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Assessing the Climate Change Adaptations of Upland Farmers: A Case of La Trinidad, Benguet, Philippines

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ABSTRACT

Adaptation to climate change impacts varies from country to country. It is difficult to capture the concept of adaptations because it includes government policies and the behavior of farmers. Undertaking regional and local assessments of adaptations is still informative because it serves as baseline data for government and other institutions in supporting the needs of the farmers to adapt to the impacts of climate change. Thus, the study aims to look at the institutional supports availed and needed by farmers for climate change adaptation and assess their cost, effectiveness, institutional capacity, and acceptability. Personal interview and Focus Group Discussion complemented by various data gathering techniques was done to provide ample description and understanding of the sources, cost, effectiveness, institutional capacity, and acceptability of the climate change adaptations of farmers in La Trinidad, Benguet. Various institutional supports were given to the farmers but not equally and equitably distributed to the farmers. Almost all of the adaptations were effective, the cost and degree of institutional capacity needed are low but highly acceptable to the farmers.

INTRODUCTION

Climate change represents a key challenge to the sustainability of global ecosystems and human prosperity in the twenty-first century (Byer et al., 2012). They become real threats to the environment and human systems specifically in agricultural production, biodiversity, and health (SEARCA, 2012). In the Global Climate Risk Index, the Philippines ranked 7th among other countries in the world which have been affected most by severe weather-related events over the past years (Kreft & Eckstein, 2014). This poses significant risks for food security in the Philippines, particularly in agriculture (Reyes et al., 2014).

Climate change adaptation is the process of preparing for and adjusting proactively to, climate change to both negative impacts as well as potential opportunities (World Bank, 2007). Adaptation to climate change varies from country to country. Applying adaptation approaches in the context of economic, environmental, and social contributions to uncertainties of the adaptations in the different countries (Yadav et al., 2011). Like most Asian

countries, the Philippines' adaptive capacity to climate change impacts is low while the vulnerability is high. This is largely due to its geographical features, low level of economic development, and exposure exacerbated by poor access to resources (Batani et al., 2013).

Societies have a long record of adaptations to the impacts of weather and climate through a range of practices that include crop diversification, irrigation, and water management (Adger et al., 2007). Asian Development Bank (ADB), enumerated major climate change adaptations components that include the following: changing agricultural practices, changing agricultural water management to promote efficient water use, diversifying agricultural practices to enhance climate resilience, developing agricultural science and technology, agricultural advisory services, and risk management practices and crop insurance (ADB, 2009). It is difficult to capture the concept of adaptations because it includes government policies and the behavior of farmers (Alvi et al., 2020) but it is still informative to undertake regional and local

assessments of adaptations (Hay & Mimura, 2006) because it serves as baseline data for government and other institution in supporting the needs of the farmers to adapt with the impacts of climate change.

Climate change has severely affected the agriculture sector of the Cordillera region that includes the province of Benguet. As a result, climate change adaptation (CCA) measures in agriculture were done by upland farmers (Sandoval & Baas, 2014). Climate change impacts are also currently negatively affecting crop output, water supplies, and farm household economies in the Municipality of La Trinidad, Benguet. To cope up, various local specific adaptations strategies were developed and practiced by the farmers in the municipality (Alfonso & Laruan, 2020). According to Laruan (2011), adaptations should be evaluated in terms of their effectiveness, cost, institutional capacity, and acceptability to the farmers. These factors influence farmer's decisions on what best adaptation strategies to consider. Thus, the study aims to look at the institutional supports availed and needed by farmers in La Trinidad to cope with the impacts of climate change. Also, the aims to assess the cost, effectiveness, institutional capacity, and acceptability of these adaptations to farmers and how it brings changes in their crop production systems, water resources management, and farm household economy.

MATERIALS AND METHODS

The study was conducted in La Trinidad, Benguet, Philippines. Personal Interview and Focus Group Discussion was carried out complemented by various data gathering techniques to provide ample description and understanding of the sources, cost, effectiveness, institutional capacity, and acceptability of the climate change adaptations of farmers in La Trinidad, Benguet concerning their crop production, water resources, and farm household economy. Purposive, convenience, and snowball sampling were used to identify the respondents from the selected barangays. The total

respondents were identified by getting 20 percent of the total number of farm households in the selected barangays (Betag, Pico, Poblacion, and Pico). Respondents were selected based on the following criteria: bonafide residents of the barangay, at least 45 years old, and has 20 years of experience in farming based on the consideration that they are more knowledgeable and experienced in terms of change in climate and farming practices. Purposive sampling was employed to identify key informants based on the following criteria: 15 at least 20 years of service in their offices, knowledgeable of the various programs and projects of various agencies, and at least 45 years old. There was 106 farm household participant, eight (8) key informants coming from different government agencies.

Data gathered from the farm household's interviews were tabulated, classified, encoded, and were presented in appropriate charts. In quantitative analysis, descriptive statistics such as mean, percentage, and frequency were employed. On the other hand, qualitative analysis employed was included in the comparison of findings with theories and review of literature, giving meanings to findings, and finally, deriving new insights from the study. The results of farm households and key-informant interviews, FGD's, field observations, and analysis of secondary data were pooled and synthesized to identify what supports are needed by the farmers that should be supported by the different government institutions and possible funding agencies.

RESULTS AND DISCUSSION

Institutional Supports Availed by the Respondents

Most of the respondents got support from leading government institutions such as the Department of Agriculture (DA), DOLE, and MLGU. Table 1 show that the respondents also obtained assistance from some other private and financial institutions.

Table 1. Institutional supports needed by respondents to cope with climate change.

Institutions	Nature of Supports Needed	Freq.	Percentage
DA	Provision of farm inputs - Seeds - Fertilizer - Pesticide, Insecticide and Fungicide - Wire mesh - Plastics for tunnel & mulch - Power sprayer	96	90.57
	Irrigation Projects - Hose - Portable water pump - Water impounding facilities - Water filtration	75	70.76
	Loans for farm inputs/ Loans for farm capital	58	54.72
	Technical service to farmers - Proper fertilizer and pesticides application - Crop protection	56	52.83
	Control price of farm inputs	50	47.17
	- Seminars and training on farming	48	45.28
	- Control price of crops	13	12.26
DENR	- Distribution of fruit trees	45	42.45
	- Tree planting near water sources	40	37.74
	- Protection of forest	30	28.30
DOLE	- Livelihood projects for farmers	48	45.28
	Provision of farm inputs - Portable water pump - Drums	30	28.30
NIA	Water irrigation projects - Water filtration	72	67.93
	- Water storage facilities	70	66.04
	- Portable water pump	55	51.89
LGU	Provision of farm inputs - Seeds - Fertilizer - Pesticide, Insecticide and Fungicide - Wire mesh - Plastics for tunnel & mulch - Power sprayer	70	66.04
	Irrigation - Water filtration - Water impounding facilities	60	56.60
	Loans for farm inputs/ Loans for farm capital	52	49.06
	Seminars and training on farming	33	31.13
	Financial assistance to older farmers	26	24.53

Among the respondents, the most availed farm inputs; training, seminars, and technical support from the various institutions were grants for services; loans for farm capital and livelihood

projects. One key respondent mentioned that the National Irrigation Project (NIA) and Benguet State University (BSU) are also planning to help with the said water impounding project.

It was noted that irrigation projects are the most common requested support from DA, LGU, and NIA. As mentioned also by respondents and key informants, the conversion also of forest land to commercial and residential establishment had greatly affected the recharging capacity of the different water sources. The key informant also from the LTWD revealed that the deep well stations of La Trinidad are becoming deeper per year as a result of too much withdrawal of water.

The valley is within the municipality of La Trinidad, Benguet which is classified as a first-class municipality. Also, unlike other barangays, Pico, Betag, Balili, and Poblacion are considered urban barangays. This may be the reason why the valley is not the priority of the different agencies for funding supports.

Though it was mentioned earlier that various institutions implemented projects such as grants for farm inputs, training, seminars, and technical services, loans for farm capital and livelihood program were still requested by the respondents. It was also concluded in the study of Reyes et al., (2020) that government institutions should provide low cost-credit so that the farmers in Benguet, Philippines can afford the necessary equipment, materials, and extra manpower that allows them to reduce the adverse impacts of climate change.

Accordingly, respondents availed of these projects in minimal amounts or minimal funding. Other respondents mentioned that these grants are not very helpful because these projects cannot even allow them to cope with the impacts of climate change. It seems that the climate change adaptation of farmers in La Trinidad, Benguet is not solely dependent on institutions but also on their initiatives. The lack of financial support from institutions might hinder the adoption of farmers to what they perceive to be more appropriate and beneficial adaptation as also coincides with the result of the study of Peñalba (2019) on adaptations of farmers in Bulacan, Philippines.

As stated in the report of UNFCCC (2014) without sustained funding, adaptation runs the risk of not being effective, and giving short-term emergency relief is not supportive to sustainable

development. The redundancy of the small-scale services and grants provided by the different institutions have a lesser impact on the enhancement and improvement of the different adaptations performed by the farmers against climate change.

The respondents' adaptations were revealed to be the results of their experiences acquired through years of farming. Though these adaptations are not permanent since climate changes every year or decade. Every farm household employs a distinct combination of adaptations based on their skills and knowledge, capability to access institutional support, financial status, and acceptability of these adaptations. Thus, the adaptation employed by the respondents to cope with the impacts of climate change had been evaluated based on the following factors: effectiveness, cost, institutional capacity, and acceptability to farmers.

Effectiveness of Climate Change Adaptations

Crop production

The effectiveness of adaptations relative to crop production was assessed by the respondents based on the estimated percentage change in the volume of harvested crops (Table 2). Respondents who perceived that their crops had moderately increased in volume are mostly practicing the use of the plastic tunnel, mulching, and those farmers with alternative livelihoods.

Furthermore, a great majority of the respondents (62.26%) mentioned that their new crop production system can cope better with climate change impacts as compared to their previous systems. It was highlighted by respondents and key informants that the use of tunnels had become a big help to farmers since it is less costly and is a highly effective adaptation against intense rainfall and it ensures protection of crops from the rain in summer. This adaptation also is very effective as a protection to the variable onset of summer and rainy seasons. Black polyethylene mulch was mentioned by the respondents as a very effective adaptation as compared to the cogon grasses, they use in the late 1990s. In the year 2000, the use of black polyethylene mulch became popular. It helps in decreasing the evaporation of water from soil at the same time controls the growth of weeds since only crops are exposed to sunlight while the soil surface is totally covered. This adaptation also promotes efficient use of fertilizers being applied on the crops

because it lessens the evaporation of water-based fertilizer applied on the crops. Given the effectiveness of these adaptations, it is important to appropriately evaluate and incorporate these factors

into future adaptation strategies, planning, and budgeting by concerned institutions (Hay & Mimura, 2006).

Table 2. Estimated percent change in the volume of crops produced due to adaptations and assessment of the adaptations to crop production.

Percentage Change in The Volume of Crops Produced	Frequency	Percentage
1-moderate decrease (26-50%)	0	0.00
2-minimal decrease (<25%)	3	2.83
3-minimal increase (<25%)	38	35.85
4-moderate increase (26-50%)	65	61.32
5-high increase (>50%)	0	0.00
Total	106	100.00
Assessment of New Production System	Frequency	Percentage
it is better	66	62.26
same	33	31.13
no better	3	2.83
Total	106	100.00

Water Resources

Most respondents mentioned that the water quantity and quality of the Watershed had been greatly affected by climate change. Thus, various adaptations are being employed by the farmers to increase the availability of water supply in their farms. Overall, the adaptation of farmers on improving water resources is therefore not effective to improve the quantity and quality of their water supply. It was mentioned by the respondents that, if the different concerned agencies will continue to ignore this problem, severe water shortage will be experienced in the future posing significant constraints not only to agricultural production but also on household water supply as supported by one key informant from La Trinidad Water District.

Household economy

Insufficient income is a common problem for almost all respondents. The continuing increase in the price of the farm inputs and the decrease in the volume of crop produced causes lower income to farmers. As mentioned earlier, when there is low income, children’s educational expenses are first

affected followed by farm capital and basic needs. To cope, almost all respondents admitted that they practice different scarcity adjustments to minimize the impacts of climate change on their households. Table 3 shows the increase and sufficiency of income and changes in living conditions due to adaptations employed by the respondents. A great majority (61.32%) of the respondent revealed that their income is sufficient after employing the adaptations. This is attributed to more opportunities for respondents to venture into other sources of livelihood in the area. The Valley is within the center of the first-class municipality of La Trinidad, so more work or livelihood opportunities are present in the area. In addition, La Trinidad is the trading center of all farm products coming from Benguet. This allows farmers to have less cost for transportation of their products and allows them to have choices on how they sell their harvested crops. They can directly sell it themselves to the market, sell it to contractors, or retail it to the tourist if the price of their crops is too low.

Table 3. Increase and sufficiency of income and changes in living conditions due to adaptations employed by the respondents.

% Increase in Income by The Adaptation		Frequency	Percentage
increased by less than 25%		54	50.94
increased by 26-50%		12	11.32
increased by more than 50%		6	5.66
Same		34	32.08
Total		106	100.00
Sufficiency of Income			
Insufficient		32	30.19
Sufficient		65	61.32
More Than Sufficient		9	8.49
Total		106	100.00
Change in Living Condition			
Worse than same		2	1.89
The Same		78	73.58
Much Better		26	24.53
Total		106	100.00

Insufficiency of income is observed among farmers having one farm of 500 square meters of land to cultivate. Farmers with single farmland appeared to be more vulnerable to the impacts of climate change since they have a 50% fail and 50% success chance to hit price upon the harvest of their crops. In the case of farmer respondents cultivating strawberries as major crops, they mentioned that 500 square meters of land are also not sufficient to sustain the needs of their household.

Though many (61.32%) mentioned that their household income is sufficient, most (73.58%) of respondents still revealed that their living conditions are the same. This could be attributed to the concept of Leary et al., (2008) that climate change impacts can never be reduced to zero. The findings also were substantiated by the report of IPCC (2007) that adaptation alone is not expected to cope with all the projected effects of climate change, especially not over the long term as most impacts increase in magnitude.

Cost of Climate Change Adaptations

In every farm household, no less than seven (7) adaptations are being employed to cope with

climate change impacts, thus cost are being compounded. It was noted that many of the respondents spent either medium or high costs on their overall adaptations due to various combinations.

Crop production

The costs of few adaptations were rated differently. In crop production, adaptation such as increasing pesticide, insecticide, and fungicide application, raised crops, mixed and raised crops and tunneling were rated by the respondent costing medium or ranging from 25,000 to 50,000 pesos. While other adaptations such as increasing use of fertilizer, multiple cropping/mix cropping, change crop or variety of crops and increase the frequency of watering were rated low (<Php.25,000). On the other hand, the greenhouse was rated high (Php. 51,000- Php. 75,000) and noted as the most expensive among crop production adaptations (Table 4). The changing of crops as a low-cost adaptation was also observed in Nepal (Dahal et al. (2009); Raut et al., 2011).

Table 4. Individual and overall cost of the of the adaptations on crop production

Adaptations in Crop Production	Individual Cost
1. Increase frequency of watering	Low
2. increased use of insecticides, fungicides, and pesticides	Medium
3. Increased use of fertilizer	Low
4. Multiple cropping/mix cropping	Low
5. Change crop or variety of crop	Low
6. Mini greenhouse “Tunneling.”	Medium
7. Raised beds or plots	Medium
8. Green House	High
9. Mixed cropping and raised beds or plots	Medium

Overall Cost Of Crop Production Adaptations	Frequency	Percentage
1-low (\leq Php.25,000)	5	4.72
2-medium (Php.26,000-50,000)	22	20.75
3-high (Php.51,000-75,000)	71	66.98
4-very high ($>$ Php.75,000)	8	7.55
Total	106	100.00

Water resources. Respondents estimated individually that all adaptation as low (\leq Php. 25, 000) cost except the construction of water storage facilities. The water storage facilities range from low to medium (Php. 26,000-50,000) cost according to the respondents. This is attributed to the kind of

materials used in constructing water storage facilities. Further, almost all (83.02%) of the respondents mentioned that overall, the cost of their adaptation on water resources is low while few (16.98%) stated that their adaptation is medium-cost (Table 5).

Table 5. The individual and overall cost of adaptations on water resources

Adaptation	Individual Cost
1. Deeper irrigation canals	Low
2. Divert water from household wastewater (water cycling)	Low
3. Less frequent watering of crops	Low
4. Secure alternative sources of water or maintain 2 sources of water	Low
5. Observe watering schedule or sharing among neighbors	Low
6. Reduce the volume of water when watering	Low
7. Construction of water storage facilities	Low to Medium
8. Plant drought-resistant crops or shift to other crops	Low

Overall Cost of Water Resources Adaptations	Frequency	Percentage
1-low (\leq Php.25,000)	88	83.02
2-medium (Php.26,000-50,000)	18	16.98
3-high (Php.51,000-75,000)	0	0.00
4-very high (\geq Php.76,000)	0	0.00
Total	106	100.00

Household economy. Respondents individually estimated their adaptations such as scarcity adjustment, loans or engagement to contract to

grow, engagement in short-term wage employment, small scale animal raising, propagation of ornamentals, home gardening, and family will work

to the government or private agency as low cost. On the other hand, adaptations like renting some parcels of land farm, store (sari-sari store and agricultural crops stool), buying and selling of vegetable crops, and producing strawberry products

had been rated by the respondents as low to high cost. Moreover, respondents rated family members working abroad as a very high cost (\geq Php.76, 000) adaptation (Table 6).

Table 6. The individual and overall cost of adaptations on household economy

Household Economy Adaptation	Individual Cost
1. Scarcity adjustment	Low
2. Rent additional parcels of the farm	Low to High
3. Obtain loans or engage in contract growing	Low
4. Engage in short-term wage employment	
a. Work for other farms or contractual laborers	Low
b. Driver	Low
c. Tourist caller for strawberry picking	Low
d. Seller of neighbors not contracted crops	Low
5. Engage in another livelihood	
a. Small scale animal raising	Low
b. Store	Low to High
c. Propagate ornamental	Low
d. Buy and sell vegetables	Low to High
e. Strawberry product producer	Low to High
6. The family will work to the government or private agency	Low
7. Home gardening	Low
8. The family member is working abroad	Very High

Overall Cost of Household Adaptation	Frequency	Percentage
1-low (\leq Php.25,000)	38	35.85
2-medium (Php.26,000-50,000)	55	51.89
3-high (Php.51,000-75,000)	8	7.55
4-very high (\geq Php.76,000)	5	4.72
	Total	106
		100.00

Furthermore, the majority (51.89%) of respondents revealed that their overall household adaptations are medium cost, ranging from Php. 26, 000 to Php. 50, 000. Many (35.85%) mentioned that their adaptations employed are low cost. Only a few (12.27%) mentioned that their adaptations costs are high or very high (Table 6). Respondents with high or very high overall adaptation costs are not necessarily the farmers having various household adaptations but more on the respondents having family members working abroad and farmers having two combinations of household adaptation with one of it is renting some parcels of land to farm.

Since 1990, the Compressive Land Use Plan (CLUP) of LGU La Trinidad, classified Betag,

Balli, Pico, and Poblacion as urban barangays and in 2010 they became major urban barangays. Accordingly, farmer respondents renting land to cultivate in La Trinidad Valley is expensive because of the conversion to built-up areas. This led some landowners to increase the land rental. Some farmers mentioned that bidding is becoming common to farmers since landowners favor farmers willing to pay a larger amount of rent. As discussed earlier, farmer-respondents are more inclined to borrow money from their relatives or neighbors who are financially stable. If relatives or neighbors cannot lend them money they borrow to middlemen or multi-purpose cooperatives.

The majority of the adaptations of the farmer-respondents to cope with the impacts of climate

change are classified as low cost because these adaptations are what they can afford. This result is substantiated by the study of Peras et al., (2008) that cost is one of the factors hindering the adaptation practices of a community. The result is also similar to the study of Zoua et al., (2013) that mentioned that the cost of the adaptation is an important factor considered by farmers for adoption.

Institutional Capacity of the Farmers in Employing Adaptations

The respondents evaluated the degree of needed institutional capacity including the technical feasibility of each climate change adaptation based on the number of formal training and technical assistance needed. Ratings can be low (no or little assistance is needed), medium (at least three), and many (more than three) formal technical training and assistance are needed.

The result in table 7 shows that all adaptations in crop production and water resources employed were classified by the respondents as no or few capacity building and knowledge transfer. It also appears that technological requirements for these adaptations are not sophisticated. As mentioned by respondents, they need financial support and

livelihood projects more than training and seminars to certain technological adaptations.

Older farmers also mentioned that their ability to comprehend these training and seminars are low, so some respondents are not attending seminars and training unless there are give-away for farm inputs during the seminars. Older respondents (24.53%) also mentioned that they need financial assistance more than training and seminars, or if not, possible livelihood projects that are adaptable to seniors. Institutional support also was mentioned by respondents would be more beneficial to them in adapting to impacts of climate change compared to training and seminars. Almost the same observation was observed in the institutional capacity of adaptations in the household economy performed by respondents. All adaptations being practiced by the respondents were based on practicality and skills being obtained by respondents in their years of experiences that were substantiated by the result of the study of Defiesta & Rapera, (2014) on the adaptive capacity of rice farmers in Iloilo, Philippines.

Table 7. Institutional capacity of adaptations in crop production, water resources and household economy

Adaptations	Institutional Capacity
Crop Production	
1. Increase frequency of watering	Low
2. Increased use of insecticides, fungicides, and pesticides	Low
3. Increased use of fertilizer	Low
4. Multiple cropping/mix cropping	Low
5. Change crop or a variety of crop	Low
6. Mini greenhouse “Tunneling”	Low
7. Raised beds or plots	Low
8. Green House	Low
9. Mixed cropping and raised beds or plots	Low
Water resources	
1. Deeper irrigation canals	Low
2. Divert water from household wastewater (water cycling)	Low
3. Less frequent watering of crops	Low
4. Secure alternative sources of water or maintain two sources of water	Low
5. Observe watering schedule or sharing among neighbors	Low
6. Reduce the volume of water when watering	Low
7. Construction of water storage facilities	Low
8. Plant drought-resistant crops or shift to other crops	Low

Household Economy	
1. Scarcity adjustment	
2. Rent some parcels of the farm	
3. Obtain loans or engage in contract growing	
4. Engage in short-term wage employment	
a. a. Work hand in other farms or contractual laborers	Low
b. Driver	Low
c. Tourist caller for strawberry picking	Low
d. Reseller of neighbors crops	Low
5. Engage in other livelihoods	
a. Small scale livestock raising	Low
b. Store	Low
c. Propagate ornamental	Low
d. Buy and sell vegetables	Low
e. Strawberry product producer	Low
6. The family member will work to the government or private agency	Low
7. Home gardening	Medium
8. The family member is working abroad	Low

Acceptability of the Climate Change Adaptations to the Farmers

The acceptability of the various adaptations to the farmers was assessed in terms of the number of adopters. Adaptation was evaluated as low, medium, or high if less than or equal to 15%, 16-30 percent, and more than 30 percent of the respondents adopted it, respectively. Table 8 shows the acceptability of adaptations to crop production, water resources, and household economy by the farmers in La Trinidad Valley.

Accordingly, respondents disclosed that they employ various adaptations to cope with the impacts of climate change. The adaptations were driven by the aspiration of the farmer respondents to improve their living conditions and to provide a better future for their children. It was emphasized by the respondents that any adaptation that will be introduced to La Trinidad Valley is highly acceptable to them and to their community. If these adaptations are low cost, effective, and require low institutional capacity. As La Trinidad Valley becomes more urbanized, customs and traditions are not already the basis of the farmer respondents to accept adaptations.

It was noted that the majority of the adaptations in crop production to cope with climate

change such as increased frequency of watering and other farm inputs, change crop or variety of crop and mini greenhouse were rated highly acceptable. On the other hand, adaptations such as growing crops in raised beds or plots, greenhouses, and mixed and raised beds or plots are rated medium or lowly accepted. Mixed cropping is rated for its acceptability as a medium by the respondents because accordingly this adaptation is not so much effective and don't have enough sale when these crops are harvested considering that the average land area of farmers is only 500 square meter.

For water resources adaptations such as deeper irrigation canals, recycling of household wastewater, less frequency of watering of crops, securing alternative sources of water or maintaining two sources of water, observe watering schedule or sharing among neighbors, reduce volume of water when watering were rated by the respondents as medium or highly acceptable adaptations. Water storage facilities or adaptations were rated low by the respondents which were also observed as medium-cost adaptation and believed that this will not so much improve the quantity of water for farm irrigation.

Table 8. Acceptability of adaptations to crop production, water resources, and household economy by the farmers

Adaptations	Acceptability
Crop Production	High
1. Increase frequency of watering	High
2. Increased use of insecticides, fungicides, and pesticides	High
3. Increased use of fertilizer	Medium
4. Multiple cropping/mix cropping	High
5. Change crop or variety of crop	High
6. Mini greenhouse “Tunneling.”	Low
7. Raised beds or plots	Low
8. Green House	Low
9. Mixed cropping and raised beds or plots	Low
Water resources	
1. Deeper irrigation canals	High
2. Divert water from household wastewater (water cycling)	High
3. Less frequent watering of crops	High
4. Secure alternative sources of water or maintain two sources of water	High
5. Observe watering schedule or sharing among neighbors	High
6. Reduce the volume of water when watering	Medium
7. Construction of water storage facilities	Low
8. Plant drought-resistant crops or shift to other crops	Medium
Household Economy	
1. Scarcity adjustment	High
2. Rent some parcels of the farm	High
3. Obtain loans or engage in contract growing	High
4. Engage in short-term wage employment	High
a. Work hand in other farms or contractual laborers	
b. Driver	
c. Tourist caller for strawberry picking	
d. Seller of neighbors not contracted crops	
5. Engage in other livelihoods	High
a. Small scale animal raising or	
b. Store	
c. Propagate ornamental	
d. Buy and sell vegetables	
e. Strawberry product producer	
6. Family will work to the government or private agency	High
7. Home gardening	High
8. Family member is working abroad	Low

In household adaptations, respondents claimed that their adaptations are highly acceptable even though these adaptations were not being practiced by 30% of the farming community. It was still noted that farmers having a family member working for a government or private agency are the ones having more financial resources and can apply more effective adaptations to improve their lives. In

general, almost all household adaptations except those with a family member working abroad were observed to be highly acceptable.

CONCLUSION

Various institutional supports were availed by the farmers in La Trinidad, Benguet but not all respondents are recipient. Institutional supports

availed are not equally and equitably distributed to or availed by the farmers. The four barangays covered by La Trinidad Valley are all considered major urban barangays. Overall, it seems that different agencies focus more on their funding support to rural areas of La Trinidad. Almost all adaptations were evaluated as effective, the cost and degree of institutional capacity needed are low but highly acceptable to the farmers.

All institutions and agencies that support the farmers should synchronize their projects or programs to address the other social needs of farmers and the ecological aspects of the Valley. In the context of climate change, not only the farmers are affected but also the various support system or elements of the ecosystem. Since all adaptations are low-cost, effective, need low institutional capacity, and are highly acceptable, these adaptations should be sustainably supported by the LGU and DA. The adaptations currently practiced by the farmers should be evaluated to determine their possible detrimental effects on the crops, the farmer, and the environment. In case, the adaptations will be evaluated as detrimental, they should be modified or replaced by a more efficient eco-friendly adaptation.

REFERENCES

- Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit & K. Takahashi. (2007). Assessment of adaptation practices, options, constraints, and capacity. *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 717-743.
- Alfonso, G.P. & Laruan, K.A. 2020. Climate change trends, impacts and adaptation of upland farmers in La Trinidad, Benguet, Philippines. *International Journal Agronomy and Agricultural Researches*, 17(1), 1-15.
- Alvi, S., Jamil, F., Roson, R., & Sartori, M. (2020). Do Farmers Adapt to Climate Change? A Macro Perspective. *Agriculture*, 10(6), 212.
- Batani RS, Napaldet JT, Camfili M, Gapasin M, Ngina KC and Calora FG. (2013). Negotiating Climate Change: Vulnerabilities and Resilience of Four Benguet Communities, *BSU Research Journal*, 69, 15-25
- Byer, P., Cestti, R., Croal, P., Fisher, W., Hazell, S., Kolhoff, A., and Kørnøv, L. (2012). *Climate Change Impact Assessment: International Best Practice Principles*. Special Publication Series No. 8. Fargo, USA: *International Association for Impact Assessment*.
- Chandra, A., McNamara, K. E., Dargusch, P., Caspe, A. M., & Dalabajan, D. (2017). Gendered vulnerabilities of smallholder farmers to climate change in conflict-prone areas: A case study from Mindanao, Philippines. *Journal of Rural Studies*, 50, 45–59.
- Dahal, B. M., Nyborg, I., Sitaula, B. K., & Bajracharya, R. (2009). Agricultural intensification: food insecurity to income security in a mid-hill watershed of Nepal. *International Journal of Agricultural Sustainability*, 7(4), 249-260.
- Defiesta, G. & Rapera, C. (2014). Measuring Adaptive Capacity of Farmers to Climate Change and Variability: Application of a Composite Index to an Agricultural Community in the Philippines. *Journal of Environmental Science and Management* 17(2), 48-62.
- Escarcha, J. F., Lassa, J. A., Palacpac, E. P., & Zander, K. K. (2019). *Livelihoods transformation and climate change adaptation: The case of smallholder water buffalo farmers in the Philippines*. *Environmental Development*, 100468.
- FAO. (2007). *Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities*, Interdepartmental Working Group on Climate Change, Food and Agriculture Organization (FAO) of the United Nations, Rome.
- Gomez, N. (2015). Climate change and adaptation on selected crops in Southern Philippines. *International Journal of Climate Change Strategies and Management*, 7(3), 290–305.
- Hay, J. & Mimura, N. (2006). Supporting climate change vulnerability and adaptation assessments in the Asia-Pacific region: An

- example of sustainability science. *Sustainability Science*, 1(1):23-35.
- Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E., Insarov, R.D. Lasco, E. Lindgren, & A. Surjan. (2014). Asia. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370.
- IPCC. (2013). *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. T.F. Stocker, D. Qin, G.-K. Plattner, M. M. B. Tignor, S. K. Allen, et al. (eds.). Cambridge University Press, Cambridge, UK, and New York.
- Kreft, S., & Eckstein, D. (2014). Global Climate Risk Index 2014: Who suffers most from extreme weather events? Weather-related loss events in 2012 and 1993 to 2012 (*Briefing paper*).
- Laruan KA. Unpublished. Climate Change Impacts and Adaptations among Highland Farming Communities of the Ambuklao Watershed, Benguet Philippines. Unpublished Ph.D. Dissertation. Graduate School, University of the Philippines Los Banos, College, Laguna.
- Lasco, R. D., Espaldon, M. L. O., & Habito, C. M. D. (2015). Smallholder farmers' perceptions of climate change and the roles of trees and agroforestry in climate risk adaptation: evidence from Bohol, *Philippines. Agroforestry Systems*, 90(3), 521–540.
- Lasco, R. D., Pulhin, F. B., Jaranilla-Sanchez, P. A., Delfino, R. J. P., Gerpacio, R., & Garcia, K. (2009). Mainstreaming adaptation in developing countries: The case of the Philippines. *Climate and Development*, 1(2), 130.
- Leary, N., Conde, C., Kulkarni, J., Nyong, A., & Pulhin, J. (2008). Eds. *Climate Change and Vulnerability*. Sterling, VA: Earthscan.
- Peñalba, E. H. (2019). Adaptation to climate change among farmers in Bulacan, Philippines. *The Journal of Rural and Community Development*, 14(2), 1-23.
- Raut, N., Sitaula, B. K., Aune, J. B., & Bajracharya, R. M. (2011). Evolution and future direction of intensified agriculture in the central mid-hills of Nepal. *International Journal of Agricultural Sustainability*, 9, 537-550.
- Reyes, C., Bancolita, J., Leyso, N., & Calubayan, S. (2014). Impacts of Climate Change on Household Food Security in the Philippines. *Food and Agricultural Organization-Community Based Management System*.
- Reyes, C.M., Domingo, S.N., Agbon, A.D., Olaguera, M.C. & Umlas A.L., & Zuluaga, K.C. (2020). "Barriers to Application of Weather and Climate Information in Smallholder Vegetable Farming in Benguet," Discussion Papers DP 2020-14, *Philippine Institute for Development Studies*.
- Sandoval, R. & Baas, S. (2014). *Adapting to Climate Change: The Cordillera Experience, Agriculture and Development Notes*. Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA) 3 (2), Pp. 1-4.
- SEARCA. (2012). *International Conference on Climate change impacts and adaptation for food and environmental security*. Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA), College, Los Baños Laguna 4031, Philippines.
- UNFCC. (2007). *Climate Change: Impacts, Vulnerability and Adaptation in Developing Countries*.
- UNFCCC. (2014). *US Climate Action Report*.
- Yadav SS, Redden R, Hatfield JL, Lotze-Campen H, Hall A. (2011). *Crop Adaptation to Climate Change*, John Wiley and Sons, Ltd., Publication.
- Zoua, X., Li, Y., Cremades, R., Gaoa, Q., Wana, Y, & Qin, X. (2013). Cost-effectiveness analysis of water-saving irrigation technologies based on climate change response: A case study of

China. *Agricultural Water Management*, 129
(2013) 9–20.