

BIBLIOGRAPHY

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ABSTRACT

The study was conducted to determine the effect of climate change in rice production in Agawa, Besao, Mountain Province. Data were gathered from the farmers of Agawa and at BSU Agricultural- Meteorological Research Station

All of the respondents were aware of climate change. Rice is planted in the study area only once a year. The production practices of the farmers were influenced by the factors such as economic factors, bio-physical, climate change and their preferences.

The common coping mechanisms for the farmers were to change the variety of their crops and to change or adjust their cropping period.

It is therefore recommended that a seminar about climate change and its effects on rice production for the rice producers to improve their production. Varieties of rice that are adapted to climate change should be introduced to the farmers. The farmers should plan their production regarding the changes in weather and temperature then implement it.



INTRODUCTION

Rationale

Rice (*Oryzasativa*) is the principal food for the tropical population, and more than half of the world's population depends heavily on rice for sustenance. It is typically grown in paddy land, which can alternately be irrigated and also drained. Rice also supplies high quality of carbohydrates, protein and sufficient stocks of rice bran feed. In the Philippines, rice is grown throughout the year (IRRI, 1985) and is the major staple food.

Rice is unique among the cereals and the only major crop that can be grown under various degrees of flooding. This plant is able to transport oxygen to the submerged roots from leaves, where oxygen is released during photosynthesis.

The International Rice Research Institute (1983) cited that rice plays an important role in stabilization of the Philippine economy because majority of the Filipinos are farmers.

Besao is one of the municipalities of Mountain Province. Most of the barangays of Besao are planting rice as their main crop. Agawa is one of the barangays of the municipality. 80% percent of the population are rice farmers.

Rice production now is low because of many factors. Climate change is one. Climate change is “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” Because of flooding or droughts, many problems occur in the farm. Soil may crack or erosion happens. Pests and diseases appear.



This study therefore will look into the effects of climate change on the production of rice in Agawa, Besao, Mountain, Province.

Importance of the Study

The result of the study could be used by farmers as a guide in coping up with climate change in their farming. This could also serve as a guide for further research.

Statement of the Problem

1. What are changes in climatic conditions for the past 20 years?
2. Are the farmers aware of climate change?
3. What are the perception /knowledge of the farmers in Besao on climate change?
4. What are the effects of climate change on the following aspects?
 - a. Changes in the agro demographic profile of the study area.
 - b. Changes in the production practices of crops.
 - c. Incidence of pests and diseases and other production problems.
 - d. Changes in yield.
5. What are the strategies/coping mechanisms employed by farmers?

Objectives of the Study

The study had the following objectives:

1. Determine the changes in climate change for the past 20 years.
2. Determine awareness of farmers on climate change.
3. Determine the perception /knowledge of farmers in Besao on climate change.
4. Determine the effect of climate change on the following aspects:
 - a. Changes in the agro demographic profile of the study area.



- b. Changes in the production practices of crops.
 - c. Incidence of pests and diseases and other production problems.
 - d. Changes in yield.
5. Determine the strategies/coping mechanism employed by farmers.

Scope and Delimitation

The study focused on the effect of climate change on rice production in Agawa, Besao, Mountain Province.



REVIEW OF LITERATURE

Climate Change

Climate change is “a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.” - *United Nations Framework Convention on Climate Change, Article 1*

Climate change is one of the most important global environmental issues of our generation. It is distinct from natural climate variability in that it exists because of human activities that have altered the composition of the Earth's atmosphere. Climate change can lead to things such as desertification, more intense storms, melting of the polar ice caps, and rising sea levels, changing the physical face of the Earth and the pattern of our everyday lives. While the possible consequences of climate change are alarming, there are many ways for every individual to take part in preventing these consequences from reaching their most dangerous potential (Ecomii Ecopedia, 2008).

Climate Change and Agriculture

The sector most affected by climate change, so far, is agriculture and food security. The sharpest fall in agricultural productions are experienced during strong El Niño events and after occurrence of severe tropical cyclones. Decrease in agricultural productivity and aquaculture will ensue due to thermal and water stress, sea level rise, floods and droughts, and tropical cyclones would diminish food security in many countries of Asia (Jabines and Inventor, 2007 and Zhai and Zhuang, 2009).



Moisture stress due to prolonged dry spells/droughts in some areas, coupled with heat stress has already been seen to affect crops, especially when these environmental conditions occur during the critical conditions of the crops. On the other hand, excessive moisture could also cause substantial crop losses due to flooding and loss of nutrients and soil erosion.

The predicted changes in temperatures and rainfall patterns, as well as their associated impacts on water variability, pests, disease and extreme weather events are all likely to affect substantially the potential of agricultural production (Zhai and Zhuang, 2009). Increasing temperature amplifies the rate of evapotranspiration, which intensifies stress in crops, particularly in areas with limited water supply. The combined effect of heat stress and drought reduces crop yields. Erratic precipitation patterns affect land preparation and planting times and alter the life cycle of major pests and diseases affecting agricultural crops. Droughts during the El Niño years cause water stress to crops and increase pest and disease infestation. These insects (also acting as pathogens) feed heavily on major agricultural crops rather than the natural vegetation in the surrounding areas. Heavy rains during La Niña years bring severe flooding, massive runoff, and soil erosion, reducing soil fertility and productivity. Rising sea levels amplify soil salinity in many low-lying agricultural areas and even expand the intrusion of sea water into ground water resources and aquifers. Higher sea levels also cause the loss of arable lands in the region (ADB, 2009).

These factors, individually and cumulatively, lead to reductions in agricultural production. Moreover, agricultural productivity will be depressed by increased climate variability and increased intensity and frequency of extreme events as droughts and floods. These factors



further contribute to the difficulties in estimating the impacts of climate on agricultural productivity (Zhai and Zhuang, 2009).

Rice Production and Climate Change

In the chapter “State-of-the-Art Research and Development on the Interface among Rice Production, Water, and Forests” of the book *Rice, Water, and Forests of the Asia Rice Foundation*, the group of Cruz explained that farmers are not just preys of climate change because they, as rice cultivators, are also contributing to this.

While farm yield is decreased due to increased night time temperature associated with global warming, they continued, chances of climate change are also higher because of increased greenhouse gas emissions from rice production. “It seems like we are reaping the effects of our agricultural activities that have contributed to climate change,” (Cruz, 2008). Among these activities is the burning of rice straws and husks that is widely known to produce greenhouse gas methane that results in climate change.

Overview of Rice Production in the Cordillera

The region is famous for its rich cultural heritage and ethnic diversity. However, agricultural productivity, especially rice production, remains dismally low. Despite of this, rice remains the dominant temporary crop.

CAR is also famous for its rice terraces. Traditional rice varieties are grown in the higher elevations and modern rice varieties are grown in the lower elevations. In the highland areas, rice grows in 6-7 months, leaving one cropping a year. Low tillering of grains and tall stalk characterize their rice varieties.

In high elevations, the rice terraces’ land-use system no longer satisfies the needs of the populace because the yield per hectare is very low. Almost 80% of the rice growers



cannot produce enough rice to meet their household consumption requirements throughout the year. On the average, the rice produced by farm -operating households in the high altitude areas is sufficient to meet their requirements for 5.1 months. However, farmers in the lower elevation areas have sufficient supply of rice because they have larger areas of rice cultivation.

The rural household survey conducted by (Delobel and Andam, 1997) revealed that most (90.5 %) of the farm-operating households grow paddy rice. About 79% of the areas are irrigated and 21% are non-irrigated. Irrigated rice terraces are the most important type of land parcels found in the high altitude areas; others include the *kaingin* farms and tree crop fields. Non-irrigated terraces are prevalent in lower to medium altitude areas for vegetable production. Except Benguet, around 82% of the farm operating households have irrigated terraced rice fields for producing rice (CECAP and Philrice, 2000).

Preventing Climate Change

The good thing is that there are ways to mitigate the negative impacts of rice production to the atmosphere to counter the negative repercussions of climate change in rice yield potential, wrote Cruz and his group in the same book.

Other than avoiding or minimizing the activities contributing to greenhouse gas emissions, the group believes that optimizing rice productivity is the best option to prevent yield loss due to climate change, and to mitigate climate change caused by rice cultivation. This opinion was based on the 2002 study of Denier van der Gon et al. It was found that during the five years of successive tropical wet and dry seasons in the Philippines, rice plants with higher numbers of filled grain spikelets, or those that more closely reach their potential yield limits emitted less methane.“But it is best if optimizing rice productivity



will go hand in hand with optimum' use of fertilizers and other inputs," Cruz suggested.

Cruz (2008), also suggested that it is crucial to protect the forest, maintain their watersheds, and have sound decisions before converting forests to rice areas, which can promote more agricultural activities that can lead to climate change due to atmospheric build-up of CO₂.

However, Cruz concluded that "studies on how the rice sector can manage the natural resources as part of an effort to reduce or mitigate climate change are still lacking. But it is better to start with these suggestions now than wait until more Filipino rice farmers experience problems relating to it".



METHODOLOGY

Locale and Time of the Study

The study was conducted in Agawa, Besao, Mountain Province. The study was conducted from October to November, 2011.

Respondents of the Study

The data were gathered from 40 rice growers. The respondents were purposively chosen at random.

Data Gathering Procedure

The study made use of primary and secondary data. Primary data were gathered through survey and interview. A transect walk was done in the study area to describe the micro niche and landscape of the area and observe some changes which maybe validated with the respondents through key informant interview. Data were validated on the collection period of questionnaire. Secondary data were taken from BSU Agricultural-Meteorological Research Station.

Data Gathered

The data gathered were the weather changes, physical features, production methods, planting practices and awareness and knowledge of farmers in climate change.

Data Analysis

The data collected were analyzed using frequency and descriptive analysis.



RESULTS AND DISCUSSION

Profile of Respondents

The profile of respondents is presented in Table 1, these include the gender, age, marital status, religion, educational background, and the number of years engaged in rice production.

Age. Table 1 shows the age of the respondents, thirty five percent of the farmers were on the bracket of 41-50 years old. Twenty percent were on the age bracket of 51-60 years old; 12.5% were 61-70 years; 10% were 31-40 years old; 7.5% were 20-30 years old and 7.5% were 71-80 years old. Three respondents were 81 years and above. The mean age was 53. This results shows that age of rice farmers in the area ranges from 41 to as old as more 80 years old. This implies that rice farming is not an attractive livelihood to younger generation. Farming actually is not attractive to young people even for those graduates in agriculture courses.

Gender. As shown in table 1, out of the 40 respondents, 15 were males and 25 were females. This result implies that farming nowadays is not only for men but it is also for women.

Marital status. Most (82.5%) of the respondents were married. One was single and six were widowed.

Religion. Most (82.5%) of the respondents were Episcopalians (Anglican). There were five Protestants, one Seventh Day Adventist and one Sagrada Pilipina Independente.

Educational background. All of the respondents attended formal education. Forty five percent had reached high school level. Four were college undergraduate and two were college graduate. From these result, majority were literate. However, the level of education



is still quite low. As one of the characteristics of farming is that farming is for individuals with limited education.

Number of years engaged in rice production. Majority (52.5%) of the respondents were engaged in rice production for 26 years or more. Some (22.5%) had been growing rice for 21-25 years. Twelve and a half percent had been growing rice for 5 -10 years while 7.5% for 16-20 years. Only one of the rice producers was engaged in production for 11-15 years and one also for less than five years. This shows that the rice farmers in Besao had been in rice production for long time because the major crop grown in the area is rice.

Table 1. Profile of the respondents

PARTICULAR	FREQUENCY	PERCENTAGE
Age		
20-30	3	7.5
31-40	4	10
41-50	14	35
51-60	8	20
61-70	5	12.5
71-80	3	7.5
81-90	3	7.5
TOTAL	40	100

Mean age = 53



Table 1. Continued...

PARTICULAR	FREQUENCY	PERCENTAGE
Gender		
Male	15	37.5
Female	25	62.5
TOTAL	40	100
Marital Status		
Single	1	2.5
Married	33	82.5
Widowed	6	15
TOTAL	40	100
Number of Children		
1-5	22	55
6-10	14	35
11-15	2	5
TOTAL	38	95
Religion		
Protestant	5	12.5
Seventh Day Adventist	1	2.5
Anglican (Episcopal)	33	82.5
Sagrada Pilipina Independente	1	2.5
TOTAL	40	100
Educational Background		
Elementary	18	45
High School	16	40
College Undergraduate	4	10
College Graduate	2	5
TOTAL	40	100
Years engaged in rice production		
Less than 5	1	2.5
5-10	5	12.5
11-15	1	2.5
16-20	3	7.5
21-25	9	22.5
26 and above	21	52.5
TOTAL	40	100
Other sources of income		
Gardening	21	52.5
Animal raising	11	27.5
Labor	9	22.5
Sari-sari store	1	2.5
SSS pension	1	2.5

*Multiple response



Changes in the Weather

Based on the weather data gathered from BSU Agricultural- Meteorological Research Station, there were changes in temperature, the increase was evident on the minimum temperature which had increased from 1990 to 2010 which means that it's getting warmer. This condition is favorable to insect pest. However, the maximum temperature was highest in 1997, which may be interpreted that global warming and climate had started as early as 1990's and there onwards that there were already changes like increase and decrease. As often mentioned by the respondents, the season is changing and unpredictable. Based on the data, the country started to experience La Nina and El Nino in 1990's. Rainfall was lowest in 2008 (2.06mm) then 2.44 mm in 2006 and 2.75 mm in 2007 which means that El Nino was experienced specifically in the Cordillera. Though the average rainfall in 2010 was low, this was the time when Cordillera experienced calamities because of the 24 hours continuous rain.

Table 2. Weather data (1900-2010)

YEAR	RELATIVE HUMIDITY (%)	MAXIMUM TEMPERATURE(°C)	MINIMUM TEMPERATURE(°C)	RAINFALL AMOUNT (MMS)
1990	80.92	23.5	14.95	15.07
1991	-	-	-	-
1992	81.83	23.36	13.66	13.92
1993	85.17	23.53	13.99	9.90
1994	84.92	23.42	13.77	9.39
1995	84.50	23.71	14.24	10.93
1996	84.17	23.92	14.38	8.66
1997	83.83	28.77	13.99	6.56
1998	85.33	24.80	13.12	14.64



Table 2. Continued...

YEAR	RELATIVE HUMIDITY (%)	MAXIMUM TEMPERATURE(⁰ C)	MINIMUM TEMPERATURE(⁰ C)	RAINFALL AMOUNT (MMS)
1999	85.75	23.63	12.32	14.73
2000	85.83	23.88	17.98	6.53
2001	86.67	24.14	15.81	12.19
2002	83.25	23.81	15.03	11.42
2003	-	23.50	14.70	9.92
2004	-	24.04	14.81	14.68
2005	80.17	24.55	19.99	2.75
2006	79.00	25.16	19.31	2.44
2007	82.09	24.61	19.35	6.31
2008	84.19	24.80	19.00	2.06
2009	86.00	24.74	18.99	5.00
2010	86.17	24.54	16.32	9.60

Source = BSU Agricultural- Meteorological Research Station

Awareness in Climate Change.

As presented in Table 3, all the respondents were aware of climate change. Most (92.5%) of the respondents were aware of abrupt changes in temperature. Sixty seven and a half percent were aware on abrupt change in weather condition; 30% were aware in occurrence of super typhoon and 30% were aware on changes in season like prolong dry and wet season. Few were aware of La Nina and El Nino. The result implies that the farmers are observant on the changes happening in the environment.



Table 3. Awareness in climate change

PARTICULAR	FREQUENCY	PERCENTAGE
Are you aware in climate change?		
Aware	40	100
Perception of climate change		
Abrupt changes in temperature	37	92.5
Occurrence of super typhoon	14	35
Abrupt changes in weather condition	27	67.5
Changes in season like prolong dry or wet season	12	30
La Nina	6	15
El Nino	5	12.5

*Multiple responses

Changes in Agro- Ecological Profile

Landscape of the farm. There were 87.5% terraced irrigated and 12.5% terraced unirrigated of the respondent's farm as presented in Table 4. It is expected that the farms were terraced because of the land topography in the study area.

Table 4. Landscape of the farm

PARTICULAR	FREQUENCY	PERCENTAGE
Landscape of the Farm		
Terraced irrigated	35	87.5
Terraced unirrigated	5	12.5
TOTAL	40	100



Changes in farm landscapes from 1990 to present. In Table 5, the change in farm landscapes from 1990 to present to present are presented. Majority (67.5%) of the changes was decrease supply of water. In some (60%) of the fields ripraps were destroyed. Some rice terraces also have eroded. There were 10 irrigated fields that became unirrigated. Two farms easily get flooded and seven easily get dry. Another two fields had soil with low water holding capacity. There was decrease in soil fertility observed in two fields while another two had loam soil that became sandy.

Causes of these changes in landscape. Table 5 also shows the causes of the changes in landscapes. Weather conditions were the most cause of the changes. Landslides in the farm (45%) and of neighbor's farm (45%) also accounts. Other causes were soil erosion (37.5%), soil structure changes from porous to compact (5%), La Nina (10%) El Nino (2.5%) and occurrence of giant earthworms (7.5%).

Table 5.Changes in agro-ecological profile

PARTICULAR	FREQUENCY	PERCENTAGE
Changes in farm landscapes from 1990-2010		
Irrigated field became un irrigated	10	25
Farm easily get flooded	2	5
Farm/soil easily gets dry	7	17.5
Decrease supply of water	27	67.5
Low water holding capacity of the soil	2	5
Rice terraces have eroded	21	52.5
Rip raps are destroyed	24	60



Table 5. Continued...

PARTICULAR	FREQUENCY	PERCENTAGE
Changes in soil type & texture		
Loam became sandy	2	5
Decrease in soil fertility	2	5
Causes of these changes in landscapes		
Weather conditions	34	85
Landslides of neighbor farm	18	45
Soil structure changes from porous to compact	2	5
Soil erosion	15	37.5
Supply of water became scarce because the source (spring/river) dried up	9	22.5
Landslides in the farm	18	45
La Nina	4	10
El Nino	1	2.5
Occurrence of giant earthworms	3	7.5

*Multiple responses

Crop grown in 1990-2010. In Table 6, the crops grown from 1990 to 2010 are presented. The main crop was rice. Sweet potato, vegetables, corn and peanut were planted after the harvest of palay. From the year 1990 to 2000, 85.5% of the farmers planted rice. The other five farmers started planting rice in either 2001 or the following years. Five percent planted sweet potato and 27.5% planted vegetables, eight farmers planted corn and only one planted peanut.



In the year 2001 to 2010, all the respondents planted rice. Fifty seven and a half percent planted sweet potato, 27.5% planted vegetables and 20% planted corn. Only two farmers planted peanut. It was known that aside from rice, other crops (sweet potato, vegetables, corn and peanut) were planted after the main crop to have other source of food.

Number of cropping per year practiced. The respondents planted rice once a year as shown in Table 7, the same for sweet potato, corn and peanut. For vegetables, some planted it twice or once depending on the length of production period.

Source of irrigation. The different sources of irrigation were the rain, irrigation canal, the spring, the creek and the river. Almost all of the rice produces source their irrigation from irrigation canal. Thirty three respondents source their irrigation from the river; others are spring and creek (11 on spring and 2 on creek). Only two respondents source their irrigation from the rain.

Table 6. Crops grown in 1990-2010

CROPS	1990-2000		2001-2010	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Rice	35	87.5	40	100
Sweet potato	25	55	23	57.5
Vegetables	11	27.5	11	27.5
Corn	8	20	8	20
Peanut	1	2.5	2	5



Table 7. Number of cropping per year is practiced

CROPS	1990-2000		2001-2010	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Rice (once)	35	87.5	40	100
Sweetpotato (once)	22	55	23	57.5
Vegetables-once	9	22.5	9	22.5
-twice	2	5	2	5
Corn-once	8	20	8	20
Peanut-once	1	2.5	2	5

Table 8 revealed that the irrigation canal, the river and the spring were the major source of irrigation of rice growers.

Changes in the source of irrigation form 1990 to present. Table 8 also presents the changes in the source of irrigation. Most (95%) percent of the respondents observed changes in their source of irrigation while 5 percent observed no change. A change in the irrigation canal was it dried up so farm became rain fed (2 respondents observed it) or it just dried-up (2 respondents). Another change for irrigation canal was it eroded. Water supply from the river and the creek became low. Aside from these changes, 31.58% observed that the spring dried during summer season. There was also a change in the flow of water from the canal, it became slow.

Table revealed that the major change was the low supply of water from the river followed by spring dries during summer season.



Table 8. Changes in the source of irrigation from 1990-2010

PARTICULAR	FREQUENCY	PERCENTAGE
Source of irrigation		
Rain fed	2	5
Irrigation canal	35	87.5
Spring	11	27.5
Creek	4	10
River	33	82.5
Are there changes in the source of irrigation from 1990 to present?		
There are changes	38	95
No change	2	5
Changes in the source of irrigation		
Irrigation canal dried-up so farm became rain fed	2	5.26
Low water supply from river	32	84.21
Spring dried during summer season	12	31.58
Low water supply from creek	2	5.26
Irrigation canal dried-up	2	5.26
Irrigation canal eroded	2	5.26
Low flow of water from the canal	2	5.26

*Multiple responses



Changes in the variety of rice grown from 1990-2010. Table 9 presents that 95% of the respondents changed the variety of rice they grow while 5% did not.

Furthermore, Table 9 presents the reasons from changing the variety of rice grown. Majority (65.79%) of the respondents changed variety for higher yield. Some (28.95%) changed because it is easy to manage and to try another variety (28.95%). Others changed because of its resistance to pest and diseases (10.53%) and adaptability to weather changes (13.16%) or climate change (10.53%). Five of the respondents changed to shorten the production period. The varieties of rice grown by the farmers in 1990-2000 were Waray, Intan, Senyora and Ginogolot. Other varieties were introduced to the farmers in 2001-2010. These were Balatinaw, Dash-1, C-18, BPI, and Taiwan.

The table shows that most of the reasons in changing the variety of rice were to get a higher yield.

Table 9. Changes in the variety of rice grown from 1900-2010

PARTICULAR	FREQUENCY	PERCENTAGE
Changes in the variety of rice grown form 1990-2010		
There are changes	38	95
No changes	2	5
Reasons for changing the variety of rice grown		
Higher yield	25	65.79
Resistance to pest & diseases	4	10.53
Easy to manage	11	28.95
Adapted to weather changes	5	13.16
Adapted to climate change	4	10.53
Try another variety	11	28.95
Shorter production period	5	13.16

*Multiple responses



Changes in the kind of crop grown. In Table 10, it was presented that twenty four respondents had change in the kind of crop they grow while sixteen had no changes.

There were 62.5% of the respondents who changed for better yield. Some (29.17) changed because it is more adapted to abrupt changes in weather or temperature. Another changed to have some other source of food. Only one changed to have higher income and then one to shorten the production period.

This implies that the farmers were after the yield (to have better yield) in changing the kind of their crop. Adaptability to abrupt changes in weather or temperature also means better yield.

Table 10. Changes in the kind of crop grown

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in the kind of crop grown?		
There are changes	24	60
No change	16	40
Reason for changing kind of crop:		
Provide higher income	1	4.17
More adapted to abrupt changes in weather or temperature	7	29.17
Better yield	15	62.5
Other source of food	4	16.67
Shorten production period	1	4.17



Changes in production management. The activities for production were weeding, irrigation, fertilizer application, harvesting and packaging. These were presented in Table 11.

Weeding. There were 5 respondents who weeded once the whole production period in the year 1990-2000. Frequency of weeding increased from 5 to 6 times in the year 2001-2011. From 1990-2000, 23 respondents weeded twice and in 2001-2011 more farmers weed their farm twice. Three times weeding were done by 7 respondents in the year 1990-2000. In 2001-2011, the number of farmers decreased to 5.

This shows that weeding can be done once, twice or thrice the whole cropping period. Majority of the respondents do it twice to avoid the damage of rats on the rice plants.

Irrigation. Four of the respondents irrigated their field every other day in 1990-2000 and four also in 2001-2011. There were two respondents who irrigated their field depending on soil dryness in 1990-2001. Only one respondent irrigated his field every week in the year 1990-2000 and one in 2001-2010.

Table 11 further shows that majority of the respondents were irrigating their fields continuously (70% in 1990-2000 and 82.5% in 2001-2011). This shows that despite the low water supply from the sources (river, spring and irrigational canal), it is enough to irrigate the farmer's fields.

Fertilizer application. Few of the rice growers applied fertilizer. Farmers only applied once either basal or side dressing. In the year 1990-2000, 2 respondents applied



basal fertilizer and 2 side dressed their farm. In 2001-2010, 6 applied fertilizer for basal and 3 for side dressing.

The result implies that many of the respondents were using organic fertilizer (the weeds from the first cleaning (preparation) of the field was mixed with the soil under the rice paddy). Few were using commercial fertilizer because of money problems to purchase fertilizer. It was cheaper to use organic fertilizer.

Harvesting practices. The farmers harvested their crop only once a year using either sickle (sickle harvesting) or a manual slicing tool (panicle harvesting). In 1990-2000, most (82.5%) of the farmers did panicle harvesting. Sixty five percent did sickle harvesting.

The harvesting practices of majority of the farmers have changed from 2001-2010. Ninety five percent used sickles in harvesting while 57.5% used the manual slicing tool (“lakem”).

This result shows that it was faster and more efficient to use sickle in harvesting palay. One reason is rice thresher was introduced in the place.

Packaging. The palay harvested by hands are bundled and palay harvested by sickle are packed in sacks. In 1990-2000, most (82.5%) farmers bundled the harvested palay. Others (65%) used sacks. From 1990-2000, 95% farmers used sacks and 57.5% bundled their harvest.

Changes on the application of fertilizers. Table 12 presents that 3 respondents had changed their application of fertilizer while the other 6 had no change on their application. The changes were increase application 40 kg triple 14 to 50 kg and change on the kind of fertilizer. From mixed triple-14 and sulfate, it was changed to mixed triple-14 and urea.



Table 11. Changes in production management

ACTIVITIES	FREQUENCY	1990-2000		2001-2011	
		F	%	F	%
Weeding	Once	5	12.5	6	15
	Twice	23	57.5	29	72.5
	Thrice	7	17.5	5	12.5
Irrigation	Every other day	4	10	4	10
	Every week	1	2.5	1	2.5
	Depends on soil dryness	2	5	2	5
	Continuous	28	70	33	82.5
Fertilizer	Basal	2	5	6	15
Application (once)	Side dressing	2	5	3	7.5
Harvesting	Sickle Harvesting	26	65	38	95
Practices	Panicle Harvesting	33	82.5	23	57.5
	Rice thresher	0	0	5	12.5
Packaging	Sacks	26	65	38	95
	Bundle	33	82.5	23	57.5



Table 12. Changes on the application of fertilizers

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in the application of fertilizers?		
There are changes	3	33.33
No changes	6	66.66
What are the changes?		
increase application T-14 40kg to 50kg	2	66.66
change on the kind of fertilizer From: T14 and sulfate to T14 and urea	1	33.33

Observation on the incidence of pests and diseases. Table 13 presents the observation on the incidence of pest and diseases. The pests observed were leaf hopper, golden kohol, bug, giant earthworm, rats, rice bird, snake, stem borer, mole cricket and slug.

In 1990-2000, leaf hopper, golden kohol, bug, giant earthworm, rats and rice bird were high during the wet season. During the dry season, leaf hopper and bug became moderate, the rest were still high. The snake was low in the wet and dry season, stem borer was moderate and mole cricket was high.

In 2001-2010, slug appeared. During the wet season, slug was high while in the wet season, it was moderate. Giant earthworm and snake were moderate in the wet and dry season of 2001-2010. The other pests (leaf hopper, bug and stem borer) in the wet season decreased from high to moderate in the dry season.



Table 13 further shows the diseases observed. “Tungro” (virus) was moderate during the wet and dry season throughout the year 1900-2010. “Denggaw” was high during the wet and dry season from 1900-2010. For “kungaw”, it was moderate during the wet and dry season of 1900-2000. Incidence became high in the wet season of 2001-2010 and went back to moderate during the dry season.

The table shows that “denggaw” was the major disease observed. “Kungaw” and tungro were moderate.”Kongaw” is called for the empty grain because the pollen fell on the ground. “Denggaw” is called when the plant’s leaves rotten because of water stress.

Control measures of pests. Table 14 presented how the farmers controlled the pests. One hundred percent of the respondents did manual picking. Manual picking were done on golden kohols, slugs, mole crickets and giant earthworms. Thirteen respondents used chemical to control some pests.

There were 13 respondents who used mouse trap, 11 used scare crow and 6 used organic to control the pests. Only one used biological control.

The table revealed that chemical is not common in the study area. Manual picking was preferred.

Changes in yield. Table 15 presents the changes in yield of palay. The average marketable yield decreased in 2001-2010, from 7.5 cavans in 1990-2000, it decreased to 6.62 cavans. The average non-marketable increased from 1.02 to 1.62 cavans.



Table 13. Observation on the incidence of pests and diseases

NAME OF PESTS AND DISEASES	1990-2000		2001-2010	
	WET (MEAN)	DRY (MEAN)	WET (MEAN)	DRY (MEAN)
PEST				
Leaf hopper	3.67	2.67	3.67	2.67
Golden kohol	3.64	3.56	3.85	3.81
Bug	3.43	3	3.23	2.77
Giant earthworm	3.95	3.63	2.69	2.31
Rats	3.86	3.4	3.82	3.21
Rice bird	3.53	3.63	3.41	3.45
Snake	2	2	3	2.5
Stem borer	3	2.5	3.25	2.5
Mole Cricket	4	3.5	4	4
Slug	-	-	4	2.57
DISEASE				
“Kungaw”	2.94	2.17	3.18	2.30
Tungro	2.57	2.29	2.65	2.26
“Denggaw”	3.25	3.33	3.25	3.3

LEGEND: Observation on the incidence of pest and diseases
 0-1-none 1.1-2-low 2.1-3-moderate 3.1-4-high



Table 14. Control measures of pests

PARTICULAR	FREQUENCY	PERCENTAGE
Use of chemicals	19	47.5
Biological control	1	2.5
Manual picking	40	100
Use of organic control	6	15
Use of mouse trap	13	32.5
Use of scare crow	11	27.5

Table 15. Changes in yield

Land Area	AVERAGE MARKETABLE (CAVANS)		AVERAGE NON- MARKETABLE (CAVANS)	
	1990-2000	2000-2010	1990-2000	2000-2010
1000(m ²)	7.5	6.62	1.02	1.62

Strategies / Coping Mechanisms Employed by Farmers. In table 16, the strategies or coping mechanisms employed by farmers are presented. Most (95%) of the respondents changed variety of their crops as their coping mechanism. Ninety percent changed or adjusted their cropping period and 47.5% changed their crops. There were 5 who planned a production program and implemented it, 4 respondents did crop rotation and only 1 shifted to organic production.

The table shows that there are a lot of coping mechanisms employed by the farmers but the most respondents adjusted cropping period and changed variety of crops.



Table 16. Strategies/ coping mechanism employed by farmers

PARTICULAR	FREQUENCY	PERCENTAGE
Changed or adjusted cropping period	36	90
Planned production program implemented	5	12.5
Changed crops	19	47.5
Shifted to organic production	1	2.5
Changed variety of crops	38	95
Crop rotation	4	10



SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was conducted to determine the changes in climate change for the past 20 years, the awareness of farmers on climate change, perception/knowledge of farmers in Besao on climate change, the effect of climate change on the following aspects: a) change in agro-demographic profile of the study area, b) change in the production practices of crops, c) incidence of pest and diseases and other production practices, d) changes in yield and the strategies/coping mechanism employed by farmers.

There were 40 respondents from Agawa, Besao, Mountain Province. The study made use of primary and secondary data. Primary data were gathered through survey and interview. Transect walk was done on the study area to describe the landscape of the study area and observe some changes. Secondary data were taken from (PAG-ASA-Baguió City).

From the results, it shows that there were increased in temperature evident on the minimum temperature. It had increased from 1990 to 2010 which means that it's getting warmer.

The age of the rice farmers in the area range from 41-50 years old and as more as 80 years old. Majority of the farmers were females showing that farming nowadays is not only for men. All of the respondents attended formal education. However the level of education is still quite low. The rice farmers in Besao had been in rice production for long time.

All of the respondents were aware of climate change. Majority were aware of abrupt changes in temperature followed by abrupt changes in weather conditions.



There were 87.5% terraced irrigated and 12.5% terraced unirrigated of the respondents farm. In the farm there were changes; majority (67.5%) of the changes was decrease supply of water followed by destruction of ripraps and rice terraces eroded. The major cause for these changes was weather conditions.

The main crop grown in the area was rice. Sweet potato, vegetable, corn or peanut were planted after the harvest of palay. These were other sources of food. Rice , sweetpotato, corn and peanut in the area.. For vegetables, some planted it twice or once depending on the length of production period.

Almost all of the rice producers source their irrigation from irrigation canal. Others source their irrigation from the river, the spring and creek. Changes in the source of irrigation from 1990 to present were observed by 95% of the respondents. The major change is low water supply from the river.

There were also changes by 95% respondents on the variety of the rice grown. Majority (62.5%) reason in the changes is to have higher yield. Others change because it is easy to manage (27.5%) and to try another variety (27.5%).

Out of the 40 respondents, 60% had change in the kind of their crop while 40% had no change. Majority reason for changing is to have better yield.

In the production management, the activities were weeding, irrigation, fertilizer application, harvesting and packaging. Weeding can be done once, twice or thrice the whole cropping period but majority of the respondents do it twice.

In the study area, majority of the respondents were irrigating their fields continuously. Some irrigate their field every other day. Few of the respondents were using commercial fertilizer. For harvesting it was done only once a year using either sickle or a



manual slicing tool (“lakem”). In 1990 -2000, most of the farmers did panicle harvesting. The practice was then changed from 2001-2010, ninety five percent use sickle in harvesting. The palay harvested are either bundled or packed in sacks.

Among the pest observed, golden kohol, rats, rice bird and mole cricket were the majority problem of the farmers. Incidence of pest and diseases was high in 1990 to 2010. For the diseases, “denggaw” is the major disease observed. Kungaw and tungro were moderate.

To control the pest, all of the farmers were doing manual picking. It was more preferred than to use chemicals.

The average marketable yield in 1990-2000 is 7.5 cavans for a 1000 square meter area. However, yield decreased in 2001-2010 to 6.62 cavans.

The average land area planted is 1000 square meter. The average non marketable yield increased from 1.02 to 1.62 cavans.

Majority of the respondents changed variety of their crops as their coping mechanism. Ninety percent changed or adjusted their cropping and 47.5% changed their crops.

Conclusions

Based on the results of the study, the following conclusions were drawn:

There was an increased in temperature shown by the evident increased in the minimum temperature since 1990-2010.

The rice producers were in their middle age and most of them are females showing that farming is also for women and for older people with low education. Farmers have had been farming for a long period of time as their way of life.



All of the respondents were aware of climate change. Farmers were observant in the abrupt changes in temperature and weather conditions.

Rice is planted in the study area only once a year. The production practices of the farmers were influenced by the factors such as economic factors, bio-physical, climate change and their preferences.

The common coping mechanisms for the farmers were to change the variety of their crops and to change or adjust their cropping period.

Recommendations

The government should inform farmers about use of chemical inputs and its adverse effect to the environment and climate. Mass dissemination to farmers about climate change and its effect to agriculture.

The farmers should plan their production regarding the changes in weather and temperature then implement it.



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