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CLIMATE CHANGE ADAPTATION STRATEGIES FOR A RESILIENT RICE-BASED PRODUCTION SYSTEM: THE CASE OF THE ZANJERA FARMERS IN ILOCOS NORTE, PHILIPPINES

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Abstract

Climate change adaptation (CCA) is a top priority for the Philippine government in addressing the impacts of the changing climate, particularly within the agriculture sector, where rice-based production holds immense significance as farmers' primary livelihood and rice is a staple for Filipinos. However, most CCA strategies adopt a generalized perspective, overlooking the importance of location- and context-specific considerations.

This research explored and examined Iloko farmers' common observations of climate change, their adaptation to its impacts on rice-based production, and the local government units (LGUs) programs and strategies to reduce the impacts. Employing a cross-sectional research design, primary data was gathered through interviews with 106 Zanjera farmers in the rice-growing areas within the Padsan River Basin (PRB) and 24 key informants from the LGU. Qualitative methods, including in-depth interviews and focus group discussions, supplemented the research.

Over the past five years, the deviation in rainfall and temperature emerged as a primary basis for farmers adjusting their rice production activities and cropping calendars. Rainfall onset, pattern, and distribution influenced land preparation timing. Farmer respondents also shifted to more climate-resilient rice cultivars. In times of water scarcity, Zanjera farmers constructed indigenous diversion dams (Arbeng) to sustain rice production, considering it a resilient adaptation strategy.

The LGUs addressed these challenges through key adaptation strategies, including rice seed loan assistance, dam repair, and infrastructure rehabilitation. Planning and designing CCA programs prioritized relevance, effectiveness, and efficiency.

Provision of sustained irrigation infrastructure, alternative livelihood, and crop insurance to augment rice production losses are among the programs that will help strengthen Zanjera farmers' adaptive capacity and increase rice-based production system resiliency.

Keywords: Climate change impacts, indigenous irrigation management, local adaptation strategy, rice-based production system

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Introduction

Many Southeast Asian countries are heavily burdened with food security while exerting much effort to reduce the impacts of climate change, particularly on rice-based production. The Organization for Economic Cooperation and Development (OECD) projected that by 2050, rice yields in the region could be reduced by 16 percent for non-irrigated rice and 17 percent for irrigated rice due to climate change (Food and Agriculture Organization, 2018).

With rice being the region's crucial staple food and cash crop, priority actions for investment and scaling up are in the rice landscapes of Southeast Asian countries like Malaysia, Vietnam, and Indonesia. The adaptation measures included using drought- or salt-tolerant rice varieties, precision farming, water recycling, and water-efficient irrigation management techniques. While early results from these strategies proved successful, addressing local concerns still required further research and experimentation.

So that adaptation measures can be workable and effective, the United Nations Framework Convention on Climate Change (UNFCCC, 2007) encouraged agencies and governments, non-government organizations, as well as institutions to integrate climate change (CC) into planning and budgeting at all levels of decision making. In synergy with government and local interventions, Rashid et al. (2014) suggest using local coping strategies and Indigenous or traditional knowledge as these are context- and location -specific. Additionally, adaptation measures, as stressed by Kupika et al. (2019), need to build upon local perceptions and experiences. For instance, communities from different parts of the world used local knowledge about ecosystems to recognize and respond to the impacts of climate change and variability. They could also interpret and construct CC trends and indicators within a cultural setting (Adger et al., 2013; Reid, 2016). Such knowledge should be recognized in understanding adaptation to CC because even the United Nations (2015) acknowledges the significant role of indigenous knowledge, cultures, and traditional practices in promoting sustainable development and management of the environment.

While higher levels of government can and must provide funding and support for adaptation, the local governments are responsible for proactively planning and implementing adaptation and strategies suitable to their specific context. Institutions, organizations, and governments then have to identify their best solutions to address the negative impacts of climate change. Local administration facilitates the participation of different actors, and people at the individual level are involved in promoting solutions. With this, the Philippine government issued Administrative Order No.1 on September 17, 2010, directing the local government units (LGUs), particularly provinces, to mainstream climate change adaptation (CCA) in their local development plans (https://officialgazette.gov.ph).

The Philippine economy is agriculture-based and climate-dependent. A large portion of the rice production areas are along river basins or near seacoasts, which are most vulnerable to the impact of climate change. Many families live in these areas because they heavily depend on the rice industry as a livelihood. Climate change (CC) intensifies extreme events such as typhoons, floods, or droughts, significantly affecting farming households. About 20 tropical cyclones enter Philippine waters yearly, with eight or nine making landfall. With typhoons getting stronger, causing floods, rice farmers experienced heavy damage to their crops. In 2015 and 2016, the Philippine Statistics Authority (PSA 2015, 2016, 2017) reported that rice yield losses were 4.31 and 2.88 percent, respectively, from the 2.87 percent gain in 2014. This was brought about by the damaging impacts of typhoons "Lando" (2015), "Karen" and "Lawin" (2016). Hence, the country's food security is threatened, and dependency on rice imports is likely to rise.

It is then essential to explore and investigate farmers' perceptions, experiences, and adaptation strategies to offer an informed framework for addressing climate change. This will provide a major source of information that can aid local government in crafting a CC adaptation plan responsive to the needs of farming households and constituents in their locality. Hence, this research initiative attempted to document and examine location- and context-specific adaptation strategies at the farmer- and LGU levels. Specifically, it described farmers' perception, observations, and experiences and their responses to the impacts of climate change on rice-based production in the locality. A case study intended to document and expand understanding of how zanjeras persistently responded to the perennial impacts of extreme typhoons, floods, droughts, and economic downturns to their rice-based farming activities. In addition, it examined how the CCA programs of institutions, particularly those with rice production orientation, are designed, planned, and implemented by the LGUs in Ilocos Norte. Furthermore, the processes and outcomes of CCA strategies/programs of selected LGUs in the province were analyzed vis a vis the adaptation needs of rice farming communities.

Methodology

Theoretical Framework

As Maddison (2006) described adaptation to climate change is a two-step process: First, farmers perceive climate change, and second, they act through adaptation. This means that farmers must be cognizant of the deviation of climate or weather before identifying and implementing the appropriate CC adaptations. This aligns with Mugula and Mkuna (2016) comments that the farmer's capacity to perceive the causes and impacts of climate change is a fundamental pre-condition for choosing adaptation strategies. As Maddox (1995) described, perception is acquiring and interpreting information from one's environment.

In the perception of climate change, farming experience, which is most associated with age, plays an important role (Maddison, 2006; Ishaya & Abaje, 2008). So, experience in terms of seasonality is an important factor that shapes individuals' perceptions. A good understanding of climate change by farmers can lead to appropriate adaptation practices.

In developing countries, the standard approach to studying the perception of farmers to climate change is based on comparing farm survey or farm group discussion results with data records from the meteorological station (Hageback et al., 2005; Thomas et al., 2007 as cited by Deressa et al., 2010).

In understanding how farmers adapt to climate change-related impacts on rice-based production, insights are drawn from Henri Tajfel's Social Identity Theory (1974). According to this theory, Social Identity is a person's sense of who they are based on their group membership. This theory further explains that social behavior is determined by the character and motivations of the person as an individual (Interpersonal behavior) and the person's group (intergroup behavior). People generally prefer to maintain a positive image of the group to which they belong. Intertwined with this theory is John Turner's self-categorization theory, which seeks to understand and explain the processes by which people form cognitive representations of themselves and others about different social groups.

An important part of their self-concept for rice farmers is their identity as zanjera rice farmer members. The extent to which a person is committed to their group influences their behavior. Compared to those who are not strongly committed to their identity, they will only stay for as long as it is beneficial or has value to them (Spears et al., 1999, cited by Manalo et al., 2020). However, those strongly committed to being zanjera farmers are likely to stay with the group no matter what. They are even willing to sacrifice to improve the standing of the zanjera. With such reasoning, adaptation to climate change may be influenced by the level of commitment farmers are to be members of a zanjera. For example, in anticipation of typhoons, floods, or drought events, the sanjera members contribute financially, working out their indigenous diversion dams called "Arbeng." If being a Zanjera member is unimportant, they will not contribute or provide labor. In comparison, those identifying themselves as zanjera members go out of their way to help despite the extreme weather events.

Selection and Description of the Study Sites

Municipalities with relatively small farming areas within the Laoag or Padsan River Basin (PRB) were chosen as sites to study CC impacts as these demonstrate diverse geophysical and climatic conditions concerning rice-based production in natural and socio-economic spheres.

The climate in the basin is characterized by two distinct seasons: wet (May to October and dry (November to April). Average annual rainfall is estimated to be 2,135mm, of which 97 percent is concentrated in the wet season. The PRB is also affected by tropical cyclones yearly, causing heavy rainfall and floods. It supports seven irrigation systems that serve 12,205 ha of agricultural land (NIA Report, 2003, 2011). In the potential flood area, there are approximately 16,300 ha of crop cultivation area.

The PRB flows through the province of Ilocos Norte and drains an area of 1,322 km^2 at the river mouth. The river originates in the Cordillera Central Mountains and has an elevation of more than 2,000 meters. The PRB flows down northwards along the western fringe of the alluvial fans in the middle reaches to the confluence of the Guisit River. After that, it turns toward the west, passes the downstream flood plain, and finally empties at Laoag City to the South China Sea. The Bongo River is the main course for the middle and upper reaches, with the confluence of the Cura River as its boundary and the Laoag River for the lower reaches. The Bongo River is joined by many tributaries, among which are the major tributaries namely: Papa, Madongan, Solsona, Labugaon, and Cura rivers that flow down from the alluvial fan along the right bank in the middle reaches (Sabo Dam Project Report of DPWH, 2006).

The first phase of the research was conducted in six municipalities and one city within PRB in Ilocos Norte (Fig. 1), which areas were vulnerable to climate risks based on maps and data provided by the LGUs. These were clustered into i) *Upstream* -

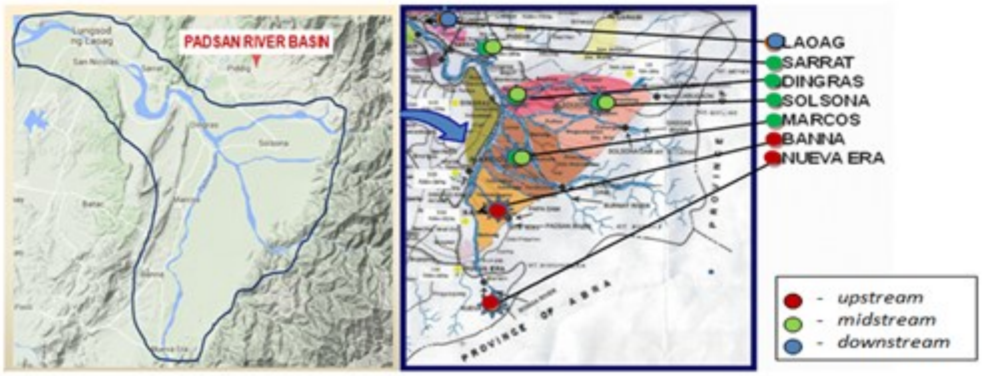

Fig. 1. Map showing the rice-growing municipalities of study sites by ecological zones within the Padsan River Basin.

Nueva Era and Banna; ii) *Mid-stream* - Marcos, Dingras, Sarrat, and Solsona; and iii) *Downstream* – Laoag City.

The second phase was carried out in five (5) the municipalities in Ilocos Norte with rice-based production as a major livelihood (Fig. 2). These were purposively identified based on their level of vulnerability to climate change as indicated in the risk assessments made by the provincial government (PGIN, 2013).

Research Design and Data Collection

Phase I of the research analyzed the farmer respondents' observations and experiences on the impacts of CC on their rice production. Phase 2 examined the adaptation programs of the LGUs as to how they effectively and efficiently assisted the zanjera farmers in coping with the impacts of CC.

The first phase used the cross-sectional approach by collecting data at one episode during the 2013 dry season (DS) cropping. In collecting quantitative data, a survey was administered to 106 randomly selected farming households within the PRB. The majority of the respondents were in their prime years, with a mean age of 53 years, predominantly married males, had attended formal secondary schooling, and had stayed in their barangay for more than 40 years. The respondents had medium-sized households (4-5 members).

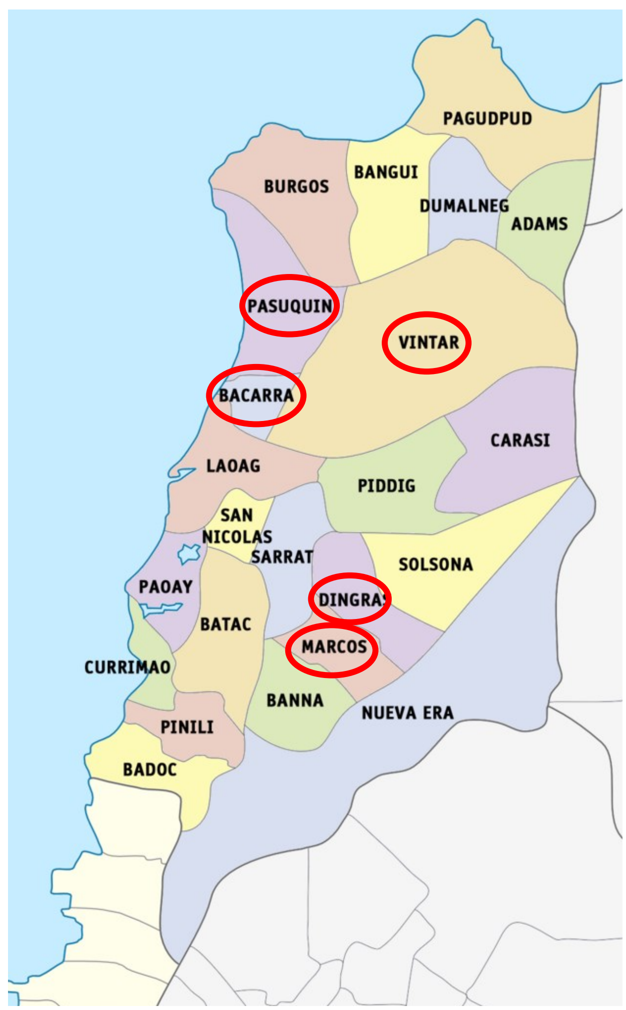

Fig 2. Location map showing the selected municipalities as study sites.

Primary data and information included farmer respondents' i) observed rainfall, temperature, and typhoon changes in the past five years (2008-2012).; ii) indicators of climate change, and iii) impacts of climate change on their rice production. Also included were their coping mechanisms, adaptation strategies, and the adjustments they have made in their farming practices in response to these changes. This research initiative also included a case study of two zanjeras in Solsona. Zanjeras were purposively chosen based on their continued irrigation management practice in rice production, the traditional "arbeng."

For phase two, data and information on LGU adaptation programs and strategies were gathered through a structured questionnaire. A total of 24 implementers served as the respondents: Municipal/City Agriculture Officer, Agricultural Technicians, Planning and Coordinating Officer, Budget Officer, and Municipal Engineer from Marcos, Dingras, Bacarra, Pasuquin, and Vintar who were directly involved in the implementation of the CC adaptation program of these LGUs.

In both study phases, primary data were supplemented with key informants (KIs) interviews and secondary data. Focus group discussions (FGDs) were also conducted to understand issues that could not be adequately investigated using quantitative approaches.

Data Analysis and Interpretation

The collected data in Phase I was analyzed and interpreted using quantitative and qualitative techniques. Descriptive statistics, i.e., frequency counts, percentages, and weighted means, were used for the quantitative analysis.

For Phase II, the Likert Scale and weighted means were used to analyze the evaluation data gathered from the LGUs. The descriptive equivalents of the corresponding range values of the 5-point rating scales are as follows:

Results and Discussion

Numerical Value	Range Values	Descriptive Equivalent
5	4.20 – 5.00	Very High
4	3.40 – 4.19	High
3	2.60 – 3.39	Average
2	1.80 – 2.59	Low
1	1.00 – 1.79	Very low

Farmers' observations and indicators of the impact of climate change

Rainfall trends

The more experienced rice farmers sensitively observed deviations in climate based on their recollection of the past five (5) years of weather events. Their indicators were variable rainfall amount, intensity, patterns, and distribution. Figure 3 reflects their varied observations as regards the onset of rainfall in the three ecological zones.

At the *downstream* of the PRB, 50% of the respondents observed the occurrence of early monsoon rain, late-onset (23% at the *midstream*), and unusually heavy or prolonged (28% at the *downstream*) rainfall season. The respondents in the mid-and upstream also observed unpredictable occurrences of early but scanty rainfall (20% and 13%), but not for those in the *downstream* zone. This can be attributed to the location of their farms near the seacoast (La Paz, Laoag City). The farmer-respondents mentioned that rice planting in the past five years (2008-2012) usually started in April or May but has now shifted to June, and the latest is July. These farmers' observations were almost consistent with the recorded data from the two PAGASA stations (Batac and Laoag). Based on records in 2008 and 2011-2012, rainfall was set in June; in 2009 and 2010, rainfall was set in early April and May. Galacgac et al. (2012) also reported occurrences of extreme rainfall, although there were recorded fluctuations from 2008 to 2010.

The onset of rainfall is significant as this signals the start of rice planting activities. The respondents also expressed concern that rainfall distribution was not even throughout rice growing seasons.

Temperature trends

Figure 4a shows that 60% of the farmer respondents in the upstream and midstream observed an increase in temperature in their respective ecozones. Those downstream (58%) reported that from December to February, during dry season cropping, the site was scorching during the day and night but colder at dawn compared to the last five years. The record of PAGASA and the study of Galacgac et al. (2012 and 2013) indicated that maximum air temperature was consistently higher (0.3°C to 0.9°C based on the 1976-2010 mean air temperature (Fig. 4b).

Tropical Typhoons/Storms

Figure 5a shows the respondents' observations and experience on the occurrence of more frequent and extreme or tropical solid cyclones that hit Ilocos Norte in the last five years. This was more pronounced in the midstream of the PRB, as observed by 95% of respondents. This

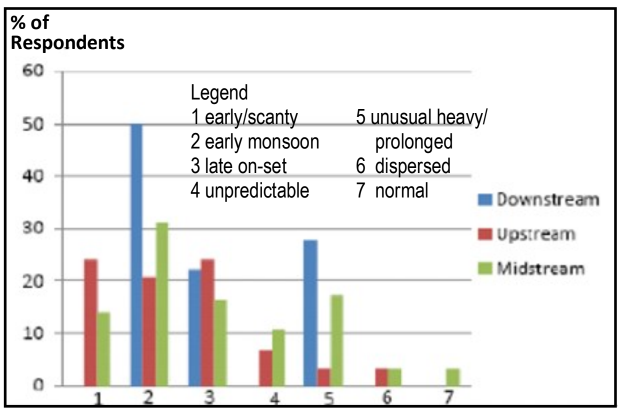

Fig. 3.Farmers' observations on the changes of rainfall occurrence for the past five years (2008 – 2012)

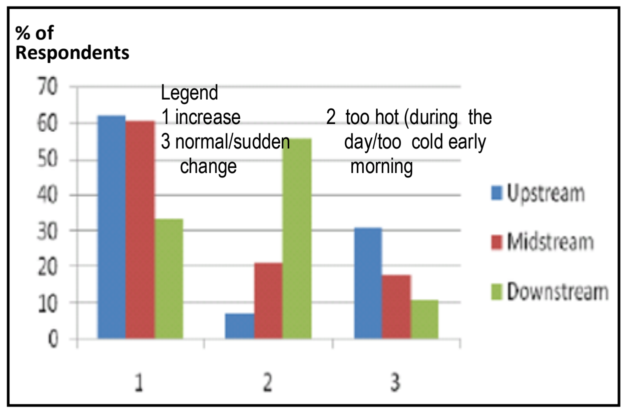

Fig. 4a. Farmers' observations on temperature changes (three ecosystems) for the past five years (2008 – 2012).

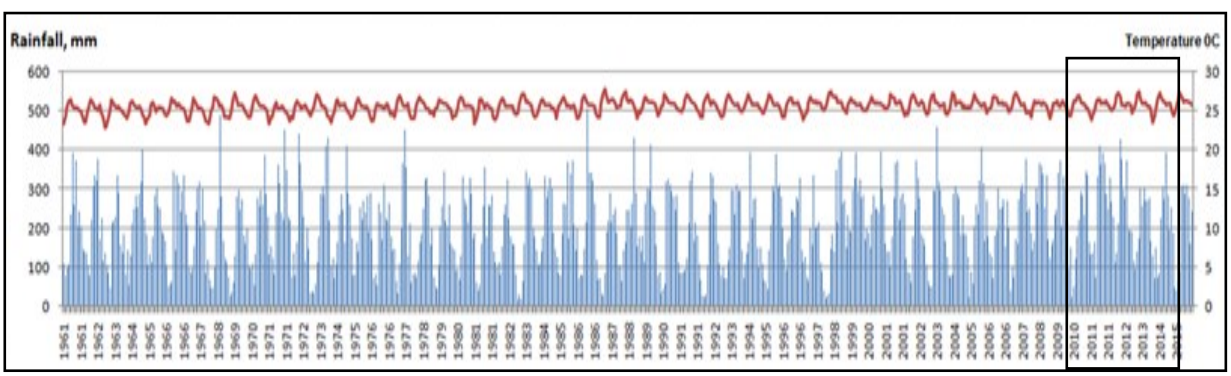

Fig4b. Rainfall and temperature occurrences in the Philippines, 1961 - 2016

phenomenon is concurred by the report of Galacgac et al. (2012 and 2013), where a remarkable change in the occurrence and strength of cyclones or typhoons (Fig.5b) and monthly trend during the wet seasons starting in the year 1990 (Fig.5c) were evident. The report also specified that the average number of cyclones in 1991-2010 had increased from the average of seven (7) that annually cross Ilocos Norte to nine (9) cyclones.

Observed impacts of climate change on rice production within the Padsan River Basin

Many farming households significantly felt the impacts of climate change as their rice-based livelihood was greatly affected. This was more pronounced in the midstream sites within the PRB. Table 1 summarizes the observed impacts of climate change on rice production within the Padsan River Basin.

Zanjera farmers' coping mechanisms and adaptation strategies

At the local level, adaptation is generally initiated by individuals or communities in reaction or response to location-specific threats of climate change and variability. Based on their perceptions or beliefs about climate change, farmers continuously adapt to changing conditions. Their attitudes toward and willingness to support adaptive actions are likely influenced mainly by what they perceive and experience about climate change and weather variations.

In response to the impacts associated with climate change and variability, *Zanjera* farmers in the study areas implemented various coping mechanisms and adaptation measures (Table 2).

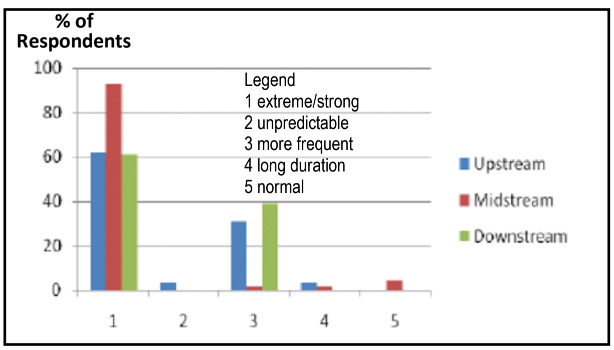

Fig. 5a. Farmers' observations on the cyclone (typhoon) occurrences for the past five years (2008- 2012).

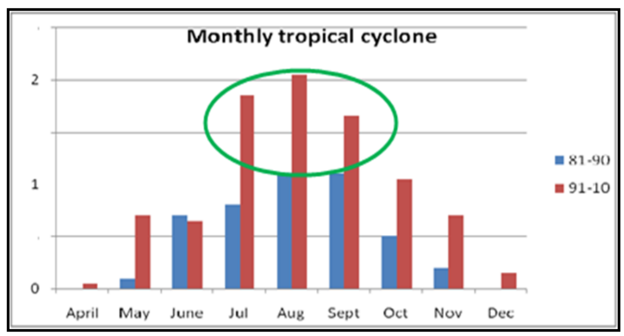

Fig. 5c. Frequency of tropical cyclones in Ilocos Norte during 1981-1990 and 1991 – 2010.

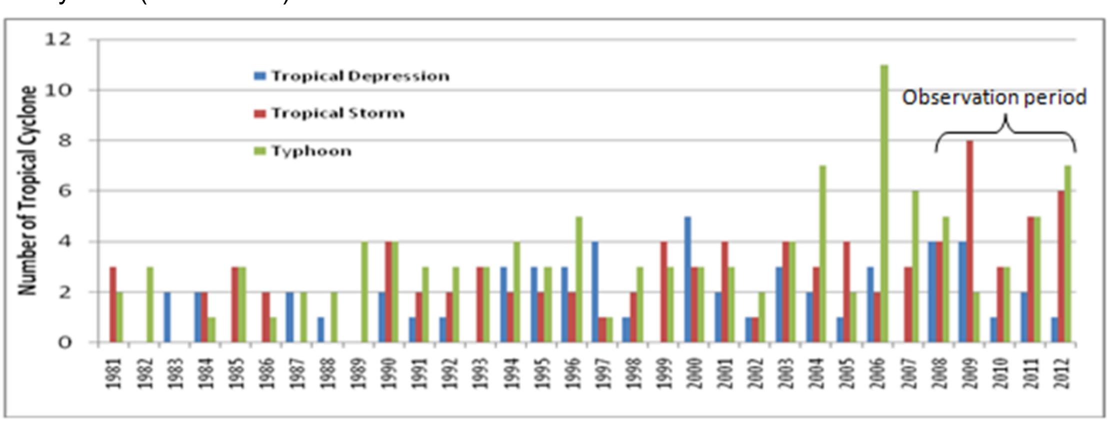

Fig. 5b. The annual number of tropical cyclones (based on strength) that passed or crossed Ilocos Norte in 1981-2010.

Table 1. Climate changes and variability impacts on rice-based production as observed by farmers in the past five years (2008- 2012).

Observed Impact	Climate Change/Variability			
	Unpredictable/ Excessive Rain/ Flood	Typhoon	Drought	Increased Temperature
Delayed planting; changes in the cropping calendar/pattern (*reduced rice cropping i.e. from three to only two*)	√	√	√	
Reduced yield/no harvest (*due to damaged crops, flooded/ silted farms*)	√	√	√	√
Increased incidence of unusual pests and insects	√		√	√
Decline water supply affecting irrigation (*drying up of river)* destroyed brush dams/flood control/irrigation structures	√	√	√	
Unable to plant due to cracking or hardened soil, crops dry up due to lack of soil moisture			√	
Reduced working hours	√	√	√	√
Reduced farm income (*damaged livelihood including piggery, poultry and livestock*)	√	√	√	√
Cannot sell products (*unpassable roads, destroyed bridges*	√	√		
Damaged irrigation structures	√			

Table 2. *Zanjera* farmers' coping mechanism and adaptation strategies to the impacts of climate change on rice-based production.

Coping Mechanism/ Adaptation Strategy	Unpredictable/ Excessive Rains	Extreme Typhoon	Drought
Adjust time of planting	√	√	√
Reconstruct "arbeng"; irrigation canals and flood control	√	√	√
Reserve seedlings (pagsugot), replant, repeat cultivation (remove silts/sediments from soil erosion)	√	√	
Improve farming practices; use/diversify suitable varieties	√	√	√
Harvest early or harvest what is left	√	√	√
Resort to credit (relatives, neighbors, banks) sell other assets or livestock	√	√	√
Engage in alternative source of income (hired labor, off-farm); work in someone else farm	√	√	√

Most farmers In the *midstream* group indicated that the availability of enough irrigation water from the PRB would signal the start of planting for the wet season. Hence, they have to adjust their usual cropping calendar or planting schedule. However, the farmers upstream and downstream preferred their usual planting date, May or June, despite the unpredictable rainfall.

To cope with the occurrence of a dry spell in the wet season cropping and water scarcity in the dry season, *Zanj*era farmers strongly rely on their traditional irrigation system called “arbeng” to sustain rice production (Fig. 6). The ‘arbeng” is repaired every after the occurrence of flood and before the dry season cropping. Although unstable, it has sustained farmers' rice production in the past years, particularly in the *midstream* zone. According to them, the “arbeng” or brush dam entails around P35,000 to construct. This is complemented by the provincial government's support in the form of heavy equipment services and needed construction materials. At the same time, the *Zanjera* counterpart is the labor of the members.

The most significant and perennial challenge of the *Zanjeras* is the unstable condition of their “arbengs,” as these are diversion dams made of brushes, woods, and like materials; frequently built as they are easily washed out by floods, which entail expenses, hence added burden to farmer-members.

In the occurrence of floods and typhoons, the farmers have practiced reserving extra seedlings for replanting (“pagsugot”). Also, more farmers have adopted hybrid and certified seed varieties, which they claim to be the resilient adaptation strategy to the changing climate. A few farmers claimed that before the extreme typhoon, they had to harvest rice early, and at times when they were not anticipating inclement weather, farmers could only harvest what was left, which implied losses and poor play quality.

Most farmers borrow or resort to informal sources, *i*.e., relatives and neighbors, but more from traders or farm suppliers for capital on rice production. According to them, the interest rate ranges from 5% to 10%, but they are compelled because of the need for seed and fertilizer inputs. Payment is done after harvest in cash or selling their palay to the trader or farm supplier. In most cases, they indicated that the income earned is used to pay debts incurred in the previous cropping season.

Figure 6. Zanjera farmer-members construct diversion dams or “arbeng” made of brush, wood, and bamboo poles.

Their debts may double due to accrued unpaid interest because of lost income after their crops that were about to be harvested otherwise had been destroyed by typhoons and floods, which implies the need to insure their crops.

The *Zanjera* officials and members reported that despite the typhoon and flood, productivity has only slightly decreased because of the increased adoption of hybrid and certified seeds. Although, the grain quality was affected because of submergence brought about by the long duration of rain during the harvesting period or intermittent drying of the palay.

In the focus group discussions (FGDs) conducted**,** the unpredictability of the seasons or agricultural calendars, prolonged wet conditions during the rice-growing season, flooding, erosion, and river sedimentation were the main reasons for the decline in rice production within the PRB. It was stressed that most farmers depend on the availability of irrigation water from the PRB, and the river's water level dictates their usual rice planting calendar or schedule. The *Zanjer*a farmers stressed that the variable weather conditions increased the risk of crop failure and production loss. Moreover, heavy crop damage and loss are incurred if these conditions prevail during harvesting and post-harvesting periods. The water-damaged grains will be of poor quality and fetch low prices on the market. On the other hand, farmers also observed a high incidence of unusual pests and diseases linked to warming, i.e., wilting of stems and graying of leaves in addition to the common disease “tungro.” Likewise, a dry spell during the wet season cropping results in scarcity of irrigation water from the river.

These research findings were consistent with the claims of Mary and Majule (2009) that the real criteria of the effectiveness and success of farming are the timing of the on-set of first rains, the distribution and length and period of rain during the growing season, and the effectiveness of each precipitation event because all these affect crop-planting regimes. In addition, changes in rainfall amounts and patterns affect soil erosion rates and soil moisture, which are important to crop yields (IPCC, 2007).

Local Government Units’ Climate Change Adaptation

Mission and Mandate

From the results of the FGDs in Phase I, the *Zanjera* farmers stressed the desire that instead of the seed dispersals and distribution of relief goods during the occurrence of extreme typhoons and floods, a program on soft loans in the form of seeds, fertilizers, and other farm inputs are far more beneficial to them. They opined that instead of paying high interest rates to farm suppliers and traders, they could avail loans and services from the government at a lower cost. The researchers also attempted to survey and interview the implementers directly involved in planning, designing, and implementing the CCA programs and projects of selected LGUs (Phase II).

The LGUs have a clear mission on climate change adaptation, disaster risk reduction, and disaster management, as shown in Table 3. Generally, these are to formulate measures and implement needed programs geared towards adaptation to climate change. Specifically, their mission is to implement and deliver agricultural services and technical assistance to increase the productivity and resiliency of rice-based production in the province.

Profile of local CCA implementers of selected LGUs in Ilocos Norte

The profile of the twenty-four (24) LGU implementers of CCA programs/strategies is

Table 3. Mission of selected LGUs in Ilocos Norte concerning climate change.

Municipality	CC Mission Statement
Bacarra	Formulate measures and implement necessary programs, projects and activities geared towards climate change adaptation and mitigation of its adverse effects and impact to all agricultural stakeholders and to the environment
Dingras	Implement and deliver agricultural service/technical assistance in the improvement of productivity and profitability of stakeholders or recipients
Marcos	Preserve integrity of the environment, increase productivity and income and produce safe and nutritious food
Pasuquin	Preserve integrity of the environment, increase production and income; Disseminate climate change awareness to the people to save mother earth; to achieve a safer, adaptive, and disaster-resilient communities towards sustainable development.
Vintar	Protect the lives and properties of the people from disasters including man-made calamities and preserve the environment from ill effects of climate changes, establish a disaster resilient LGU.

shown in Table 4. These are from the LGUs of Bacarra -10; Pasuquin -3; Vintar -3, Dingras -3; and Marcos -5. Most of them are married, a few singles, and widowed; male and female are almost equal in number and evenly distributed to the young, middle, and old age brackets. Most are agriculture graduates majoring in extension, animal science, and crop science and soils, one with a master's degree. Six CCA program implementers had been employed for over 30 years. However, nine of them were less than five years in the job either as an agricultural technologist (19), farmworker (1), administrative staff (1), or municipal agriculturist (3) at the time of assessment. However, their educational attainment and work experience ensure high reliability in their assessment and perception of the CCA programs' processes, effects, and impacts under their respective agencies.

Each team member had a role in climate change adaptation, mitigation, or risk management. Respondents' activities vary, reflecting the complexity of the issue and the need for varied and locally specific adaptation projects cutting across different sectors.

Climate change adaptation programs/ strategies implemented by LGUs related to rice production resiliency

As shown in Table 5, the LGUs of Bacarra and Pasuquin indicated rice seed loan assistance as their major direct CCA program. In Bacarra, 536 farmers in 43 barangays benefited from this program, while in Pasuquin, 33 barangays could access this program; however, the specific number of farmers needed to be indicated. Related to this program was the provision of drought/ lodging-resistant rice varieties demonstrated in municipal farms, specifically in the fifteen barangays of Dingras. Hazard mapping, repair and rehabilitation, and construction of river flood control structures and communal irrigation systems (CIS) and dams were the major direct CCA of LGU Pasuquin and Sarrat.

Table 4. Profile of CCA implementers of selected LGUs in Ilocos Norte.

Characteristics/ Variable	Bacarra *n=10*	Pasuquin *n=3*	Vintar *n=3*	Dingras *n=3*	Marcos *n=5*	TOTAL *n=24*
Age						
<25	2	1			1	4
26-35	1	2	2		1	6
36-45	3			3		6
46-55	1				1	2
56-65	3		1		2	6
Sex						
Male	5		2	3	1	11
Female	5	3	1		4	13
Civil Status						
Single	3	1			2	6
Married	7	2	3	3	2	17
Widowed/ separated					1	1
Education						
BS Agriculture	5		1			6
Extension	2		1	2	2	7
Animal Science	1	1	1			3
Crop Science		1			2	3
Soils		1				1
BS Agr'l. Eng'g.	2					2
BS Forestry					1	1
Master in Agriculture				1		1
No. of years as employee						
<5	2	2	2		3	9
6-10	1		1	1		3
11-15	2	1		2		5
16-20	1					1
21-25						
26-30						
Above 30	4				2	6
Position held in the agency						
Mun. Agriculturist	1			1	1	3
Agr'l. Technologist	8	3	3	1	4	19
Farm Worker				1		1
Admin. Staff	1					1
Nature of Work in the agency						
Extension worker	7		3	1	5	16
Administrative	3	3		2		8

Source: Survey 2015

The indirect CCA program or alternative source of income common to the selected study sites was organic farming and vermicast fertilizer production, which benefited more than 1,000 farmers. Dispersal of palay, corn, and vegetable seeds was also commonly implemented by the selected LGUs to many farmers in their respective areas.

Selection process in targeting potential beneficiaries of CCA programs

Table 6 indicates the degree of success ranging from 3.8 to 5.0 in targeting potential beneficiaries depending on the kind of CCA program. The criteria for selecting either individual farmers or groups/associations were on *poverty level* and *risk of drought or extreme climate change.* Some CCA

Table 5. Climate change adaptation programs/strategies towards rice production resiliency implemented by selected LGUs/MAOs in Ilocos Norte.

Adaptation Program/ activities	Location		Recipients/Beneficiaries	
	Municipality	No. of Brgys.	No.	Type
A. Direct CCA				
Rice Seed Loan Assistance program	Bacarra Pasuquin	43 33	536 -	farmers farmers
Provision of drought/ lodging resistant rice varieties	Marcos Pasuquin	25 33	325 27/year	farmer-members/ association farmers
Techno demo farm for flood/drought resistant rice varieties	Dingras	15	all	farmers
Hazard mapping	Pasuquin	33	548	residents/ farmers
Repair, rehabilitation and construction of river flood control structures	Pasuquin Sarrat	7 All barangays	548	farmer members – associations
Rehabilitation of Communal Irrigation System (CIS)	Pasuquin	33	58	CIS
Construction of Sulbec Dam	Pasuquin	1(Sulbec)	1,954 900 has	farmers land area
B. Indirect CCA				
Organic farming/ fertilizer production/ vermiculture	Vintar Marcos Pasuquin Solsona Sarrat Bacarra	33 22	- 548 660	farmers farmer-members/ association vermicompost organic fertilizer producers farmers
Synchronized planting	Vintar	33	250	farmers
Seed dispersal (rice, corn, vegetable)	Dingras Pasuquin Solsona	10 33 22	1,000 40/yr 3,000	farmers farmers farmers

Table 6. Selection and criteria in targeting potential beneficiaries of CCA programs of selected institutions in Ilocos Norte.

CC A Program/ activities	Beneficiaries	Criteria in selection	Responsible in the selection	Rate or degree of success in targeting
Direct CCA				
Rice Seed Loan	Farmers	Poverty level	AT and Brgy officials	4.5
Provision for drought/ flood resistant rice varieties	1 to 10 farmer associations	Poverty level Land access/ tenure Capacity of knowledge of beneficiaries Presence or capacity of service provider (extension, credit, inputs)	MAO	4.5
Techno-demo of drought/ flood resistant rice varieties	10 farmer organizations	Risk of drought or extreme CC Capacity of knowledge of beneficiaries Ability to provide complementary inputs	MAO	4.0
Hazard mapping	548 farmers/ Community	Risk of drought or extreme climate change	MDRRMC	4.5
Construction of river/ flood control structures	548 farmer-members	Risk of drought or extreme climate change	MDRRMC	5.0
Indirect CCA				
Palay, corn, vegetable seed dispersal	Individual farmers Members of household/ extension agent	Poverty level, food and nutrition status Risk of drought or extreme climate change Political stability	MAO LGUs CSOs	3.8
Farmers Field School	Community based organization	Capacity of knowledge of beneficiaries	MAO	5.0
Organic/ vermicast fertilizer production	Individual farmers, members of households, LGUs, community-based organization	Poverty level Ability to provide complementary inputs Presence of existing formal groups	LGUs, civic society DA	4.3

programs required *a capacity of knowledge; among these were techno-demos and the provision of drought/lodging resistant rice varieties and farmer field schools*. This is because these programs require technical know-how in their implementation. The implementers cited that their knowledge capacity also determined the beneficiaries' understanding and cooperation.

The implementers also emphasized that the CCA program beneficiaries were consulted in preparing the project/activity plan. Their degree of involvement ranged from 3.7 to a high of 4.8 (Table 7). Their involvement was due to their interest and receptiveness, or they consider the program a livelihood promising profit. If they are involved, they feel their significance, and if they foresee profit from the program, they tend to cooperate and be actively involved. The implementers perceive that selecting beneficiaries and their hands-on participation affect the success of the CCA program/ activity. As to the gender aspect, the percentage of female beneficiaries, depending on the nature of the CCA program, ranges from a low of 4 percent to 30 percent. This corroborates the influence of the Social Identity Theory (Tajfel, 1974) that farmers, for example, are focused on involvement and economic analysis, i.e., farmers' decision to adopt a mechanism is high if they find it economically viable.

Seventeen or 70 percent of the implementers pointed out that the process of selecting beneficiaries affected the success/ failure of the CCA/DRM project/activity in the following aspects:

- Their capacity of knowledge dictates their understanding and cooperation 2
- They give importance to the project or activity 1
- They commit to sustain the PPA if they benefit from them 1
- The adoption of the programs, and the recommended technologies 2
- There is a prejudice in the selection process 2
- Acceptability/adaptability of the project 2
- Implementation of PAPs is successful 1

Table 7. Degree and reason for involvement of beneficiaries in designing and planning CCA programs.

CCA Program/activities	Reason for involvement of beneficiaries	Degree of involvement
Direct CCA		
Rice Seed loan	capacity to avail of the program	4.8
Provision of drought/flood resistant rice varieties	Resiliency, willingness and	4.5
Conduct of techno-demo for drought/flood-resistant rice varieties	Receptiveness, interest	4.0
Hazard mapping	Familiarization of hazard-prone areas	4.5
Construction of river/ flood control structures	Protection, security	5.0
Indirect CCA		
Provision of palay, corn, vegetable seeds		3.7
Organic/vermicast fertilizer production	Interest, receptiveness livelihood	4.2
Farmer Field School	interest	4.0

Program planning and design

Detailed individual adaptation measures can be designed after the overall necessity and priority of adaptation have been clarified. Rather than planning new adaptation measures from zero, greater priority should be given to incorporating the concept of adaptation into existing governmental plans and projects. This approach is taken to utilize resources effectively and promote effective and efficient adaptation initiatives by utilizing existing structures and frameworks to the greatest extent possible.

Table 8 shows that a timetable or work plan is of utmost importance in CCA planning and designing. This is because it serves as a guide in the program implementation. Specifically, the implementers rated financial sustainability (3.9) followed by the project's acceptability, environmental impact, participation of beneficiaries in the implementation, and suitability to ecological zone (each with 3.8 ratings) as important factors or issues to consider in the planning and designing CCA programs. Profitability or economic feasibility (3.7), technical feasibility (3.6), and political, social, and cultural constraints (3.5) were factors followed closely. Gender aspect and closeness to product or input markets were rated 3.2, but this does not imply that they do not matter so much.

Budget requirement and provision

Funding is a central hurdle for adaptation action, requiring the development of a more robust justification of investments. The CCAs may or may not be pursued depending on the availability and adequacy of the necessary and appropriate resources to support their implementation. Table 9 shows that the proposed budget for each CCA program was more or less the same as the actual budget amount. The major budget source was in the form of grants and LGU or agency funds. Resource sharing and linkage are the common method of generating resources. The LGUs and concerned agencies provide either financial or technical or a combination of these for implementing the CCAs. The counterpart of the beneficiaries was in the form of labor. The implementers perceived this role/contribution to be high performance, with a rating of 4.0 to 5.0.

Table 8 . Factors and degree of importance in project planning and designing CCA**.**

Factors	Weighted Mean
Technical feasibility	3.6
Suitability to ecological zone	3.8
Profitability or economic feasibility to beneficiaries	3.7
Closeness to product and input markets	3.2
Environmental impact	3.8
Acceptability of the project to intended communities	3.8
Participation of beneficiaries in the implementation	3.8
Financial sustainability of project	3.9
Political, social and cultural constraints	3.5
Gender differences and inequality	3.2
Timetable or workplan	4.0

Table 9 . Budget requirement and provision.

CCA Prog/ Activities	Proposed Budget Allocation	Source	Actual Budget	Method of Resource Generation	Role/ Contribution	Performance of Role/ Contribution	Timeliness	Adequacy
A. Direct CCA								
Rice Seed loan (plant now pay later program)	720,000 680,000	Grant 20% dev't fund	718,400 680,000	Loan and grant	Financial assistance	4.0	3.0	4.0
Provision of drought/food resistant rice variety						5.0	5.0	5.0
Provision of palay, corn, and vegetable seeds	500,000	DA PGIN	>500,000	Linkaging	Technical and financial assistance	4.5	5.0	4.0
Techno-demo for drought and flood resistant rice varieties		Grant			Technical and financial assistance	4.0		
Hazard Mapping	80,000	Calamity Fund	50,000	Resource sharing	Labor counterpart	5.0	4.0	4.0
Construction of Flood/river control	1,870,000	EDF NGA/ LGU	1,870,000	Resource sharing	Both farmers and Technical assistance	4.0	4.5	4.0
Construction of dam	4,000,000	NIA	4,000,000	Resource sharing	Labor counterpart	5.0	4.0	4.0
B. Indirect CC								
Organic/vemicast fertilizer production	100,000/ municipality	LGU	100,000	LGU funds	Technical and financial assistance.	4.7	4.7	4.0

Program Implementation

Table 10 shows *that regular funding or releases of funds (3.8)* are of utmost importance during CCA program implementation. This is because it is the fuel of the program. On the other hand, *the consultation, availability, and participation of beneficiaries, local groups in the target communities, implementers, and beneficiaries* (3.7) are also significant issues that the implementers considered.

Delivery and implementation

As reflected in Fig. 7, the different aspects of implementing CCA programs depend on the nature of the program. The implementers rated Hazard mapping with a high 5.0 in all aspects because of its importance and urgency. *Adequacy* on rice seed loans was rated low, which may imply that more is needed to cater to the needs of target or potential beneficiaries, as was reported.

Degree of participation of implementers

Overall, the implementers perceived themselves to have very satisfactorily participated in the program process, starting from the assessment of the needs and identification of target beneficiaries either as an individual farmer or group/association, in planning and programming to implementation until monitoring and evaluation of CCA programs in their respective area or jurisdiction (Figure 8).

Monitoring and evaluation of CCA programs

Adapting to climate change requires local knowledge, expertise, institutional capacity, and monitoring and evaluation. Most implementers rated *beneficiary participation in program implementation (3.6), followed by coordination and linkages with other organizations (3.5), as important indicators in the* monitoring and evaluating CCA programs. However, an important indicator to consider is an implementer's rating of a high 4.0 perceived production, surplus, calamity reserve, storage, and distribution of produced rice to other provinces (Table 11). This might be because these indicators indicate productivity, profitability, and resilience concerning rice-based production.

Table 10. Issues of important considerations during the implementation of the CCA program/ activities.

Factors	Weighted mean
Consultation of beneficiaries (men and women) prior to project implementation	3.7
Suitability to ecological zone	3.6
Availability of transportation for field operations	3.4
Availability of local groups within targeted communities that take on implementation	3.7
Acceptability of the project in the community	3.6
Having all staff required to implement the project regardless of	3.7
Participation of beneficiaries in the implementation	3.7
Public infrastructure in the project area (roads, irrigation, etc.)	3.7
Regularity of funding or fund releases	3.8

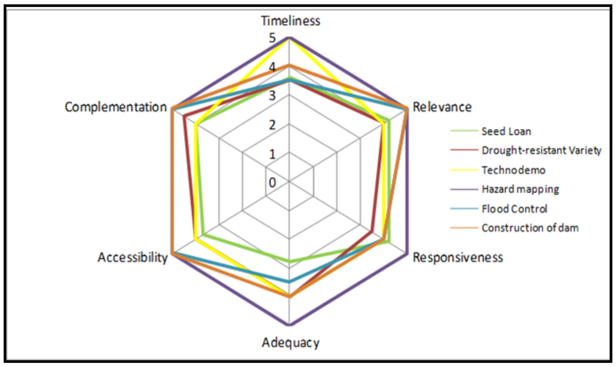

Figure 7. Delivery and implementation of the CCA program/activities.

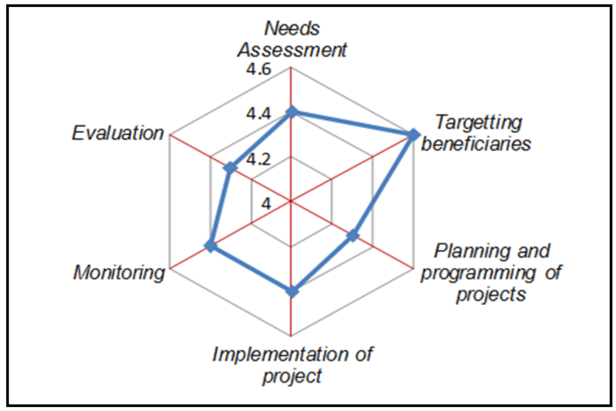

Fig. 8 Program process/degree of participation of implementers.

Table 11. Indicators and degree of importance in monitoring and evaluation of CCA.

Factors	Weighted mean
Changes in productivity of farmer's plot/area	3.3
Changes in household asset holdings	3.2
Changes in the access to services and information	3.2
Changes in household income	3.3
Measure of farmer's empowerment	3.3
Measures of environmental sustainability	3.3
Participation of beneficiaries in the implementation	3.6
Level of coordination and linkages with other organizations	3.5
Production, surplus, calamity reserve, storage and rice distribution	4.0

Rice Production Status in Ilocos Norte

While rice farmers are often flexible in dealing with the impacts of annual weather variability and climate change, there is nevertheless a high degree of adaptation of local programs and projects implemented by the provincial and local government units and other organizations of similar rice production orientation.

The province of Ilocos Norte has been recorded as one of the top rice-producing provinces in the country since 2014 (https://ilocosnorte.gov.ph/news despite the increasingly changing climate and variable weather. The Provincial Government reported that rice production increased by 2.16 percent in 2015 compared to 2014, and the surplus production improved by 4.82 percent from 165.27 percent to 173.23 percent in 2014 and 2015, respectively.

Conclusions and Recommendations

Experienced rice farmers sensitively observed changes in temperature and rainfall, typhoons, floods, and drought occurrences based on their recollection of the past five (5) years of climate events, which served as their indicators of climate change. Their reported observations were almost consistent with the climatic data and records of the two PAGASA meteorological stations in Ilocos Norte and previously reported research findings. Their observations and experiences were bases for adjusting their cropping calendar, whether they resorted to early planting or used short-duration rice cultivars and other adaptation strategies in response to climate change impacts.

Despite the threats of typhoons, floods, and water scarcity, the farmers could still produce and harvest from their rice production with minimal yield losses. This is the result of their well-managed traditional irrigation system, particularly the "brush dam" or "arbeng" and the collective action of the *Zanjera* members.

On the LGUs' part, the implementers succeeded in the planning, design, and implementation processes. The CCA programs were extended to the proper beneficiaries, farmers/zanjeras, using criteria on *poverty level and risk of drought or extreme climate change* which gained a high rating. The most urgent among the CCAs were *hazard mapping*, *repair and rehabilitation*, and *construction of river flood control structures* and *communal irrigation systems (CIS) and dams*. These required local knowledge, expertise, and institutional capacity.

The beneficiaries wanted to be involved because of their receptiveness, interest in the CCA program, or consideration of the program as a livelihood promising profit. If they foresee profit from the program, they tend to cooperate and be actively involved. Moreover, their involvement made them feel significant. The availability and adequacy of the necessary and appropriate resources to support CCAs' implementation determined whether the CCAs may be pursued. Also, the regularity of funding or releases of funds is of utmost importance during implementing the CCA program. This is because it is the fuel of the program. Sharing and linkage appeared to be the common method of generating resources for implementing CCAs. The counterpart of the beneficiaries was in the form of labor.

Among the important factors or issues considered in the planning, designing, and implementation of local CCA programs included financial sustainability, acceptability of the project and participation of beneficiaries, environmental impact, and suitability of t*he program to the ecological zone*. Other factors were profitability, economic or technical feasibility, and political, social, and cultural constraints.

Ilocos farmers' observation of the variability or changes in temperature, rainfall occurrences, and experiences of extreme typhoon and flood events are close to empirical trend analysis of meteorological stations of PAGASA in Laoag and Batac. This indicates that farmers are knowledgeable about climate change and have sufficient evidence of its impacts on their rice-based livelihood. Policymakers, programmers, and planners should consider harnessing farmers' observations, experiences, and local knowledge in coping with and adapting to climate change impacts as significant input for rice-based production resiliency.

Officials of farmer associations like the *Zanjeras* should be involved in the formulation of local CCA programs to be more relevant and responsive to the needs of target clientele in the rice production sector. Likewise, Local government units should continue to support Zanjeras to enhance their adaptive and resilience capacity and strategy to cope with these changes. These can be in the form of the provision of sustained irrigation infrastructure instead of or to complement the temporary traditional "arbeng" or brush dam, augmentation of economic losses, and provision of alternative livelihood to reduce the negative impacts of climate change on their rice-based livelihood.

The program implementers at the LGUs must prioritize incorporating the concept of CC adaptation into existing plans and projects rather than planning new adaptation measures. With this approach, local institutions and associations can utilize resources effectively with existing structures and frameworks to the greatest extent possible.

The recommendations incorporating local observations and adaptation strategies in planning, programming, and policymaking for a resilient rice-based production system in Ilocos Norte are forwarded for consideration by concerned agencies and organizations.

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