per municipality for 2020. Tabuk has the largest area devoted to corn farming, and it has the highest number of farmers, followed by Pinukpuk and then Rizal. However, regarding the number of beneficiaries measured by the total number of farmers, the Rizal municipality recorded the highest with 74.48%, followed by Tabuk with 65.46%. Regarding the area with crop insurance, Tabuk farmers insured 40.66% of their total corn area, followed by Rizal with 37.95%. Overall, 39.79% of the corn farmers in the province were able to avail of crop insurance, while only

23.25% of the total land area devoted to corn farming is insured. These results imply that the majority of the farmers and a larger portion of the corn areas in the province have no crop insurance. This result is similar, even higher than the results of Reyes *et. al.,* 2017. This percentage of availing crop insurance is similar to Reyes *et. al.,* 2017 who reported that 38% of corn farmers in Region 2, and 50% of corn farmers in Region 7 availed of crop insurance. However, the high number of farmers availing crop insurance in Region 7 was since these areas were hit by Super typhoon Yolanda (Reyes *et. al.,* 2017).

Table 33. Total area and number of corn farmers with crop insurance in Kalinga per municipality.

Municipality	Total area (ha)	Total no. of farmers	Total beneficiaries	% of farmers w/ crop insurance	Total area w/ insurance (ha)	% under crop insurance
Pinukpuk	3,539	2,777	505	18.19	456.26	12.89
Rizal	2,942	1,485	1,106	74.48	1,116.44	37.95
Tabuk	4,322	2,800	1,833	65.46	1,757.47	40.66
Balbalan	15	48	1	2.08	1	6.67
Pasil	1,400	59	-	-	-	-
Lubuagan	1,783	116	-	-	-	-
Tanudan	1,417	2,173	318	14.63		
Total	**15,418**	**9,458**	**3,763**	**39.79**	**3,585.42**	**23.25**

Farmers' Understanding of Crop Insurance

Table 34 itemized further the understanding of the corn farmer – beneficiaries about crop insurance. Assessing the farmer's understanding of crop insurance is necessary to determine how knowledgeable the farmers are regarding crop insurance. The results show that the farmers availed crop insurance due to the assistance or support they could get when a calamity damages their crops. Accordingly, the support may be in the form of financial aid or seeds. Some mentioned that insurance could help the farmers. Although the amount is minimal, it could help them recover from possible losses brought by calamities like typhoons and drought.

Table 34. Understanding of crop insurance, corn farmer-beneficiaries.

Items	Frequency	%
If crop is damaged there is assistance from the government	6	26.09
Crop is insured when calamity strike	4	17.39
There's financial assistance, some used it to pay seeds	3	13.04
If insured and your corn is damaged by typhoon they will pay you	2	8.7
It can help farmers	2	8.7
If in case of drought you can expect assistance from PCIC	1	4.35
If there is no harvest there is a little help from PCIC	1	4.35
It seems you don't have a loss because your crop is insured	1	4.35
It's good because there is support during drought	1	4.35
When you lose, they should give assistance, like seeds	1	4.35
It is subsidized. Hence, no need to pay	1	4.35
Total	**23**	**100**

Table 35 below enumerates how the corn farmers who are non-beneficiaries of crop insurance understand crop insurance. Only four (4) of them claimed that they have no idea about it or may have heard about it but are not familiar with it. Most farmers' understanding of crop insurance actually describes what crop insurance does and what it is expected to deliver to protect the farmers' crop against losses.

Table 35. Understanding of crop insurance, corn farmer – non – beneficiaries

Items	Frequency	%
They give assistance during calamities to replace some of our expenses	7	29.17
They help farmers and gives them security	6	25
Is seems like crop insurance is when your crop is damage there is someone who can help	2	8.33
No idea	2	8.33
Apply RSBSA for insurance	1	4,17
Available and helpful	1	4.16
Crop is insured	1	4.17
I heard about it, but I don't know what it is	1	4.17
It's good but I do not know	1	4.17
We help them so they can help us	1	4.17
It's good to be a member, they can help us if there are assistance and opportunities	1	4.17
Total	**24**	**100**

Number of Farmer – Beneficiaries, by Type of Insurance Scheme

Table 36 describes the number of corn farmer – beneficiaries of crop insurance according to the type of insurance scheme. The PCIC offers two insurance programs, regular and special or subsidized. Data showed that most corn farmers availed themselves of the special/subsidized insurance program wherein the premium is paid by the sponsoring agency such as the PCIC. Only a few of the farmers paid their insurance premium from 2018 to 2020, and they are the same farmers who availed of the subsidized insurance program. Still, since PCIC can cover only a limited area, farmers who have a larger area will have to pay a premium for their whole area to be covered. Since the farmers acknowledge the benefits of crop insurance, they are willing to shell out some amount in exchange for the benefits that they can derive.

From 2018 to 2020, most farmers availed themselves of the subsidized insurance. According to them, there is no difference in the amount of indemnity paid to them, even if they are paying a premium or availed of subsidized insurance. It will only vary on the percentage of the damaged crops. Hence, the paying farmers are those who choose to pay a premium for their farm area that exceeds the qualified area covered by the subsidized insurance. This subsidized area varies per season depending on the availability of funds.

Table 36. Number of beneficiaries by type of corn crop insurance scheme.

Municipality	2018		2019		2020	
	Free	Paying	Free	Paying	Free	Paying
Pinukpuk	822	0	1,304	8	493	12
Rizal	348	3	1,489	4	1,065	41
Tabuk	1,709	12	2,408	245	1,818	15
Balbalan	-	-	-	-	1	0
Pasil	-	-	3	0	-	-
Tanudan	364	0	799	1	316	2
Total	**3,243**	**15**	**6,003**	**258**	**3,693**	**70**

Reasons for Not Availing of Crop Insurance

Table 37 showed that out of 21 corn farmers, 28.57% claimed that they are not availing crop insurance because they do not have any idea about it. Some claimed that they are late in processing their application for insurance given that they are busy with their farm operations, and they do not have time to visit the PCIC office with a percentage of 14.29 each. The other farmers claimed that their application was denied, and or they forgot to process their application with 9.52% each. Other reasons are shown below with 4.76% of each reason. This indicates that farmers should be reminded when it comes to processing their insurance on time so that all of them would be able to avail of the crop insurance since it can help them lessen the cost of loss in times of calamities in the area.

Table 37. Reasons for not availing of crop insurance, corn farmers, 2020.

Items	Frequency	%
No idea about crop insurance	6	28.57
Cut-off application time	3	14.29
No time to visit PCIC office	3	14.29
Denied application	2	9.52
Forgotten to process	2	9.52
Farm location is near the river	1	4.76
Shy to ask or inquire	1	4.76
In those cases, it seems like we are separated from the barangay and their information drive is not enough	1	4.76
Unaware of policy, I didn't know that we should insure every cropping	1	4.76
We have a *SIKAT SAKA* loan for rice that's why they don't allow us	1	4.76
Total	**21**	**100**

Table 38 details the year when corn farmers started availing crop insurance. One of the farmers claimed that he started to insure his crop in 2004 and another one in 2013. However, data showed that many farmers have begun availing crop insurance in recent years. With the threats of climate change and the increasing awareness of farmers on the benefits of crop insurance, farmers have started to acknowledge the importance of insuring their crops to protect them from potential losses.

Table 38. Year when corn farmers started availing crop insurance.

Year	Frequency	Percentage
1996	-	-
2004	1	4
2010	2	8
2011	-	-
2013	1	4
2014	2	8
2015	3	12
2016	-	-
2017	2	8
2018	5	20
2019	3	12
2020	6	24
	25	**100**

Table 39 shows that from 2018 to 2019, more than one-third of the total number of corn farmers who availed of crop insurance was able to claim indemnity. During the validation, farmers claimed that in the year 2018 and 2019, farmers were significantly affected by drought. They further claimed that farmers who could not receive indemnity payments were due to some reasons, such as wrong information written in their application or late application. Some of them were not able to attend the postharvest interview, which is one of the requirements for the indemnity payment.

But for 2020, the rate decreased to only 20.64%. This result can be associated with the late processing of documents for claims and, more importantly, filing a notice of loss within 20 days after calamity. Accordingly, the farmers prioritize saving or fixing the damages; hence, they unintentionally forget to process their documents with the PCIC. This failure to process immediately results in a delay in the filing of indemnity claims. Based on PCIC guidelines, farmers should file their claims within ten days after flood and other calamities and 20 days for drought, pests, and diseases (Philippine Crop Insurance Corporation, 2020).

Table 39. Number of corn farmers who received indemnity from 2018 – 2020.

Municipality	2018			2019			2020		
	Availed	Claimed	%	Availed	Claimed	%	Availed	Claimed	%
Pinukpuk	822	237	28.83	1,312	265	20.20	505	38	7.52
Rizal	351	57	16.24	1,493	244	16.34	1,106	237	21.43
Tabuk	1,721	847	49.22	2,653	1,201	45.27	1,933	486	25.14
Tanudan	364	59	16.21	800	308	38.50	318	36	11.32
Pasil	-	-	-	3	-		-	-	-
Balbalan	-	-	-	-	-	-	-	-	
Total	**3,258**	**1,200**	**36.83**	**6,261**	**2,018**	**32.23**	**3,862**	**797**	**20.64**

Perceived Constraints and Benefits of Availing Crop Insurance

Based on the focus group discussions and farm surveys, the following themes describe the farmers' perceptions about the benefits and constraints of availing of crop insurance. The data were summarized, and common themes were selected to represent the common feedback generated from the farmers (Table 40). Out of the 22 farmers who responded, a higher number (45.45%) mentioned that the primary benefit in availing of crop insurance is because they expect future financial benefits or assistance in the form of indemnity. Some (18.18%) of them availed themselves of crop insurance so that whenever their crops are damaged or infested by pests/diseases, their crops are insured. A smaller number (13.64%) of the farmers have stated that crop insurance provides financial assistance when their crop is damaged due to calamities or when pests and diseases infest the crop. Only a few farmers claimed that they used the indemnity payment to purchase seeds and other inputs and or farming materials to be used in the next cropping. The rest of the farmers perceived that it provides support for them to recover some of the losses and/or expenses they have incurred. Further, availing of the insurance helps them, and lastly, it provides seminars/training.

Table 40. Perceived benefits of crop insurance, corn farmers, Kalinga, 2020.

Perceived Benefits	Frequency	%
Expectation of future financial benefits/assistance	10	45.45
Crops are insured	4	18.18
Provides financial assistance when the crop is damaged due to calamities or when the crop is infested by pest and diseases	3	13.64
Indemnity payment used to purchase seeds & others	2	9.09
Provide financial support to recover some of the losses and/or expenses incurred	1	4.5
Its good It can help farmers	1	4.5
Provides Seminars Training	1	4.5
TOTAL	22	100

On the other hand, Table 41 enumerates the various constraints of crop insurance as perceived by the farmers. Out of the 22 farmers interviewed, a higher number (31.82%) claimed that they do not encounter any problems in availing of crop insurance. But still, some farmers claim that validation is not uniformly done because some of the adjusters validate through a phone call, and some do not visit the field or the area. They just stand on the road instead. According to some of the farmers, the late validation causes misjudgment to the extent of the damage. Further, some of them claimed that the terms and conditions were not clear to them. In addition, delayed payment of indemnity and the many requirements were the other constraints raised by the farmers.

Table 41. Perceived constraints of crop insurance, corn farmers, Kalinga, 2020.

Perceived Constraints	Frequency	%

None (no problem)	7	31.82
Validation is not done uniformly-some do not actually check/visit the field, some validate through phone call	2	9.09
Misjudgment of the extent of damage	2	9.09
Terms and Conditions are not clear	2	9.09
Delayed payment of indemnity	2	9.09
Many Requirements	2	9.09
Late Validation	1	4.55
Wrong Area Validated	1	4.55
The amount of indemnity payment is minimal/insufficient	1	4.55
Some policies are not pro-farmers	1	4.55
Lack of transparency, e.g denied application and nonpayment of indemnity	1	4.55
TOTAL	22	100

Cost and Return Analysis

Corn Farming With and Without Crop Insurance

Table 42 presents the costs and returns analysis of corn farming for farmers who availed of crop insurance and those who did not. During the validation, farmers claimed that there is no difference in terms of management practices and amount of input in corn production whether beneficiary or not a beneficiary of crop insurance. The cost and return analysis of corn farming described how profitable the production of corn in the province was. Corn farming still generated a negative return even if the average indemnity payment is added for the farmers who availed of the insurance.

The low profitability of corn farming in the province implied that the farmers need some intervention to increase the profitability of corn farming in the area. The average farmgate price in the province is lower than the average farmgate price in the region and in the country, which is PhP 12.41 and PhP 13.04 per kg, respectively (Philippine Statistics Authority, 2020).

Table 42. Costs and returns analysis of corn farming, 2020 Wet Season (n=67).

Items	Per hectare	Per kg	Production Cost-share (%)
n	67		
Average Area Cultivated (ha)	1.85		
RETURNS (Php/ha)			
Total harvest (kg ha-1)	4017.38		
Dried	11.50		
Average Indemnity benefits	3253		
Gross Returns (P/ha)	**46,199.91**		
COSTS (Php/ha)	**COST/HA**		
Seed/Planting Material	9,189.83	2.29	13.83
Fertilizer	9,323.22	2.32	14.03
Herbicides	1,850.62	0.46	2.78
Pesticide	361.73	0.09	0.54
Hired Labor	18,947.28	4.72	28.51
Non-hired labor	5,099.34	1.27	7.67
Prevailing rental value	2,433.51	0.61	3.66
Interest on loan capital	2559.35	0.64	3.85
Food Cost	7,174.96	1.79	10.79
Fuel Cost	1,117.85	0.28	1.68
Transportation cost	1,793.95	0.45	2.70
Land tax	372.88	0.09	0.56

Repair and maintenance	3,006.62	0.75	4.52
Communication expense	367.43	0.09	0.55
Packaging(sacks, etc)	49.25	0.01	0.07
Depreciation cost	2,818.65	0.70	4.24
Total Production Cost	**66,466.47**	16.54	100
Net Profit (P/ha)	**-20,266.55**	5.04	
Net Profit-Cost Ratio	**-0.30**		
Net Returns to Land Management	**-15,167.22**		

Cost-Benefit Analysis of Corn Production in Kalinga

The analysis of the cost and benefit of corn production in the province is not profitable, as shown by the NPV and BCR values. NPV is used to assess the profitability of a certain project, while BCR measures the overall relationship between the relative costs and benefits of a certain project. A positive NPV implies the project is attractive, while a BCR greater than one assumes that the project's benefits outweigh the project's costs. This finding implied that the corn production in the area is not giving the farmers a positive return. The table below also compares the NPV and BCR of those who availed of crop insurance and those who did not avail of crop insurance. The result showed that the incremental cost of those without crop insurance is higher than those without crop insurance, which means the loss is greater for those without crop insurance than those without crop insurance.

Table 43. Cost-benefit analysis of corn production with yearly typhoon damage (5 – year, 10% discount rate).

Indicator	Value		Indicator Meaning
	With Crop Insurance	**Without Crop Insurance**	
NPV	-106,429.52	-124,529.20	Not profitable; the negative value implies that the incremental cost is higher than the incremental benefit
BCR	0.74	0.70	Not profitable; the project's costs outweigh the project's benefits.

Table 44 shows the costs and returns analysis of corn farming for farmers who manually harvest their crop and those who use combine harvesters. As can be seen from the table, farmers who manually harvest their crop have higher costs and a negative return, while farmers who use the combine harvester have lesser costs. Though it has a negative profit, they have earned a net return to own labor and management. This implies that using a combined harvester can lessen production cost and a possibility of farmers having a minimal positive income from corn farming.

Table 44. Comparative Cost and Returns in Corn Production Using Combine Harvester and Manual Harvesting, Kalinga, 2020.

Items	Manual Harvesting	Using Combine Harvester
n	17	17
Average Area Cultivated (ha)	1.77	2.05
RETURNS (Php/ha)		
Total harvest (kg ha^{-1})	4,333.81	4,608.72
Dried Price (P kg^{-1})	11.50	11.50
Gross Returns (P/ha)	**49,804.26**	**53,000.23**
COSTS (Php/ha)		
CASH COSTS		
Seed/Planting Material	9,748.32	8,703.85
Fertilizer	9,377.17	9,168.57
Herbicides	1,636.20	1,727.58

Pesticide	106.05	74.51
Land Preparation	1,736.83	2,565.51
Planting	5,917.65	5,169.41
Fertilizer Application	1,813.92	1,399.63
Herbicide Application	972.16	664.33
Pesticide Application	50.98	221.18
Harvesting	4,930.04	6,002.94
Other Activities	7,787.84	3,336.83
Land Rental	1,413.24	1,102.94
Food	4,061.74	3,977.40
Fuel	1,211.12	309.56
Transportation	941.98	577.29
Depreciation	1,434.75	1,406.96
Other costs	3,706.09	3,959.25
Total Cash Costs	56,846.08	50,367.74
Non-cash Costs		
Seed/Planting Material	911.76	411.76
Labor		
Land Preparation	514.71	82.65
Planting	136.97	625.44
Fertilizer Application	178.74	271.32
Herbicide Application	161.51	377.35
Pesticide Application	-	64.71
Weeding	14.12	-
Harvesting	320.94	615.40
Other Activities	1,815.69	2,349.35
Land Rental	-	258.82
Total Non-Cash Costs	**4,054.44**	**5,056.81**
Total Production Costs	**60,900.53**	**55,424.55**
Net Profit (P/ha)	**-11,096.26**	**-2,424.31**
Net Profit Cost-Ratio	**-0.18**	**-0.04**
Net Returns to Land Management	**-7,953.59**	**2,220.73**

Study 3. Evaluation of Selected Adaptation Options for Coffee in Kalinga

Based on the results of CRA, climatic hazards affecting coffee were typhoons and drought. Unfortunately, there was no adaptation/mitigation practices mentioned by coffee farmers that are considered management practices for their coffee production. Hence the study tried to get farmers' perception and awareness of different adaptation technologies. The study interviewed nine coffee farmers, mostly from barangay Pangol in the municipality of Tanudan. The farmers were asked what the top disaster risks affecting their production were.

All coffee farmers rank typhoons as the first, drought as the second, and pest infestation. The coping mechanisms identified for typhoons were removing or cleaning old branches that might fall during a typhoon and cleaning after a typhoon if needed. At the same time, five farmers claimed that they do not have any coping mechanism for a typhoon. The majority of the farmers claimed that they do not have any coping mechanisms for drought and pests.

Farmers claim that they are not using commercial fertilizers because it is laborious given that they need to carry them up to the mountain. Instead, they are using what is already on their farm, like the fallen leaves from the shade trees. The interviewed farmers have an average yield of 117 kg of dried coffee in a year with an average price of Php 105/kg. They were asked about their awareness of any technology to mitigate the potential of climate hazards on their crop. Only one farmer is aware of such technologies claiming that soil testing can help mitigate climate change. Follow – up questions regarding their awareness on technologies/adaptation options for hazards were also given. Table 45 below shows their response per hazard and technology.

Table 45. Coffee farmers' awareness of adaptation options (n=9).

Climate Hazards	Adaptation options	No. of Farmers Aware	No. of Farmers Not-Aware
Increasing/High temperature	Planting under shade trees	7	2
	Pruning	9	0
	Use of cover crops	1	8
	Mulching	0	9
Strong Winds	Use of tree windbreaks	0	9
	Use of cover crops	0	9
	Coffee rejuvenation	9	0
Prolonged Rain	Mulching	1	8
	Use of cover crops	0	9
Drought	Use of drought resistance variety	0	9
	Irrigation system	0	9

Farmers' Perceptions of the Identified Adaptation Options

1. Planting under Shade Trees.
Farmers practicing 'planting under shade trees' claimed that it can help boost fruit production and prevent death from direct sunlight, while other farmers who do not practice 'planting under shade trees' reasoned that they already have enough trees on their farms.

2. Pruning
Farmers that are pruning claim that it eases harvesting because they do not need to climb the coffee trees to harvest the berries; they also claim that pruning could help increase the yield of coffee berries.

3. Coffee Rejuvenation
Farmers who were practicing coffee rejuvenation claim that they are doing it to make their old coffee trees "young" again for better growth and increased yield.

4. Mulching
Farmers claimed that mulching helps lessen the growth of weeds, while other farmers insisted that they are not mulching because fallen leaves from shade trees are enough as natural mulch for their coffee trees.

5. Use of cover crops
Farmers said they are not using cover crops because they do not have time, and it is not needed because many trees already exist on their farm that serves as shade trees.

6. Drought Resistant Variety
Farmers said they do not use drought-resistant varieties because of a lack of awareness. They also recommended that technicians teach them about these varieties, including their sources.

7. Irrigation System
Farmers claimed that they do not have an irrigation system because water cannot reach their farms. Also, they do not have time for it, and they do not need it.

8. Use of windbreaks
Farmers claimed that they are not using windbreaks because they also do not have time for it, and no one is practicing such in their area. Shade trees planted on their farms also serve as windbreaks.

Awareness of farmers regarding Crop Insurance

All coffee farmers interviewed are not insured with PCIC. Four (4) out of the nine (9) farmers interviewed claimed that they were not aware of the crop insurance, while three farmers said that crop insurance assists when a typhoon damages the crop. Farmers were asked what conditions would convince them to avail crop insurance, and they answered if they would be given tools for cutting or any tools to maintain their coffee. They were also asked if they were willing to pay for crop insurance, and 3 out of 9 were willing to pay 500 pesos for the insurance.

Production costs and returns in coffee production

Based on focus group discussion with coffee farmers in Tanudan, Tables 46 and 47 showed a rough estimate of the variable costs and returns in coffee production, largely imputed labor costs. Roughly calculating the gross returns taking the yield of 3 bags at 25 kg per bag and price of PhP 100/kg would mean an estimated gross return of only PhP 7,500 which is not even 50% of the estimated costs, which is unlikely compared to the averaged maintenance cost of coffee production which is PhP 36,927/ha in 2017 with average yield of 550kg/ha with PhP 93.30 farmgate price based on the results of updated cost and returns of PSA (2018). However, if the assumed yield is 17 bags at 25 kg/bag and price of PhP 75/kg, the gross margin would be positive. Further studies to determine the yield impact and ascertain required labor of the implementing the identified adaptation strategies needs to be conducted before a full cost – benefit analysis can be implemented.

Table 46. Estimated costs in coffee production based on FGD in Tanudan, Kalinga.

Inputs	Cost/ha
Land preparation and planting	3,000.00
Weeding with minimal rejuvenation	6,000.00
Fertilizers	N/A
Pesticides	N/A
Field Monitoring	4,800.00
Harvesting	800.00
Other Cost	1,000.00
Total Cost	**15,600.00**

Table 47. Estimated yield and price of coffee production in Tanudan, Kalinga.

Year	Average Yield/year (nakiskis)	Average Price
1980 – 1990	40 bags @ 25 kg	75
2000 – 2010	17 bags @ 25 kg	75
2010 – 2020	3 bags @ 25 kg	100

Almost all of the coffee trees in the municipality of Tanudan are 20 years old. Land preparation and planting are done consecutively, given that they just remove the weeds and plant the coffee seedlings. After planting weeding is done twice a year or every six months. Farmers claim that they are also practicing coffee rejuvenation during weeding, but they do not rejuvenate all the trees at once. For example, for every three coffee trees, they rejuvenate one tree to still harvest coffee berries with the two (2) unrejuvenated ones to secure a continued harvest. Field monitoring is done two days a month. Harvesting starts three years after planting

Study 4. Evaluation of Selected Adaptation Options for Banana in Kalinga

The interview was conducted in Ammacian, Pinukpuk, which the OMAG recommends since they have the highest banana production in the municipality. A total of ten (10) farmers were interviewed. They have an average area of 1.8 ha with an average of 2,814 kg of harvest per ha in a year with an average price of PhP 12.5/kg.

Farmers were asked what the top disaster risks affecting the banana production are and they ranked typhoon first, followed by "*tungro*" or banana bunchy top. In contrast, two (2) farmers answered drought as their 2nd disaster risk. The main coping mechanism identified for typhoons was the removal of some of the leaves before the occurrence of typhoon. However, this mechanism is only applied on trees near their houses and not on all trees since it is laborious. Some of the farmers said that they could not do anything to mitigate the effects of the typhoon. For the banana bunchy top or "*tungro*", they said that cutting the whole tree or the leaves is the only practice that they are doing. The trees cut are immediately replaced with healthier suckers.

Farmers were also asked if they are aware of various adaptation technologies to mitigate typhoons' effect, and the majority of them answered no. Follow – up questions about farmers' awareness to other technologies (Table 48) were also given.

Table 48. Banana farmers' awareness of adaptation options.

Climate Hazards	Adaptation Options	Number of Farmers Aware	Number of farmers not-Aware
Typhoon	Leaf Removal	9	1
	De-topping	10	0
	Staking/Propping	1	5
	Early Harvesting	9	1

Farmers' Perceptions of the Identified Adaptation Options.

1. Leaf Removal/de-leafing

Farmers are practicing leaf removal to lessen the volume of leaves, minimizing the effect of strong winds during a typhoon. Some farmers also said that they are practicing leaf removal for better fruit development so the banana trees will look good. One farmer is not practicing leaf removal because it is not their practice.

2. De-topping

Farmers are practicing De-topping, especially if there are too many suckers. These suckers will also serve as new planting materials.

3. Early Harvesting

Farmers are practicing early harvesting, especially before the typhoon.

4. Staking

Farmers are not practicing staking/propping because they do not have time for this. It would also be difficult for the farmers to clean their farms if these stakes were on the way.

Awareness of farmers regarding crop insurance

Farmers were also asked about their awareness of crop insurance. Majority of them did not answer the question while four farmers answered they are not aware of crop insurance. Three farmers answered that they are willing to pay PhP 500 to PhP 1,000/ha for the crop insurance. Farmers who are willing to pay asked the following questions: "*kas-anu jay sangpet jay refund nu ada mabagyo diyay mula*" (How will we receive the indemnity in case the typhoon will destroy our crops?); "*nu ag apply ak inya nga agency*" (In case I will apply, what is the agency in charge, in case I will apply?); "*basta sigurado nga bayadan da nu ada madadael when it comes to disaster*" (I am sure that they will release the indemnity payments when it comes to disaster); "*nu kasparigan nagbagyo ada ngata iti tulong*" (Are they going to help us, in case our crops will be destroyed by the typhoon?). Farmers who are not willing to pay for crop insurance said the following: "*awan met lang eted da dibali awan met unay paggastusan mi ijay basta haan da matungru"* (They will not indemnify us. Anyways, we do not incur significant expenses for as long as our crops will not be destroyed by a disease.); and "no idea."

Estimated profitability of banana production in Pinukpuk, Kalinga

Focus group discussion was done to come up with the average production cost of banana in Pinukpuk, Kalinga (Table 49). Farmers claim that they are not using any synthetic fertilizer or pesticides. They mentioned that their land is still fertile and that is why they are preserving it by just cutting weeds and putting them in the base of their banana trees. The group interviewed were also starting to do processing of banana chips with the processing equipment given by the DTI.

Table 49. Estimated Production Cost of Banana Production in Pinukpuk, Kalinga.

Activities	Cost/ha
Land preparation	5,000.00
Planting	5,000.00
Weeding	24,000.00
Harvesting and hauling	37,440.00
Total Cost	**71,440.00**
Average yield in kg	**9,360.00**
Average price	**10.50**
Gross Returns	**98,280.00**
Total Net Returns	**26,840.00**

VI. CONCLUSION

Climate – resilient agriculture captured the perceptions and experienced of farmers and stakeholders with regards to the effects of climate change. The results indicate that of all the hazards felt, typhoons and drought and/or prolonged dry season has the greatest effect on crop production especially on rice and corn. Its effect contributes to the reduction of yield and/or total loss of crops and losses in income. To minimize the effects of climate change farmers and stakeholders employ various strategies to cope, adapt and mitigate its effect. Applying or availing crop insurance the top adaptation of rice and corn farmers. On the other hand, coffee and banana are mostly considered as secondary crops by the farmers thus inadequate management and minimal intervention is being done. In line with this, cost – benefit analysis attempted to evaluate the acceptability and economic viability of selected climate – resilient adaptation strategies using the KII and FGD data. For rice and corn, the analysis focused on crop insurance and use of combine harvester as adaptation strategies for climate – related hazards. For the use of crop insurance, while crop insurance products are available and being implemented by the Region 2 PCIC (with sub-office in Kalinga), most of the rice and corn farmers are not availing crop insurance based on the 2018 to 2020 period. Most of those who availed are enrolled with the free or subsidized insurance program. Extreme weather events appear to increase the number of farmers availing crop insurance, as in the case of rice and corn farmers in 2019 due to the 2018 typhoon disasters. The cost – benefit analysis of using crop insurance as adaptation strategy indicates that for rice production, it pays to invest on crop insurance for rice when they incur yearly damage in rice production. For corn production, while corn production appears to be not economically profitable when all costs are considered, part of the loss is recouped for those who availed of crop insurance. For both rice and corn farmers, use of combine harvester was confirmed to provide positive financial net benefits to the farmer relative to manual harvesting. Use of combine harvester helps farmers shorten harvest time, especially in an impending climate hazard, reduce harvesting and threshing costs, and minimize postharvest loss. For the coffee and banana, further studies on the yield impacts of implementing the potential adaptation options are necessary before full cost – benefit analysis can be performed.

In addition, the climate risk vulnerability of the agriculture sector in the seven (7) municipalities and Tabuk City of Kalinga was assessed through a series of consultative workshops with the local experts. The assessment showed areas for prioritization of climate adaptation and mitigation technological interventions. The assessment mainly focused on the key commodities in Kalinga, which are rice (conventional and heirloom), maize/corn (hybrid) and high value crops (Robusta coffee and banana). Findings are based on modeling results which may have limitation, such as the MaxEnt and socio – economic variables used. However, despite these limitations, the results of CRVA with the guide of existing literatures and methodologies on climate change impacts as well as realities in terms of vulnerability, was validated by the stakeholders. The adaptive capability of each municipality was determined using the QGIS software while sensitivity analysis and crop suitability (current and future suitability) of conventional rice, heirloom rice, hybrid corn, Robusta coffee and banana of the province were quantified using the MaxEnt model. In addition, hazard maps (tropical cyclone, flood, landslide, soil erosion, drought, sea level rise, salt water intrusion and storm surge) using the methodology being followed by CIAT were generated. The overall vulnerability is determined as: 15% Exposure (Natural Hazards), 15% Sensitivity (cc impact on agri-fishery systems) and 70% Adaptive Capacity, as suggested by partners/experts. Results are at the municipal level (finer resolution) and option to scale up to landscape level vulnerability (e.g. watershed). From reports, tabular data, survey, existing data, participatory maps, and other sources, maps showing the priority areas for a particular crop were developed. These maps can be easily understood by different stakeholders, from technical to non – technical people.

VII. RECOMMENDATION

The municipalities of Pinukpuk, Rizal and Lubuagan are the municipalities which were identified to be highly vulnerable for the production of the selected crops. It is therefore recommended that the decision makers – DA, extension staff, local government units of Kalinga and private sectors – prioritize the above-mentioned municipalities for agricultural interventions, particularly in the production of the crops included in the assessment. Also, it is further recommended that concerned research and extension institutions shall organize a communication program that will enhance the awareness of farmers, stakeholders and other sectors concerned about climate change and adaptation strategies. Climate – smart technologies especially on coffee and banana production should be reemphasize to reduce impact of climate change and increase yield and income. Furthermore, given the high vulnerability of the target areas to climate risks as indicated in the vulnerability assessment, farmers will benefit in availing of crop insurance to mitigate the impacts of climate change. However, the total indemnity amount cannot fully recoup the potential losses of farmers in times of calamities. Hence, it is recommended to revisit the crop insurance policies and procedures to have more financial impact to farmers. Information dissemination activities are still in order considering that many farmers are still unaware of crop insurance. Also, PCIC may consider establishing a regular sub – office or a processing and collection center in Kalinga to ensure more efficient transactions with the farmers. The establishment of a provincial office will also address the farmers' concerns regarding the absence of an office that will regularly cater to their needs. The study recommends further study of crop insurance as adaptation strategy from the point of view of the government and society. In addition, given the economic viability of using combine harvester during harvest of rice and corn, the DA and concerned agencies can consider the provision of additional combine harvesters to farmers' associations and cooperatives to help farmers lessen their costs from rentals of the machine from private individuals. More units of combine harvesters available combined with accurate and timely dissemination of weather forecasts may result in less damages for corn and rice farmers during typhoons since more farmers can be serviced simultaneously. For the coffee and banana adaptation strategies, it is recommended that further experiments be conducted to determine the potential changes in yield and other parameters, which can be used in profitability or cost-benefit analysis.

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IX. ACKNOWLEDGMENT

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