

RESEARCH NOTE

Assessment of climate change vulnerabilities of upland vegetable farmers in selected areas in Benguet, Philippines

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ABSTRACT. Farming is the main livelihood of the people of Benguet Province. This makes them highly vulnerable to climate change hazards as their security and safety depend on unstable agro-climatic conditions. Thus, the climate change vulnerabilities of upland farmers must be assessed to better aid them in coping with the worsening scenes. The study aims to identify such vulnerabilities and determine climate change adaptation and coping measures practiced by upland farmers. Policy interventions that may be relevant to eliminate or lessen vulnerability will also be identified. The typical exposure factors identified in Benguet are landslides, erosion, extreme temperatures, and climate events. The province has a sloping, rugged topography, and intensive land tillage or cropping system. This indicates that the area is sensitive to soil erosion and landslides. The area's soil and water conservation practices are not enough to address heavy rains and drought. The adaptive strategies practiced by upland farmers are using drought and water-resistant crops; water-impounding facilities; greenhouse or crop shelter; tree planting; and planting high-value crops, such as coffee, cacao, lemon, and other fruit trees. Through policy review, comprehensive policy actions were recommended and instituted to address identified vulnerabilities, such as tree planting, information drive, and deputization of barangay officials and volunteers to perform environmental functions. Further, it is recommended that the Sangguniang Panlalawigan, Sangguniang Pambayan, and Sangguniang Pambarangay develop forestry policies with the technical assistance of the Department of Environment and Natural Resources. These recommendations are expected to avert disasters while maximizing the usefulness of the lands and, ultimately, support the upland farmers in their livelihood.

Keywords: adaptivity, exposure, mitigation, policy, sensitivity

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INTRODUCTION

It is widely known that climatic patterns are erratic, causing several societal problems. The Philippines is highly prone to climate-related natural disasters like tropical cyclones, floods, and rain-induced landslides (Perez, 2009). He stated that there are observed changes in extreme weather patterns and climate anomalies, such

as rising day and night temperatures, shifting typhoon pathways, sea level rise, and decreasing the number of rainy days. The prevention and reduction of the adverse impacts of climate change have been declared a national policy by issuing the Climate Change Act of 2009 (RA 9729). This law identifies local government units (LGUs) as the frontline agencies in formulating, planning, and implementing climate change action plans

in their respective areas. It mandates them to consider climate change adaptation as one of their regular functions.

Agriculture is vulnerable to climate change hazards as it is highly dependent on the climate. Dar (2012) listed some of the adverse effects on agriculture due to climate change, such as an increase in water scarcity, increased frequency of drought, increased risk of heat or drought stress to crops and livestock, possible change in the length of the growing period, reduced yield due to physiological changes in crops, and reduction in pesticide effectiveness. This is especially true for upland farming areas in the Philippines, such as the Benguet Province.

Benguet is predominantly an agricultural province susceptible to the hazards of climate change. Most of the labor is in the province's vegetable or cut-flower farming (Reyes *et al.*, 2017). These upland farmers are highly vulnerable as they mostly depend on water availability for their cropping system.

While most upland farmers developed their planting calendar based on climatic patterns observed over time, farmers are finding it difficult to predict the start of the rainy season. The country is experiencing longer drought in one year and longer rainy days in another year. The rainy season is mostly accompanied by strong typhoons, heavy rainfall, and floods that destroy crops and properties.

With agriculture being a primary source of livelihood in Benguet, the impact of climate change highly affects activities in this sector. Hence, the climate change vulnerabilities of upland farmers in Benguet must be assessed. Assessment is essential in the analysis of existing policies. This will then identify policy reforms needed to improve climate change adaptation and mitigation in Benguet. This will ultimately support upland farmers, protect the watershed area, and sustain its use.

Hence, the study specifically aimed to: 1) identify climate change vulnerabilities of upland vegetable

farmers in selected areas in Benguet; 2) determine climate change adaptation and coping measures applied by upland vegetable farmers; and 3) evaluate existing policy and regulations to address climate vulnerabilities of upland vegetable farmers in Benguet.

METHODOLOGY

Benguet (**Figure 1**) is comprised of 13 municipalities and one city. The study was implemented in three selected municipalities: La Trinidad, Atok, and Bugias. These areas are considered the salad bowls of the Philippines, as these are the major sources of upland vegetables that supply the requirements of Luzon, particularly Metro Manila.

Moreover, challenges were met in implementing the methods as data was highly dependent on the availability of the respondents and key personnel, the accessibility of some study sites, as well as the natural calamities and hazards that delay travel. These challenges were among the criteria in selecting the study sites aside from the availability of forest lands occupied or tilled by village farmers and the LGU members' willingness to participate in the activity. La Trinidad, Atok, and Bugias were selected since these municipalities passed all criteria. From each of these three municipalities, two barangays were selected: Brgy. Silan and Brgy. Beckel of La Trinidad, Brgy. Cattubo and Brgy. Paoay of Atok, and Brgy. Loo and Brgy. Amlimay of Bugias.

Site description

Benguet Province is one of the six provinces of the Cordillera Administrative Region (CAR). It is the fourth biggest province in the region, accounting for 15.65% of the total land area of CAR. It is predominantly an agricultural province. At least 54% of the labor is in vegetable and cut-flower farming.

Among the three municipalities, Atok has the largest total land area of 21,499 ha with eight barangays, followed by Bugias with an estimated land area of 21,279 ha with 14 barangays, and lastly, La Trinidad, with a total land area of 8,080

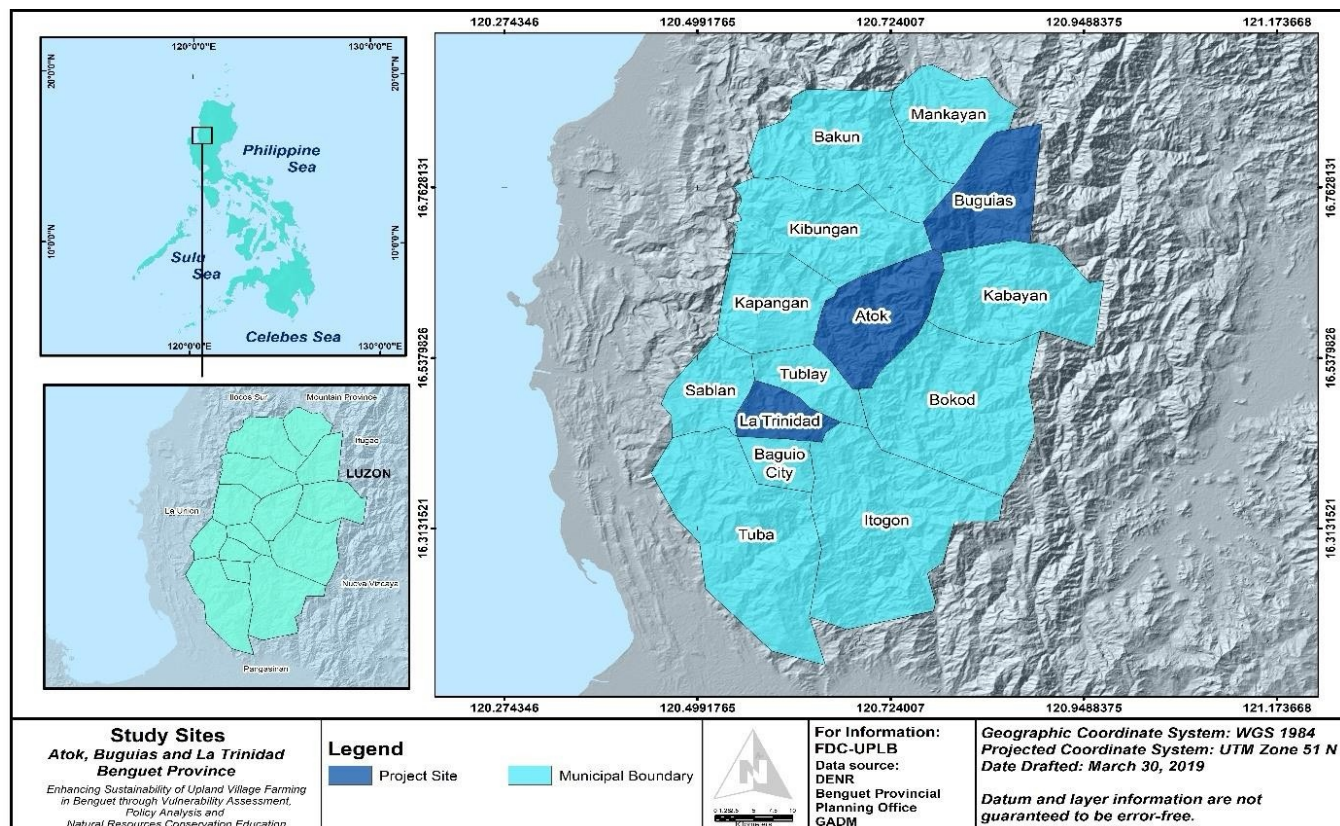


Figure 1. Study sites in Benguet Province.

ha, with 14 *barangays*, and lastly, La Trinidad, with a total land area of 8,080 ha, with 16 *barangays* (La Trinidad Comprehensive Land Use Plan, 2016-2025).

Vulnerability assessment methods

Vulnerability is a function of the character, magnitude, and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity (IPCC, 2007). Data that determined vulnerability were gathered to conduct a descriptive analysis of existing farming practices and crops planted to determine climate change adaptation and mitigation measures applied by the upland vegetable farmers in selected parts of Benguet. The GIZ's Vulnerability Sourcebook was used in the vulnerability assessment (Fritzsche *et al.*, 2017).

The LGUs provided a list of farmers in the *barangays* from the selected municipalities. From the provided list, participants were selected based on their accessibility and availability.

Site visits, household interviews, key informant interviews (KIIs), and focus group discussions (FGDs) with farmers, local government units (LGUs), the Department of Agriculture (DA), and the Department of Environment and Natural Resources (DENR) were done. Secondary data or reports, such as the Comprehensive Land Use Plan (CLUP), Local Climate Change Action Plan (LCCAP), Forest Land Use Plan (FLUP), Disasters Risk Reduction Management Plan (DRRMP), and Environmental Code and policy issuances, were analyzed as a basis for the primary data.

The information gathered to determine exposure to climate change, such as temperature, rainfall, and extreme climate events, was collected from Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA), KIIs, and FGDs.

The sensitivity element determines the degree to which a system is adversely or beneficially affected by a given climate exposure. Data or information assessed to evaluate the sensitivity element were data on a natural or physical event, such as slope or topography, the capacity of different soil types to resist erosion, and land cover type. Other data that determined sensitivity were on societal events or human activities, such as cropping systems, tillage, market, and water management. Both information on biophysical and societal components were gathered from PAGASA, DENR, Bureau of Soils and Water Management (BSWM), KIIs, and FGDs.

Adaptive capacity was measured in terms of how the upland vegetable farmers adjust to the potential impacts of climate change. To evaluate this vulnerability, data or information on technology, availability of adaptive strategies or technologies to address climate change impacts (*e.g.*, drought-resistant species, flood-resistant crops, fire-resistant species, and water conservation technologies), institutions, disaster risk preparedness of LGUs, early warning systems, research institutions on climate change, zoning, and climate change adaptation plan were gathered and assessed.

Policy evaluation

Relevant and related national and local policies on climate change adaptation, mitigation efforts and natural resources management, and all available policy issuances on the study sites have been compiled and collated for content and process analysis. A recommendation of policies and identification of issues, concerns, and problems were accomplished after compiling and analyzing necessary data.

RESULTS AND DISCUSSION

Vegetable farming and flower production are the respondents' primary occupations (Table 1). In Atok and Buguias, almost all respondents were engaged in vegetable farming, comprising 65% and 90% of the respondents, respectively. The vegetables grown by the respondents include mustard, spinach, lettuce, cabbage, broccoli,

sayote, pechay, carrots, and potatoes. Strawberries were also cultivated by farmers in La Trinidad. The temperate climate in the three areas is ideal for agricultural production.

Cut flower production in La Trinidad is a major source of livelihood. In La Trinidad, more than half (58%) of the respondents were engaged in cut flower production, while 30% were involved in vegetable farming. Agricultural production data from the Municipal Agriculture Office shows that in 2015, cut flower production reached 18,546,965 Mt, surpassing vegetable production (16,108 Mt). Among the popular cut-flowers produced were Malaysian mums, aster, anthurium, alstroemeria, and rose. Coffee production amounted to 29,250 Mt, while strawberry production had 3,135 Mt.

The respondents have been engaged in farming for an average of 17.8 yr. The total household income of the respondents in the three municipalities ranged from PHP 19,000 to PHP 2,160,000, with an average of PHP 306,328 yr⁻¹. Among the three sites, Atok has the highest average annual income of PHP 390,474, while Buguias has the lowest average income of PHP 209,346 yr⁻¹.

Hazards experienced by upland vegetable farmers

Typhoons frequently hit the CAR from June to November during the rainy or wet season. These typhoons brought more rainfall, which caused rain-induced landslides in the region and the municipalities of La Trinidad, Atok, and Buguias in Benguet. The climate in the three municipalities is typical of the first type of climate under the Coronas Classification System, with rainy days from May to October followed by dry spells from November to April in La Trinidad, dry from November to April, and wet from May to October in Atok, and dry season from the December to April and wet season during the rest of the year in Buguias.

Steep mountains and high terrain characterize the topography of the sites. La Trinidad's valley floor elevation is 1,300 m above sea level (m asl). The

Table 1. Occupation of respondents from the three municipalities.

Item	La Trinidad (n=27)		Atok (n=26)		Buguias (n=26)		Total (n=79)	
	No.	%	No.	%	No.	%	No.	%
Vegetable farming	11	30	24	65	26	90	61	60
Flower production	21	58	6	16	0	0	27	26
Employment (Local/abroad)	1	3	3	8	2	7	6	6
Livestock raising	1	3	1	3	0	0	2	2
Others:								
Beekeeping	1	3	0	0	0	0	1	1
Store	1	3	1	3	0	0	2	2
Carpentry	0	0	2	5	0	0	2	2
Food vendor	0	0	0	0	1	3	1	1
Total	36	100	37	100	29	100	102	100

lowest is 500 m asl, while the highest is 1,700 m asl. Amidst the mountain peaks is an approximately 350-ha valley. Atok is predominantly upland, while the remaining 63% covers steep mountain slopes. Buguias has a characteristically rugged and mountainous topography with elevations ranging from 1,300 m to 2,819 m asl.

Due to the rugged topography, geologic composition, and extreme rainfall climate, it is highly vulnerable to geologic hazards, such as landslides, erosions, and ground movements. The Mines and Geo-Sciences Bureau (MGB) studies show that the three municipalities are susceptible to rain-induced landslides, especially in steep slopes where residential developments occurred and as identified in their municipal hazard maps. The province is vulnerable to soil erosion, with at least 16.59% of the total land area expected to experience severe erosion. Almost half, or 46.94% (140,522 ha) of the land is classified under slight erosion, while 31.89% is classified under moderate soil erosion.

Based on the household interviews conducted in Atok, Buguias, and La Trinidad municipalities, all 78 farmer respondents claimed that they were affected by climate change. The effects or hazards that these farmers experienced were recorded in their municipalities' respective management plans (Table 2).

Typhoon is the primary hazard in the three municipalities. Rainfall data from PAGASA shows that La Trinidad had lower annual rainfall of 111 mm in 2012 compared to the 30-year average from 1971 to 2000 which is 3877.8 mm. This was due to the La Niña and El Niño phenomena. Also, La Trinidad has a relatively cool temperature, with a mean average of 15°C. For the last five years, the average minimum temperature has been at 14.68°C while the average maximum temperature is at 23.6°C.

Large amounts of rainwater-induced landslides destroy crops, houses, and infrastructures, affect transportation and mobility, and negatively affect economic and social activities. Also, many farm lots were destroyed and carried off by flood waters.

La Trinidad and Buguias are also susceptible to flooding. During heavy rains, the Balili River in La Trinidad and its tributaries are filled up with silt from the erosion of slopes from the mountainsides, which causes the water bodies to swell and flood the valley area along the banks of the Balili River and its tributaries downstream. The Agno River in Buguias, where the Loo Valley is located, stretches from Barangay Bangao down to Baculongan Norte, passing through Barangay Loo and Buyacaoan. This valley is susceptible to flooding, particularly during heavy rains and typhoons, as landslides occur along mountain slopes.

Table 2. Hazards experienced in La Trinidad, Atok, and Buguias municipalities, according to their LCCAP and DRRMP.

La Trinidad	Atok	Buguias
· Landslides brought about by continuous rain/typhoon · Floods brought about by continuous rains/typhoons · Earthquake · Forest fire · Drought	· Landslide · Typhoon · Earthquake · Drought · Hailstorm	· Rain-induced landslide/sinking · Flooding · Strong winds · Landslide · Rupture/Shaking · Scarcity of domestic water supply · Scarcity of irrigation supply · Pest and diseases outbreak · Wildfire/Forest fire

Hailstorm is one unique hazard that can be observed in Atok since it has the highest elevation among the three municipalities (the highest elevation is 2,255 m asl). The temperature is generally cold, ranging from 15 to 20 °C, with December to January recording the coldest temperatures (Atok Local Climate Change Action Plan, 2017). During the year's cold months, the municipality experiences very low temperatures reaching 9 °C. This causes frost to settle on the ground resulting in millions of damages to crops but drawing tourists to the town. The community of Buguias, particularly the farmers, has experienced a decrease in water supply for irrigation and domestic use.

Effects of climate change on farming

The following are the effects of climate change on their crop production: 1) lower income, 2) lower volume of harvest, and 3) damages to crops and flowers. These three effects of climate change on farming are interrelated. Damaged crops and flowers due to climate change have resulted in a lower harvest volume and income (**Table 3**).

The FGD results showed the climate change effects on farming: 1) limited and unpredictable water supply due to drought and prolonged rainy season; 2) flooding, which resulted to damage of their farms; 3) landslides and soil erosion which affected their farm soil fertility; and 4) existence of pests and diseases in the area.

Effects of climate change on community and family

Overall, climate change affected the income of Atok and Buguias respondents due to its effects on their crops. Respondents from La Trinidad cited that climate change has affected their health. The number of sick people increased due to more diseases brought about by the extreme change in weather conditions. The decrease in food availability ranked second in the overall effects of climate change experienced by the community and families in La Trinidad and Atok. In Buguias and Atok, damaged roads were ranked second due to frequent landslide occurrences (**Table 4**).

Climate change adaptation strategies practiced by upland vegetable farmers

The effects and hazards of climate change are experienced by all the respondents, as discussed above. Further, the hazard and vulnerability maps were posted in their barangays. Despite the common knowledge of the farmers and residents of their community's highly vulnerable and hazardous areas, they are reluctant to leave as they do not want to abandon their houses and livelihoods. The respondents said that they resort to prayers for their safety. **Table 5** shows the vulnerabilities of the farmers and residents and the corresponding strategies practiced in coping and adapting to the identified vulnerabilities.

In a study conducted by Parao *et al.* (2016), the hazards experienced in Poblacion and Puguig, La Trinidad, Benguet are typhoons, landslides, frost, strong winds, El Niño, La Niña, hailstorms, intense rainfall, flooding, and pests. With these hazards, coping strategies must be applied to sustain the farmers' livelihoods. To address these hazards, coping strategies, such as tunneling, tree planting, water harvesting, hilling up, irrigation, mulching, watering, construction of diversion canals, and spraying fungicides, are practiced respectively.

The recommended list of crops by the regional office of DA-CAR suitable to withstand the climate change effects in Benguet is commonly planted by farmers. However, it has been observed that the recommended timing of planting is not being practiced due to traditional practices and market

Table 3. Effect of climate change on farming.

Item	La Trinidad (n=27)		Atok (n=26)		Buguias (n=26)		Total (n=79)	
	No.	%	No.	%	No.	%	No.	%
Farming practices affected by climate change?								
Yes	27	100	26	100	26	100	79	100
No	0	0	0	0	0	0	0	0
Total	27	100	26	100	26	100	79	100
Effects on farming								
Lower income	19	38	23	32	26	37	94	36
Lower volume of harvest	20	40	25	35	22	31	89	34
Crop damage/flower damage	11	22	23	32	23	32	80	30
Total	50	100	71	100	71	100	263	100

demand. The following are water-tolerant crops and their recommended planting months: 1) broccoli (October to December; May to June); 2) cabbage (April to June, October to December); 3) eggplant (November to January); 4) garlic and onion (November to January); 5) carrots (July to December); 6) lettuce (October to December), 7) sayote (May to June, November to January); and 8) cauliflower (October to December, June to July).

The priority programs and projects addressing the effects of climate change hazards were also identified through the provincial DRRMP and municipal LCCAP, CLUPs, and local DRRMP. These programs and projects (**Table 6**) reflect the coping or adaptation strategies to be implemented at the provincial and municipal levels in response to climate change.

Policy evaluation

National and provincial level

In response to the global concern about climate change, the Philippine government enacted Republic Act (R.A.) No. 9729, otherwise known as the Climate Change Act of 2009. Further, R.A. No. 10121, or the Disaster Risk Reduction and Management Act of 2010, emphasizes the institutionalization of arrangements, strategies, programs, and activities by LGUs to deal with disaster risks and climate change impacts.

R.A. No. 9729 created the Climate Change Commission (CCC) to formulate the Framework Strategy and Program on climate change at the national level. The framework will be based on climate change vulnerabilities, adaptation needs, and mitigation potential, all in accordance with international agreements. This Act further mandates the CCC to formulate the National Framework Strategy on Climate Change 2010-2022. This framework strategy is committed to ensuring the adaptation of our natural ecosystem and human communities to climate change. This will serve as a guide to preparing the Provincial Development Plans, Provincial Physical Framework Plan, and at the local level, the Comprehensive Land Use Plan and Comprehensive Development Plan. The Framework shall also serve as a basis for preparing the NCCAP, a key component for developing the LGUs' LCCAP.

These laws provide, among others, LGUs as frontline agencies in formulating, planning, and implementing climate change action plans in their respective areas. The formulated LCCAP shall be consistent with the provision of the Local Government Code (R.A. 7160), the Framework, and the NCCAP. It enhances inter-local government unit collaboration in the conduct of climate-related activities.

Table 4. Effects of climate change on community and family.

Items	La Trinidad (n=27)		Atok (n=26)		Buguias (n=26)		Total (n=79)	
	(n=27)	%	(n=26)	%	No.	%	No.	%
Increase in the number of sick people/more diseases	18	43	14	18	12	16	44	22
Decrease in food availability	9	21	20	26	9	12	38	24
Less income/money for expenses	2	5	22	28	27	35	51	26
Yellowing of leaves of plant/plants are destroyed	5	12	0	0	3	4	8	4
Roads are damaged	4	10	20	26	15	19	39	20
Lower harvest of flowers/crop	1	2	0	0	4	5	5	3
Pests and diseases of plants	1	2	0	0	0	0	1	1
Too much heat causes flowers to bloom even if still small	1	2	0	0	0	0	1	1
When the temperature is low, flowers have difficulty to bloom	1	2	0	0	0	0	1	1
Increase in natural disaster	0	0	0	0	1	1	1	1
Change of jobs	0	0	0	0	3	4	3	2
Increase of migration	0	0	0	0	1	1	1	1
No employment	0	0	2	3	1	1	3	2
Threatens purity of water	0	0	0	0	1	1	1	1
Total	42	100	78	100	77	100	197	100

Table 5. Effects of climate change on community and family.

Vulnerability	Adaptation strategy
Changing rainfall patterns	Tree planting, alternative livelihood, change of crops or concentrate on crops that withstand climate change effects, construction of greenhouse and crop shelter, adjustment of cropping calendar
Extreme hot and cold temperatures	Change of crops or concentrate on crops that withstand climate change effects, adjustment of cropping calendar
Unpredictable strong typhoons, winds, and monsoon rains	Change of crops or concentrate on crops that withstand climate change effects, construction of greenhouse and crop shelter
Drought and water scarcity	Water impounding, rainwater harvesting
Drastic temperature changes	Change of crops or concentrate on crops that withstand climate change effects
Flood occurrence	Tree planting, planting of bamboo, riprapping
Landslide	Riprapping, IEC, early warning system
Low level of soil fertility	Crop rotation, no mono-cropping practices, use of chicken dung as fertilizer, organic farming
Pests and diseases	Change of crops or concentrate on crops that withstand climate change effects, construction of greenhouse and crop shelter, a local ordinance prohibiting the use of inorganic pesticides
Forest fire	Tree planting, IEC, fire brigade, local ordinance

In Benguet, Resolution No. 02-2016 was signed by the Sangguniang Panlalawigan, otherwise known as "A Resolution Approving the Updated Provincial Disaster Risk Reduction and Management Plan (PDRRMP), CY 2013-2017." The PDRRMP embodies the strategies, programs, projects, and activities consistent with the mitigation, preparedness, response, and rehabilitation pillars of disaster risk reduction and management and climate change adaptation

action plan, including a contingency plan and an Incident Command System consistent with standard operating in every scenario. Considering that the province of Benguet has adopted the PDRRMP, La Trinidad, Atok, and Buguias municipalities prepared their LCCAP.

Municipal level

In line with the LCCAP of La Trinidad, Barangay Shilan prepared its DRRMP for CY 2017-2020,

approved by the Office of Sangguniang Barangay as Resolution No. 16, Series of 2017. The four-year DRRMP aimed at strengthening its capacity with partner stakeholders to build disaster-resilient communities. This includes institutionalization arrangements and mechanisms to reduce disaster risks, such as projected scenarios, adaptation and mitigation of climate risks, and enhancing disaster preparedness and response capabilities at the community level. Through this, a Barangay Disaster Coordinating Committee was formed.

The Buguias LCCAP (2016 to 2021) was used as a guiding tool by the local climate change managers and community people to mitigate climate change effects and increase the community's resilience. The LCCAP of Buguias identified the different climate change vulnerabilities of the municipality, the disaster risk reduction and management programs, projects and activities, the disaster preparedness and response programs, projects and activities, and the social services key activities and description. To implement the LCCAP, various strategies such as 1) building adaptive capacity; 2) creating of functional climate change adaptation core team and technical working group; 3) setting guiding principles for adaptation; and 4) other support systems were identified.

The Atok LCCAP was patterned from the NCCAP and PDRRMP, which have the following work priorities and target outcomes such as food security, water sufficiency, ecosystems and environmental stability, human security, climate-smart industries and services, as well as knowledge and capacity development. Vulnerability and adaptation assessment covers climate-related hazards and their impacts on the municipality; the elements, sectors, and institutions exposed to climate change hazards; and the exposure analysis and influence diagram. Each municipality created an LCCAP with policies on conserving and protecting environmental and natural resources and climate change adaptation and mitigation strategies. However, about 45% of the respondents said that the barangay officials implemented these policies. Each municipality created an LCCAP with policies on conserving and protecting environmental and natural resources

and climate change adaptation and mitigation strategies. However, about 45% of the respondents said the barangay officials implemented these policies. Moreover, according to field interviews and the household survey, few respondents knew these policies (**Table 7**). Some answered that the barangay-level policies were implemented by the national government, DENR officials, private forestland owners, Philippine National Police (PNP), and LGUs.

All respondents from La Trinidad know policies and local ordinances related to the conservation and protection of natural resources (Table 7). Buguias and Atok (73%) respondents answered negatively. All the respondents from La Trinidad knew about the policy on the logging ban. Atok respondents have knowledge of the following policies: 1) bantay gubat; 2) road landscaping; 3) patrol of forest areas; 4) proper waste disposal; 5) kijowan (Ibaloi practice on conservation); and 6) existing national policies.

The following local ordinances were recommended by the key informants to address climate change adaptation and mitigation: 1) plant trees and protect the environment; 2) stop illegal logging activities; 3) stop burning the farms after harvest; 4) educate the young generation the importance of maintaining the environment biodiversity; 5) practice waste segregation; 6) establishment of drainage system; and 7) strict implementation of policies for compliance of all.

Based on the FGD results, the following policies were recommended: 1) adoption of alternative energy sources; 2) enactment of the local ordinance on climate change; 3) practice of agroforestry system/reforestation; 4) adaptation of organic agriculture; 5) cancellation and discontinuing the issuance of land title or tax declaration in watershed areas and communal forests; 6) use of crops that are suited to drought and periods of La Niña; and 7) provision of enough budget/funding in the implementation of environmental programs.

Table 6. Priority programs and projects based on the study sites' LCCAP and CLUP.

Buguias	Atok	La Trinidad
1. Production support services • Promotion of good agricultural practices, good manufacturing practices, and organic agriculture • Farmers' training • Establishment and maintenance of technology and demonstration farms • Maintenance of composting facilities • Maintenance and operation of soils laboratory 2. Enhancement of production through support activities • construction of greenhouses • farm mechanization • multi-tiller hand tractor • grass shredders/chopper • purchase of Micro Tiller • coffee post-harvest equipment (depulper, dehuller) 3. Promotion and development of Organic Agriculture • establishment of soil and organic farm inputs laboratory • establishment of the composting center and vermiculture facilities with equipment (grass shredder, etc.) 4. Extension, support, education, and training services • support to Municipal Agriculture and Fishery Council and • support to JAEC projects on SAVERS technology	1. Production support services • Procurement and distribution of planting materials/seeds/seedlings • Production and distribution of planting materials • Establishment of production support facilities • Greenhouses • Nurseries • Seed potato storage • Farm machinery and equipment 2. Research, Extension Support, Education, and Training • research/technology dissemination • crop protection • soil and water conservation • Organic agriculture • Good agricultural practices • support to the nutrition program • safe vegetable project and marketing resources • market promotion and development • credit facilitation • Rural Based Organization (RBO) strengthening • Farmer's Information and Training Service (FITS) Center • sisterhood program/ young farmers exchange program 3. Plan and policy formulation, advocacy, and M&E • Planning and information services • Support to agricultural-related council activities 4. Agri-infrastructure support services Validation/Provision/Establishment • Irrigation facilities • Production support facilities • Farm-to-market roads • Postharvest and processing facilities Other infrastructure support facilities	1. Construction of overpass and flyover Kilometer 5 and Buyagan National Road Junction 2. Improvement of alternate roads 3. Improvement of La Trinidad drainage system (Valley Floor) 4. Comprehensive La Trinidad Sewerage and Septage System 5. Comprehensive rehabilitation of the Balili River 6. Pico-Capjaran-Toyong- strawberry farm-Bugayan access road 7. Eco-tourism development and protection of watersheds/communal forests (Poguis, Alapang, Alno, Shilan, and rehabilitation of Busol Watershed) 8. Diversion Road (along Balili River) 9. Km5- Tebteb, Balili- Tawang Road 10. DOST- Cruz Bypass Road 11. Comprehensive Flood Control System for La Trinidad Valley 12. Bineng-Tuel (Tublay)-Alno Road 13. Eviction of illegal occupants within the municipal lots, barangay cemeteries, and communal forests/watersheds 14. Construction/Establishment of Municipal Abattoir 15. Construction/Establishment of multi-level parking 16. Automated guided transit 17. Renewable energy/ waste to energy for SWM

CONCLUSIONS AND RECOMMENDATIONS

The vulnerability of the Benguet province was assessed, and the typical exposure factors identified are landslides, erosion, extreme temperatures, extreme climate events such as heavy rain and typhoons, and drought. The salient hazard of climate change felt in the province through its effects on their community, family, and farming was the extreme weather condition or climate events.

The province is characterized by sloping and rugged topography and intensive land tillage or cropping system; thus, it is sensitive to soil erosion and landslide. Moreover, most farmers are engaged in crops and cut flower production. Their farms are mostly located in sloping and steep areas, making them vulnerable to such hazards. The area's soil and water conservation practices are not enough to address heavy rains and drought.

Table 7. Knowledge of policies and local ordinances related to the conservation and protection of natural resources.

Item	La Trinidad (n=27)		Atok (n=26)		Buguias (n=26)		Total (n=79)	
	No.	%	No.	%	No.	%	No.	%
Knowledge of policies?								
Yes	27	100	7	27	0	0	34	43
No	0	0	19	73	26	100	45	57
Total	27	0	26	100	26	100	79	100
Kind of policies								
Log ban	27	100	0	0	0	0	27	79
Bantay gubat	0	0	1	14	0	0	1	3
Road Landscaping	0	0	1	14	0	0	1	3
Patrol forest areas	0	0	1	14	0	0	1	3
Proper waste disposal/management	0	0	2	29	0	0	2	6
Kijowan	0	0	1	14	0	0	1	3
National policies	0	0	1	14	0	0	1	3
Total	27	100	7	100	0	0	34	100
Knowledge of who implements this policy								
National government	16	37	0	0	0	0	16	31
Barangay official	17	39	6	86	0	0	23	45
DENR/Foresters	9	20	0	0	0	0	9	18
Owner of the forest/land	1	2	0	0	0	0	1	2
PNP	1	2	0	0	0	0	1	2
LGU	0	0	1	14	0	0	1	2
Total	44	100	7	100	0	0	51	100

To address the climate change vulnerabilities of the upland farmers in Benguet, the following adaptive strategies were employed: use of drought and water-resistant crops or species; water impounding facilities; greenhouse or crop shelter, planting of high-value crops, such as coffee, cacao, lemon, and other fruit trees. The three municipalities' provincial DRRMP, the LCCAP, and CLUP also state coping and adaptation strategies to address climate change. Through the policy evaluation, it is found that the three municipalities were equipped through their provincial and local plans. However, the implementation of the plans and knowledge and awareness of the farmers should be strengthened.

Based on the study's findings, it is recommended to 1) institute comprehensive policies and measures to address vulnerabilities. This is to mitigate or avert disasters and reduce the risks

of disasters; 2) conduct tree planting in areas that need rehabilitation as identified by DENR, LGUs, and other concerned offices; 3) conduct information drive (information, education, communication) such as creation or construction of warning signages in hazardous areas in the barangay; 4) deputize barangay officials and non-disabled residents or volunteers by the DENR or Deputized Environment and Natural Resources Officers (DENROs) subject to specific rules and regulations to perform environmental functions, including forest protection; 5) facilitate orientation and training to equip them with the proper authority to apprehend, confiscate and file charges against violators in accordance to DENR Administrative Order No. 2008-22; 6) DENR, LGUs, and PNP including other para-military units shall coordinate closely on forest protection and enforcement of forest laws and regulations.

With the implementation of R.A. 7160, it is recommended that the Sangguniang Panlalawigan, Sangguniang Pambayan, and Sangguniang Pambarangay shall develop forestry policies with technical assistance from DENR. They shall prescribe policies ensuring good governance in forest management through transparency, due diligence and accountability, predictability, and participation of different sectors and stakeholders in the decisions and actions to govern the environment and natural resources.

LITERATURE CITED

- Atok Communal Forest Management Plan Technical Working Group. (n.d.). *Atok Communal Forest Management Plan*. Atok, Benguet.
- Atok Comprehensive Land Use Plan Technical Working Group. (n.d.). *Atok Comprehensive Land Use Plan*. Atok, Benguet.
- Atok Local Climate Change Action Plan Technical Working Group. (n.d.). *Atok Local Climate Change Action Plan*. Atok, Benguet.
- Buguias Comprehensive Land Use Plan Technical Working Group. (n.d.) *Buguias Comprehensive Land Use Plan 2013-2022*. Buguias, Benguet.
- Buguias Local Climate Change Action Plan Technical Working Group. (n.d.). *Buguias Local Climate Change Action Plan 2016-2021*. Buguias, Benguet.
- Buguias Municipal Disaster Risk Reduction Plan Technical Working Group. (n.d.) *Buguias Municipal Disaster Risk Reduction Plan*. Buguias, Benguet.
- Dar, W. D. (2012). *Climate Change Impacts and Adaptation in the Semi-Arid Tropics*. Paper presented at the International Conference on Climate Change Impacts and Adaptation for Food and Environmental Security, SEARCA Auditorium, UPLB, Los Banos, Laguna, Philippines, November 21, 2012.
- Fritzsche, K., Schneiderbauer, S., Bubeck, P., Kienberger, S., Buth, M., Zebisch, M., & Kahlenborn, W. (2017). *Vulnerability Sourcebook: Concept and Guidelines for Standardized Vulnerability Assessments*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Germany.
- IPCC [Intergovernmental Panel on Climate Change]. (2007). *Climate Change 2007: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Parry, M. L., Canziani, O. F., Palutikof, J. P. van der Linden, P. J., and Hanson, C. E. (eds.), Cambridge University Press, Cambridge, UK, 976 p.
- La Trinidad Climate Change Technical Working Group. (n. d.). *La Trinidad Climate Change Action Plan 2016-2025*. La Trinidad, Benguet.
- La Trinidad Comprehensive Land Use Plan Technical Working Group. (n. d.). *La Trinidad Comprehensive Land Use Plan*. La Trinidad, Benguet.
- La Trinidad Disaster Risk Reduction Management Plan Technical Working Group. (n. d.) *La Trinidad Disaster Risk Reduction Management Plan*. La Trinidad, Benguet.
- La Trinidad Forest Land Use Plan Technical Working Group (n. d.) *La Trinidad Forest Land Use Plan*. La Trinidad, Benguet.
- Parao, M., Pablo, J. P., Wagan, A. M., Garcia, J. N. M., & Medina, S. M. (2016). Climate change vulnerability assessment in selected highland areas of Benguet: An application of VAST-Agro Tool. *Mountain Journal of Science and Interdisciplinary Research*. Benguet State University. <<http://journals.bsu.edu.ph/index.php/BRJ/article/view/14/218>>.
- Perez, R. T. (2009). *Climate Change in the Philippines*. Paper presented at the Symposium on the Economics of Climate Change in SE Asia, De La Salle University, November 17, 2009.
- Reyes, C. M., Domingo, S. N., Agbon, A. D., & Olaguera, M. D. C. (2017). *Climate Sensitive Decisions and Use of Climate Information: Insights from Selected La Trinidad and Atok, Benguet Agricultural Producers*, PIDS Discussion Paper Series, No. 2017-47, Philippine Institute for Development Studies (PIDS), Quezon City.