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FARMERS' PERCEPTION ON THE IMPACTS OF CLIMATE CHANGE IN MALINAO DAM COMMUNITY, PILAR, BOHOL

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Climate change is considered as one of the pressing environmental issues in the world today, which influences several sectors in the economy, including agriculture. This study analyzes the perception of farmers on the impacts of climate change in Malinao Dam community situated in Pilar, Bohol. Data were gathered in three selected barangays (Estaca, Buena Suerte and San Isidro) from November to January 2014. Mitigating measures and adaptations in response to climate change were also investigated. Eighty percent (80%) of the respondents claimed that they have enough knowledge on climate change, which they mostly learned from their own experiences and observations. Some perceived causes of climate change mentioned by the respondents include burning garbage, cutting trees, burning forest and overpopulation. The main use of Malinao Dam is for irrigation but 90% of the farmers answered that there is no enough water for their rice fields, causing their yield to decrease and their lands to become unproductive. Adaptation measures mentioned include using new rice varieties, construction of water pump systems and planting drought-tolerant crops. Mitigating measures recorded include tree-planting activities, river clean-up, and solid waste segregation programs. Most of the respondents mentioned that the policy direction of the government may focus on continually educating the community about climate change. Furthermore, it is recommended that information drive, awareness campaign and capacity building activities should be done by relevant agencies in the grassroots level to encourage localized actions.

Keywords*:* adaptations, agriculture, Bohol, climate change, mitigating measures

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1. INTRODUCTION

Climate change poses numerous challenges worldwide. Due to the variation and disruption in the global or regional climate systems, it is projected that extreme weather events could increase in frequency and severity for the next coming decades (IPCC, 2012). Agriculture is one of the most vulnerable sectors and is heavily affected by climate change since crop production is directly influenced by climatic conditions (Deressa et al., 2009). Variation in climate patterns could affect crop yields and production costs of farmers, which somehow influence the prices of agricultural products. Somboonsuke et al. (2018) suggested that proactive preparations with due understanding and adaptation capacity are vital to cope up with the possible impacts of climate change.

In the Philippines, recurring crop failures due to frequent climate-related disasters (i.e., typhoons, flooding and dry spells) pushed some farmers to shift from crop to livestock production as a buffer activity to recover from crop losses (Escarcha et al., 2018). Moreover, Shah et al. (2017) indicated some coping and income-generation strategies that were critical responses to crop loss, damage, or unmet household needs resulting from water and non-water related stressors among rice-farming households in Bulacan Province, Central Luzon. Results revealed that the most popular strategies included water substitution, farm labor, planting different crops, remittance flows, construction and industrial labor, and food vending. Furthermore, Shah et al. (2017) highlighted how hope, faith and spirituality collide and articulate livelihood diversification and hard work as important for livelihood resilience.

Sanchez et al. (2012) reported that in rural areas, farmers are likely to inhabit the same area where they were born, thus, their knowledge could be part of a living record of weather variations and patterns. Hence, the integration of views from local people not only help to fill the gap in climate research but also enables the understanding on the social impacts of climate change along with its physical impacts (Savo et al., 2016). Studies focusing on the perspectives of Filipino farmers on climate change are limited. According to Abid et al. (2018), a better understanding of climate change perceptions, existing adaptation patterns and its key drivers is necessary in the development of adaptation policies.

Bohol is the tenth largest island in the Philippines and it is an agricultural province, where 45% of the land area is cultivated for crop production (Bavor & Genson-Torrefranca, 2016). The Wahig-Inabanga watershed, the largest watershed in the island, is one of the most important sources of water for agriculture and domestic use (Olivares et al., 2016). The

upper portion of the watershed is the catchment basin of the Malinao Dam reservoir, which is the convergence point of two major tributaries – the Pamacsalan River in the eastern part and the Wahig River in the south-western side. The dam was designed to serve about 5000 ha of adjoining agricultural land since 1996 (Olivares et al., 2016).

This study investigates the perception of farmers on the potential and existing impacts of climate change in the Malinao Dam community, particularly in the municipality of Pilar, Bohol. Their awareness, knowledge and some of their adaptations in response to this global phenomenon were also explored.

2. METHODOLOGY

The study was conducted in three selected barangays in Pilar, Bohol, namely: Estaca, Buena Suerte, and San Isidro (Figure 1). These barangays depend on Malinao Dam for water supply and irrigation for the rice fields. The main respondents of the study were farmers who served as beneficiaries of the dam. The number of respondents interviewed was determined through random sampling which was 30% of the total number of identified farmers in each barangay.

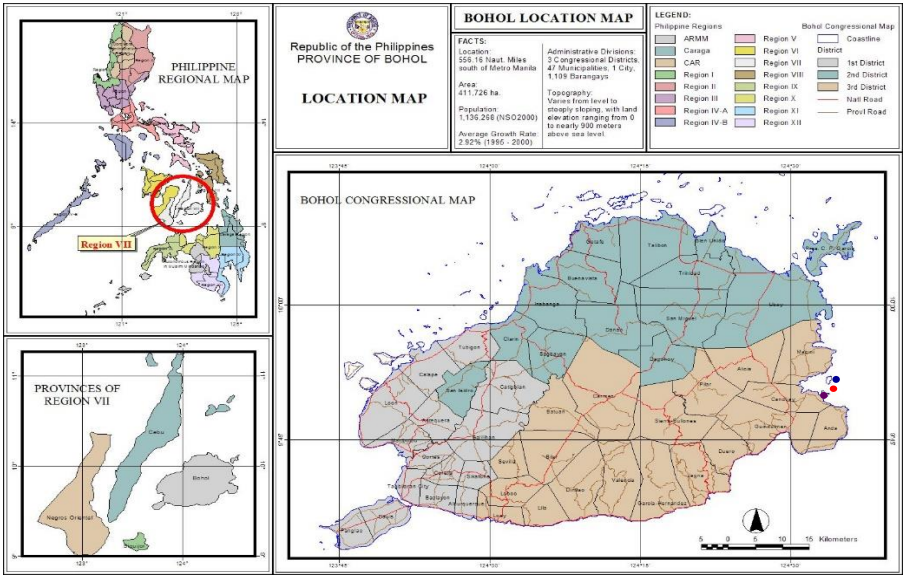

Figure 1. Map showing the three selected study areas in Pilar, Bohol, namely; Estaca (purple), Buenasuerte (red) and San Isidro (blue) (Source: PPDO Bohol)

A semi-structured questionnaire was prepared and used to facilitate in getting the information needed. Prior to the conduct of the study, an initial survey was done for the purpose of ascertaining the desired information to be gathered. It was prepared in English and was translated into vernacular version (Cebuano) for the convenience of the respondents. Data were collated, tabulated and analyzed. Analysis was based on the frequency counts of the responses to each item in the questionnaire.

3. RESULTS AND DISCUSSION

Demographic Profile of the Respondents

The demographic profile contained various characteristics of human population that is essential as an exercise in making generalizations. Table 1 shows the demographic profile of the respondents in the study sites. A total of 170 respondents were interviewed. Based on the data, most of the respondents were 36-45 years old (25.88%). In terms of educational attainment, about 50% reached elementary level, around 36.47% in high school level while around 12% reached college level. The respondents of the survey were composed of 53.5% males and 46.47% females. Based on primary occupation, most of them were farmers (81.18%) while others were plain housewives (12.94%) and storekeepers (5.88%). In terms of household size, 40.59% were composed of 1-3 members while some were composed of 4-6 members (35.88%) and others reached up to 7-9 members (16.47%).

Knowledge on Climate Change

Table 2 presents the respondents' knowledge on climate change. It is good to note that 80% of the respondents had knowledge on climate change, indicating that majority of the respondents were aware of this global issue. In the Eastern Cape province in Africa, Muller and Shackleton (2014) reported that only 48% of commonage farmers were aware of climate change while commercial farmers had higher awareness level. Apparently, the extent of climatic impacts depends on farmers' awareness and their capacity for adaptation in response to changes in the climate (Seriño et al., 2017).

However, 20% of the respondents answered that they do not know what it is all about, which suggests the need for these people to be informed and

educated on this matter. Manalo et al. (2016) suggested that addressing issues relating to climate change requires concerted efforts, which can be done only through proper education of key stakeholders. In the Philippines, the education sector is required by Republic Act No. 9729, known as the Climate Change Act of 2009, to incorporate basic concepts and principles in climate change in the education curricula. With enough knowledge, stakeholders could be motivated to change their behavior towards climate change.

Table 1. Demographic profile of the respondents in the three selected barangays

Profile of Respondents	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Age					
36-45 years old	16	12	16	44	25.88
46-55 years old	12	11	14	37	21.76
56-65 years old	10	11	9	30	17.65
Education					
Elementary level	12	23	39	84	49.41
High School Level	27	29	16	72	36.47
College Level	9	6	5	20	11.77
Sex					
Male	26	30	35	91	53.53
Female	34	20	25	79	46.47
Occupation					
Farmer	50	43	45	136	81.18
Housewife	7	6	9	22	12.94
Storekeeper	3	1	6	10	5.88
Household size					
1-3 members	16	24	29	9	40.59
4-6 members	28	17	16	1	35.88
7-9 members	9	9	10	28	16.47
No. of respondents	**60**	**50**	**60**	**170**	

Table 2. Knowledge of climate change by the respondents

Variable	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Has Knowledge	48	38	50	136	80
Has No Knowledge	12	12	10	34	20
Total	60	50	60	170	100

Perception of the Respondents on Climate Change

According to Vedwan and Rhoades (2001), people's perceptions of climate and the environment are essential in order to understand the adaptive responses of humans to climate change. These perceptions and local knowledge could be the basis of making decisions and strategies in mitigating the impacts of climate change.

Table 3 presents the perception of the respondents with regards to climate change. Data show that most of the respondents answered that climate change refers to the abnormal changes of climate (49.78%) while others answered that it refers to the calamities that we experienced nowadays (30.94%) like strong typhoon, flooding and drought. These results imply that farmers are increasingly conscious of climate change and variability in their locality.

In a related study conducted in Pilar and Danao, Bohol, Lasco et al. (2016) analyzed how farmers, household members, and community leaders in the Wahig-Inabanga watershed perceived climate change and how they valued the roles of trees in coping with climate risks. The study found that the most commonly perceived changes in climate were related to rainfall, increase in temperature and increased frequency of typhoons. Similarly, in a study conducted in northern Ethiopia, farmers revealed their local experience of climate change based on the variability in terms of the onset and cessation time of the rainy season, the decreased number of rainy days, a raise of drought severity, and the increased number of hot days (Kahsay et al., 2019).

Table 3. Respondents' perception about climate change

Variable	Village/Barangay			n	%
	Estaca (n=60)	Buena Suerte (n=50)	San Isidro (n=60)		
Abnormal changes of climate	42	37	32	111	49.78
Calamities	20	5	44	69	30.94
Polluted environment	10	5	13	28	12.56
Natural phenomenon	1	3	11	15	6.73
Total	73	50	100	223	100

*multiple response

Source of Information about Climate Change

Table 4 shows the sources where the respondents get the information and knowledge regarding climate change. Most of the respondents answered that it is based on their own opinion (36.52%), which may imply that they are learning based on what they observed or experienced in their surroundings. These direct experiences may have shaped the farmers' perceptions towards climate change.

Other respondents mentioned television (28.09%) as information source, which may include news, advertisements, movies, documentaries and others. Only 21.91% of the respondents answered that they learned it from school. This could be a good challenge for schools as a learning institution to include topics on environmental issues in the curriculum design as required by the Climate Change Act of 2009. Other information sources mentioned include through attending symposia (9.55%) and listening to radio programs (3.93%).

Table 4. Respondents' sources of information about climate change

Variable	Village/Barangay			n	%
	Estaca (n=60)	Buena Suerte (n=50)	San Isidro (n=60)		
Own opinion	27	19	19	65	36.52
Television	18	11	21	50	28.09
School	11	13	15	39	21.91
Symposium	5	4	8	17	9.55
Radio program	0	3	4	7	3.93
Total	34	31	48	113	100

*multiple response

Similar results were apparent in a study in West Africa, which reveals that personal experience of farmers is the main source of information on climate change and this was followed by radio and advising by extension agents (Nzeadibe et al., 2011). However, in northern Ethiopia, Tesfahunegn et al. (2016) found that a significantly higher number of respondents learned climate change from extension services advising (88%), followed by personal experiences, media mainly radio, agricultural affair exhibition and television.

Respondents' Perception on the Causes and Effects of Climate Change

Table 5 shows the perception of respondents on the causes of climate change. Based on the data gathered, most of the respondents answered that cutting trees (34.70%) and burning garbage (33.44%) are the major causes of climate change while 17.03% answered that it is due to pollution. Others mentioned that burning forests (12.62%) and overpopulation (2.21%) also cause climate change. With more deforestation and burning activities, carbon dioxide levels in the atmosphere will increase, thus, affecting the carbon cycle. It has been reported that carbon dioxide is the most important greenhouse gas that contributes to global warming (IPCC, 2000).

Similarly, in northern Ethiopia, farmers perceived deforestation (93%) and soil degradation (88%) as the main causes of climate change (Tesfahunegn et al., 2016). However, in Nigeria, high proportion of respondents perceived that the use of agrochemicals could cause climate change (Farauta et al., 2011).

Table 5. Perceived causes of climate change according to the respondents

Variable	Village/Barangay			n	%
	Estaca (n=60)	Buena Suerte (n=50)	San Isidro (n=60)		
Cutting trees	38	30	42	110	34.7
Burning of garbage	39	32	35	106	33.44
Pollution	17	19	18	54	17.03
Burning of forest	13	13	14	40	12.62
Overpopulation	1	5	1	7	2.21
Total	108	99	110	317	100

*multiple response

It seems obvious that any significant change in climate would somehow affect our environment, as well as people's lives. Table 6 shows the perceived effects of climate change to the community and the environment in terms of temperature, water supply, vegetation, and farming. This table focused on the respondents who have enough knowledge on climate change as shown in Table 2. Based on the results, 67.65% believed that temperature in the surroundings increased compared to previous years. In terms of water supply, 71.32% said that its level decreased and 72.79% said that planted vegetation decreased in production. Most farmers said that their crop production decreased (53.68%) and others mentioned that their agricultural fields became unproductive (17.65%) due to the decrease of water supply.

In Bangladesh, Alauddin and Rashid (2014) reported that almost all of the farmers perceived an increase in annual and summer temperatures in their areas. In the study of Tesfahunegn et al. (2016), farmers in northern Ethiopia used common indicators of climate change and that include uneven rainfall distribution, rainfall amount, length of rainfall season, rate of erosion, late start of rainy season, temperature, early cease of rainy season, and agricultural output. Moreover, farmers also noted that variability in rainfall and temperature are the main causes for emerging of other indicators such as climate born diseases, pests, drought, and flood conditions.

Table 6. Perceived effects of climate change to the environment and dam community

Variable	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Temperature					
Increase in temperature	45	1	46	92	67.65
The same, no changes	3	37	4	44	32.35
Water supply					
Decrease in water supply	33	32	32	97	71.32
The same, no changes	12	4	18	34	25
Increase in water supply	3	2	0	5	3.68
Vegetation					
Decrease in production	41	30	28	99	72.79
The same, no changes	6	3	20	29	21.32
Increase in production	1	5	2	8	5.88
Farming					
Decrease in production	23	23	27	73	53.68
Unproductive fields	9	9	6	24	17.65
The same no changes	5	1	8	14	10.29
Unstable	5	2	6	13	9.56
Increase in production	6	3	3	12	8.82
No. of respondents	48	38	50	136	

*multiple response

Uses of Malinao Dam and Perceived Impacts of Climate Change

Table 7 presents the uses of Malinao Dam to the community. Based on the data, 85.52% of the respondents answered that the main use of the dam is for irrigation of their rice fields. Some mentioned that aside from irrigation, they also

do some fishing activities in the dam (6.20%) for food consumption while others said that it is used for tourism purposes (8.28%).

Table 7. Uses of Malinao Dam to the community

Variable	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Irrigation	48	38	38	124	85.52
Fishing	9	0	0	9	6.2
Tourism	0	0	12	12	8.28
Total	57	38	50	145	100

Table 8 shows the perceived impacts of climate change in the dam community. The respondents revealed that in terms of farming, 60.96% said that their production decreased while 18.49% mentioned that their fields became unproductive. In terms of irrigation, 90.44% answered that there is no enough water for their rice fields causing their yield to decrease. In terms of fishing, 66.18% answered that their fish catch also decreased. These results imply that if these socio-economic impacts will continue, food resource will be greatly affected which may further threaten the people in the dam community.

Table 8. Perceive impacts of climate change to the community

Variable	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Farming					
Decrease in production	31	27	31	89	60.96
Unproductive fields	7	12	8	27	18.49
The same/ no changes	5	3	9	17	11.64
Increase in production	3	2	3	8	5.48
Unstable	2	0	3	5	3.42
Irrigation					
Not enough water for rice fields	42	35	46	123	90.44
Enough water for rice fields	4	1	2	7	5.15
The same, no changes	2	2	2	6	4.41
Fishing					
Low fish catch	28	32	30	90	66.18
The same, no changes	17	3	15	35	25.74
High fish catch	3	3	5	11	8.09
No. of respondents	48	38	50	136	

According to the Bureau of Agricultural Statistics (2011), about 69% of the 4.3 million hectares of land for rice production in the Philippines is irrigated from deep well pumps, shallow tube wells and water supply via gravity. In the island of Bohol, there are three national irrigation systems, namely; Malinao Dam of Bohol Irrigation System (BIS1) in Pilar; Capayas Irrigation System (CIS) in Ubay; and Bayongan Dam of BIS 2 in San Miguel (Valdivia et al., 2016). However, Malinao Dam has been ineffective in providing equitable water in its own service area due to declining water supply and inefficient water use, which led to low farm incomes and a decline in the total rice production in the province (Lampayan, 2006).

Adaptation Measures done by the Farming Community

Table 9 shows the adaptation measures done by farmers in response to climate change. Most of the farmers use new varieties of crops (34%), especially rice varieties that mature early. Some mentioned that they established pump systems (32%) to have available water for their farms while others planted other crops like corn and sweet potato (9.33 %) because these can adapt to dry conditions.

Table 9. Adaptation measures done by the dam community

Variable	Village/Barangay			n	%
	Estaca	Buena Suerte	San Isidro		
Use new varieties	24	9	18	51	34
Establish pump system	8	22	18	48	32
None	9	4	10	23	15.33
Plant other crops	4	9	1	14	9.33
Wait for rain to come	5	2	7	14	9.33
Total	50	46	54	150	100

In India, farmers changed their farming practices in response to climate change (Tripathi & Mishra, 2017). These practices include changing sowing and harvesting timing, planting short-cycle crops, and inter-cropping techniques. In Thailand, Boonwichai et al. (2018) mentioned some selected adaptation strategies by rice farmers and these include changing planting dates, changing fertilizer application dates and doses, and supplying irrigation water. It was reported that provision of irrigation water was the best strategy to increase yields under long-term climate change scenarios. In China, Huang et al. (2015) reported that adjusting farm management and disseminating warning information as

management strategies from extreme droughts can significantly increase rice yield. Moreover, in the Eastern Himalayan region of India, it was observed that rice farmers were changing transplanting and harvesting timing as a response to water scarcity (Rymbai & Sheikh, 2018).

Philippines does not only confront insufficient water supply but also inequitable water distribution in most irrigation systems, like the Malinao Dam (Valdivia et al., 2016). As farms in the upstream end obtain more frequent and greater volumes of water, inadequate supply remains at the downstream end of the irrigation source (Sibayan et al., 2010).

Valdivia et al. (2016) examined how alternate wetting and drying (AWD) affected the economic aspect of lowland rice farming in Bohol. AWD is a water-saving technology introduced in the Bohol Irrigation System in 2006. The authors found that farmers from the downstream areas had a more reliable water supply after AWD implementation, resulting in a closing of the yield gap between upstream and downstream farmers.

Mitigating Measures by the Dam Community

Table 10 shows some mitigating measures done by the dam community to reduce the effects of climate change in the area. Most of the respondents mentioned that tree-planting activities (44.26%) were done to reduce the impacts. Others answered river clean-up (27.66%) could help lessen the impacts most especially in the watershed. In the northern Philippines, Peras et al. (2008) evaluated the impacts of climate change and the adaptability of local communities in the Pantabangan-Carranglan watershed, which covers the provinces of Nueva Ecija, Nueva Vizcaya and Aurora. It was reported that the long experience of smallholder farmers in coping with the impacts of climate change has allowed them to establish local adaptation strategies, which include reforestation and agroforestry, among others.

According to van Noordwijk et al. (2011), trees play a critical role in reducing vulnerability to uncertain and shifting climates. Trees and shrubs on farms could help overcome biophysical and socioeconomic stresses to farmers by supplying food and alternative sources of income and providing feeds for livestock and shade for crops (Lasco, 2014). Moreover, trees could also serve as windbreaks and shelterbelts, buffer microclimates, modulate water flows, store carbon, provide habitat for plants and animals and serve as corridors (Nguyen et al., 2013).

Table 10. Some mitigating measures done by the dam community

Variable	Village/Barangay			n	%
	Estaca (n=60)	Buena Suerte (n=50)	San Isidro (n=60)		
Tree planting	37	30	37	104	44.26
River clean up	20	27	18	65	27.66
Proper waste disposal and segregation program	25	9	15	49	20.85
None	7	0	10	17	7.23
Total	89	66	80	235	100

*multiple response

Other respondents believed that proper disposal and solid waste segregation programs (20.85%) could be great options. However, 7.23% of the respondents said that they do not have any mitigating measure to lessen the impacts of climate change. This could be an evidence of their lack of concern since they do not have a thorough knowledge of this global problem, thus, proper understanding and awareness of climate change are necessary.

Government Actions to Reduce the Effects of Climate Change

Table 11 presents the actions that the government should do to reduce the harsh effects of climate change according to the respondents. Based on the data gathered, most of the respondents answered that there should be a force implementation of laws (48.07%) like zero-burning-plastic policy in their respective barangays. Others said that people should be educated (22.65%) so that they will understand the causes and impacts of climate change and how they would mitigate these impacts. Some mentioned that people should be encouraged to support pro-environmental movements (9.94%) and there should be information dissemination on climate change (8.84%) in their areas. Moreover, others mentioned that there should be enough funds for some environmental programs (6.63%) in the barangay and corruption should be stopped (1.10%). Some believed that cooperation of everybody (2.76%) is very important to reduce the effects of climate change to the community.

Table 11. Actions that the government should do to reduce the effects of climate change

Variable	Village/Barangay			n	%
	Estaca (n=60)	Buena Suerte (n=50)	San Isidro (n=60)		
Force implementation of laws	31	21	35	87	48.07
Educate the people	17	12	12	41	22.65
Support pro-environmental movements	7	5	6	18	9.94
Disseminate information about climate change	3	6	7	16	8.84
Enough funds for environmental programs	3	4	5	12	6.63
Cooperation of everybody	0	1	4	5	2.76
Stop corruption	0	0	2	2	1.1
Total	61	49	71	181	100

*multiple response

4. CONCLUSIONS AND RECOMMENDATIONS

Understanding local perceptions of climate change among the Malinao Dam community is essential in adopting measures aiming to mitigate the adverse impacts of climate change. The Malinao community is an agricultural village heavily dependent on the dam as their main source of water for irrigation. It is vital that the local community will have clear understanding on the implications of changing climate patterns and variability in their farming system since these will have direct impacts on food security and livelihood in the community.

Results show that most of the respondents in the Malinao Dam community have enough knowledge on climate change but there is a small fraction that does not know about this global problem. Their perceptions on climate change include abnormal changes of climatic patterns, occurrence of calamities and pollution. Knowledge on climate change was mostly based on the respondents' observations and experiences through the years. Other information sources mentioned include television, school, symposia and radio programs. Some perceived causes of climate change were burning of garbage, cutting of trees, pollution, burning of forests and overpopulation. For the perceived effects

of climate change, respondents recognized temperature to be increasing, accompanied by decreased water supply, resulting to low production yield.

Data show that farmers clearly suffered from the negative impacts of climate change, namely, decreased crop production and fields turned unproductive due to water shortage in the irrigation systems. These results may imply that if these adverse conditions will continue, food supply will be affected, thus, threatening food security and livelihood of the local community.

The use of new crop varieties, construction of pump systems to irrigate fields and planting drought-tolerant crops were the major adaptation strategies done by farmers to ameliorate the perceived impacts of climate change. Mitigating measures done by the community include tree planting activities, river clean up, proper disposal and solid waste segregation in the locality.

Results of the study imply that there is a large scope for government and non-government organizations to continue awareness campaign and capacity building activities in relation to measures aiming to reduce the impacts of climate change at the grassroots level. Most of the respondents mentioned that the policy direction of the government may focus on continually educating the community about climate change – its causes and long term effects. Information drive on this issue is better done at the village level and in primary schools so that localized actions can be encouraged.

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