BIBLIOGRAPHY

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ABSTRACT

This study was conducted to document the weather changes in the locality for the last 10 years; determine the effects of climate change in rice cultivation with the following aspects (a) changes in the production practices; (b) changes in yield; (c) changes in availability of water sources; incidence of pests and diseases.

The result showed that there were changes in production/cultural management practices. Weeding is done through the use of weedicide to minimize labor used during weeding exposure to intense heat from the sun. There were also changes with regard to pest management. In 1990-2000, no spraying activity was done to control the golden snail but in 2001-2010 the respondents were now using spray per cropping. In terms of marketable yield during first cropping in 1990-2000 were much higher than the first cropping of year 2001-2010. Most farmers their adaptation strategies were adjust cropping period.

Based on the findings of the study, most of the respondents were applying inorganic fertilizers to increase fertility of the soil. The higher incidence of pests and diseases was

influenced by environmental factors such as temperature, relative humidity, rainfall and soil conditions such as the reduction in soil nutrients. The major problems faced by farmers on rice production were calamities and damages brought about by insect pest and diseases believed to be a factor of climate change. Farmers should minimize the application of inorganic fertilizers and instead practice applying organic fertilizers. Farmers should fallow the land or practice crop rotation in order to improve and regain the soil fertility of the land. To minimize the damage caused by insect pests and diseases, the farmers should try to find other methods of controlling pests specially using biological control methods and not to be dependent on chemicals as is a tendency that the insect pests become more resistant to the chemicals.

INTRODUCTION

Rationale

Climate has been changing since the start of time, as civilizations developed; its effect on man's survival has been an increasing urgent concern of people from all walks of life. Its effect on natural and social environments has elevated interest to address climate change either through adaptation or mitigation activities.

Climate change refers to the change in the average weather or a change in the distribution of weather events around an average (e.g greater or fewer extreme weather events).

Any change in the world's climate is a potential threat to global food security. Climate change such as increase in CO_2, temperature and ultraviolet-B radiation will influence the production of rice, the world's most important food crop. As a source of atmospheric methane and nitrous oxide, rice cultivation may contribute to climate change. The contributions of this volume cover aspects of global climate change, its effect on rice ecosystems and agriculture (Peng *et al.,* 1995). Changes may be driven by internal processes, external forces or most recently, by human activities. It can be caused by dynamic processes on earth, variations in sunlight intensity, and in the past hundreds of years by human activities such as clearing of forests, technology and industry (ABS-CBN, 2010). Climate change is the result from the interaction of the atmospheric and oceanic factors. It is the ultimate effect of global warming. The (UNFCCC) put more emphasis on anthropogenic causes of climate change particularly fossil fuel burning (Tebtebba Foundation, 2008).

The sector most affected by climate change, so far, is agriculture and food security. Planting time and growing season have been changing due to erratic patterns of precipitations. Farmers, particularly those who depend on rainfall for water supply have to take more risks in growing crops. When hit by El Nino in the middle of the growing season, the shortage of water will impair crop growth and consequently reduce its potential yield. During the El Nino period, crops become vulnerable to pest attacks and diseases. La Nina years bring heavy rain, causing massive run off, severe erosion of fertile soils and inundation of agricultural areas and aquaculture farms (ADB, 2009).

The sharpest fall in agricultural productions are experienced during strong El Nino events and after the occurrence of severe tropical cyclones. Decreased in agricultural productivity and aquaculture will ensure 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, 2007). The predicted changes in temperature and rainfall patterns, as well as their associated impacts on water availability, pests, disease and extreme weather events are all likely affect substantially the potential of agricultural production (Zhai and Zhuang, 2007).

Rice is the world's most important food crop, more than half of the people in the world eat rice as a main part of their meals. Almost all the people who depend on rice for food live in Asia.

In the Philippines, rice is a major component in the budget of Filipino families. Filipinos are highly dependent on rice (Oryza sativa) since it is the staple food of the people and the lifeblood of the nation. It is the whole of the people's diet, nearly all of their agriculture and much of their hope (IRRI, 1977).

Thus, this study aimed to document the effects of climate change to rice production in Mangaldan, Pangasinan.

Importance of the Study

The result of the study would serve as guide for agricultural technologists and rice program implementers; and enhance their capacity to understand how climate change influences food security, impart better understanding of climate change and its effect in rice production among farmers or communities, help select alternatives for policies, practices, technologies or even adaptation strategies they implemented or use to sustain the rice production level.

Statement of the Problem

1. What are the weather changes in the locality for the last 10 years?

2. What are the effects of climate change in rice cultivation on the production practices changes in yield, availability of water sources, incidence of pests and diseases?

3. What are the strategies or coping mechanism being done by the farmers?

Objectives of the Study

1. To document weather changes in the locality for the last 10 years.

2. To determine the effects of climate change in rice cultivation on the following aspects:

    a. Changes in production practices

    b. Changes in yield

    c. Changes in availability of water sources

    d. Incidence of pests and diseases

3. To identify the adaptation strategies being done by the farmers.

Scope and Delimitation

The study was undertaken in three barangays of Mangaldan which served as representative of the rice farming communities. The study focused on the effects of climate change in rice production and adaptation strategies of farmers. Evaluation of changes in weather patterns covered the past 10 years only.

REVIEW OF LITERATURE

Rice

Rice is a cereal grain, belongs to the grass family (includes wheat, maize, and oats). This grain grows best in shallow water for the reason that, the flooding of the field supplies the growing plants with moisture and kills weeds and other pests. It also thrives in many tropical (warm, wet climate) areas especially Southern Asia, India and China are best examples for they produce more than half of the world's yearly rice harvest, which make them as the world's leading rice-producing countries.

Climate Change and Its Impacts

Climate change would adversely affect food security, fresh water supply, rural and urban settlements and their infrastructure, even if emissions would be curbed immediately. Thus, humans need to adapt to face challenges due to some climate change that is already inevitable. Biodiversity loss would also be inevitable due to the changing dynamics in the natural system particularly increasing temperature of which many species might not able to adapt thereby resulting to the irreversible loss of keystone species. This would have various feedback effects not only on the natural system but also on the communities (notably indigenous communities) that depends on biodiversity for their existence. Climate change is the current crisis the world is experiencing today. It is an international issue that concerns all fields of research and expertise including politics and economics. A number of conferences and negotiations have been organized globally concerning this anthropogenic phenomenon and one of its active supporters is the Philippines (FAO, 2006).

The Philippines is generally characterized by four climatic types in terms of the relative duration and intensity of the wet and dry period in the different parts of the country.

Type I climate is the wet period from May to November and dry period from December to April.

Type II climate is no dry season and maximum rainfall is experienced from November to January.

Type III climate is no distinct wet and dry seasons but it is relatively dry from November to April.

Type IV is presence of rainfall more or less evenly distributed throughout the year.

Adaptation Strategies

Rainfall is the most important weather factor for successful rice cultivation. Temperature,rice is a tropical and sub-tropical plant. As such as, temperature is another climatic factor that significantly influences the development,growth and yield of rice. Rice requires a fairly high temperature between 20^{o}C and 40^{o}C. The optimum temperature of 30^{o}C during daytime and 20^{o}C during night time seems to be more favorable for the development and growth of rice crop (Mitin, 2009).

Principles and Practices of Rice Production

According to Rabbit (1940) as cited by de Datta (1981) rice provide employment to the largest sector of the rural population in most Asia. And this was supported by IRRI (1977) and stated that rice plays an important role in the stabilization of the Philippine economy because majority of the Filipinos are farmers.

In the Philippines, rice farming is common nationwide. About 85% of the people depend on it. Rice can be grown everywhere across the country from Aparri to Jolo. It is usually planted with irrigation twice a year, once a year in extremely cold areas, and thrice a year in other areas. The three cropping are experienced in areas where there are less calamities, like typhoons, better and dependable water supply, where farmers practice excellent and appropriate irrigation system management where acceptable modern technologies are employed and where high yielding varieties are commonly grown. Rainfed areas are common elsewhere, which are also planted with rice during wet season. This indigenous technology sometimes called as "chance farming" is still practice because of the lack of government assistance in terms of irrigation infrastructure in the area. As a result, the agricultural practice in un-irrigated areas depends on the raining months and remains idle during the rest of the years. The slow irrigation developed in the provinces leads to smaller planted rice areas, which results to a minimal yearly incremental increase in rice production. Thus, the production cannot suffice to meet the population demand for rice.

Farmers have always had to cope with the environment that surrounds them, gradually adapting to it. Most small-scale farmers have to deal with sufficient resources, and many are trying to grow crops in soils which are less fertile, or deal with recurrent pests and diseases. The speed of which the climate is changing and the resulting situations, whether temporary dry period or a hurricane only adds to the list of challenges and to the change of urgency.

With climate change, higher temperature can lead to lower water levels in dams, thus the greater need for rice that requires less water. Rice growing requires around 3 liters

to produce one kilo of palay or un-husked rice. However, farmers planting it should also learned integrated crop management-crop rotation, water saving systems, in order to attain a good yield of up to four metric tons (MT) per hectare per season.

Principles of Field Crop Production

Effects of temperature, is the most important factor to consider in rice production. Rice can grow successfully in regions that have mean of 21^{o}C or above. Higher yield is obtained in warmer places, which may experience a low summer rainfall compared to the humid places (Martin and Leonard, 1970).

Fundamentals of Rice Crop

Within the critical low and high temperature, temperature affects grain yield by affecting tiller, spikelet formation, and ripening. There is usually an optimum temperature for different physiological processes and these vary to some degree with variety. Therefore, the results of an experiment depend on the variety used and on whether the range of temperatures studied is above or below the optimum. Within a temperature range of 22^{o}C-31^{o}C, the growth rate increases almost linearly with increasing temperatures (Yoshida, 1981).

Adaptations and Mitigations of Climate Change

Adaptability refers to the degree to which adjustments are possible in practices, processes or structures of stems to projected and actual changes of climate. Adaptation can be spontaneous or planned and can be carried out in response to or in anticipation of change in conditions. Adaptation measures and options vary according to sector and maybe constrained or enhanced by national or local conditions, for agriculture for example some

adaptation options could include adjustment of planting dates or changes in fertilization rates, irrigation application, cultivar traits and selection of animal species. For water resources integrated water resource management techniques can be applied to adapt hydrologic impacts of climate change (Watson *et al.*, 1996).

Evaluation to Rice

Effects of pests and diseases, the major insect pest of rice in the Philippines are rice stem borer, leaf hopper, army worm and whorl maggots. Which cause 50-100% reduction yield. Strategies of farmers, hand weeding was done when necessary after transplanting. Insect pests and diseases was controlled and monitored to reduced economic losses. Other recommended cultural management practices was followed to ensure better yield (Urbano, 2008).

METHODOLOGY

Locale and Time of the Study

The study was undertaken in three barangays of Mangaldan which is the representative of the rice growing areas of the municipality. These barangays include; David, Landas and Buenlag. The study was conducted from October to November, 2011.

Respondents of the Study

The data was gathered from 60 rice farmers. The respondents were chosen at random.

Data Gathering Procedure

The study made use of primary and secondary data. Primary data were gathered through survey and interview. Survey questionnaire were distributed to the respondents and followed with an interview during the collection of questionnaire. Secondary data on weather were gathered from PAGASA Dagupan.

Data Gathered

The data gathered were demographic profile of the respondents, adaptation strategies of farmers for rice cultivation, changes in production practices and yield and weather data (average monthly rainfall and minimum and maximum average temperature).

Data Analysis

The data collected were tabulated and analyzed using frequency and descriptive analysis.

RESULTS AND DISCUSSION

Profile of the Respondents

Table 1 presents the background information of the respondents according to gender, age, status, occupation, education, religion, years engaged in rice production, other source of income and average monthly income. A total of 60 rice farmers served as respondents. Twenty of the farmers were taken from each barangay namely: Buenlag, Landas, and David.

Gender. Most (87%) of the interviewed respondent were male and the rest were female. This implies that rice farming in the area is usually the work of men.

Age. Majority (62%) of the respondents were under the age bracket of 41-60 years old, followed by ages falling under 20-40 years old (22%) and the rest were under 61 years and above. This means that rice farmers in the area were at their prime years in farming.

Status. Majority (85%) of the respondents were married (12%) and 3% were single and widowed respectively.

Educational background. On the educational background, 45% reached high school level; 23% reached elementary level; 10% were college graduate and 8.33% reached both college level and vocational course. This means that most of the respondents had attended formal education.

Religion. Eighty five percent (85%) of the total respondents were Roman Catholic; 13.33% were Born again Christian while 1.67% were Iglesiani Cristo.

Years engaged in rice production. Of the sixty (60) respondents, 56.66% had a farming experience of 26 years and above; 20% from 16-20 years; 10% from 21-25 years; 8.35% from 5-10 years and 5% from 11-15 years of farming experience. This means that

majority of the rice farmers interviewed had long years of experience in cultivating their land.

Other sources of income. Majority, (73.33) of the respondents, had no other sources of income except farming. Ten percent were in salt making while 8.33% in hog raising, 6.67% were government employee, and 1.67% were employed in parlor as means of augmenting their incomes. This means that most of the farmers' incomes are dependent on their rice production.

Average monthly income. On the average, 50% of the respondents said that they are earning an average monthly income of P6000-P10000 while 35% earns less than P5000, 13.33% earn P11000-P15000 and 6.67% earn (P16000 and above).

Table 1. Distribution of respondents according to different characteristic

CHARACTERISTICS	BARANGAYS			
	BUENLAG	DAVID	LANDAS	PERCENTAGE
Gender				
Male	18	14	20	87
Female	2	6	0	13
TOTAL	20	20	20	100
Age				
20-40	7	3	3	22
41-60	10	15	12	62
61and above	3	2	5	16
TOTAL	20	20	20	100

Table 1. Continued…

CHARACTERISTICS	BARANGAYS			
	BUENLAG	DAVID	LANDAS	PERCENTAGE
Married	19	16	16	85
Single	1	4	2	12
Widowed	-	-	2	3
TOTAL	20	20	20	100
Educational background				
Elementary	7	4	3	23.3
High school	8	10	9	45
Undergraduate	-	1	4	8.3
College graduate	2	4	-	10
Vocational	3	1	4	13.3
TOTAL	20	20	20	100
Religion				
Roman catholic	15	17	19	85
Born again	5	3	-	13.3
Iglesia ni Cristo	-	-	1	1.7
TOTAL	20	20	20	100
Year engage in rice production				
5-10	1	2	2	8.3
11-15	1	2	-	5
16-20	6	5	1	20

Table 1. Continued…

CHARACTERISTCS	BARANGAYS			
	BUENLAG	DAVID	LANDAS	PERCENTAGE
21-25	3	2	1	10
TOTAL	20	20	20	100
Other source of income				
Parlor	1	-	-	1.7
Government employee	4	-	-	6.7
Salt making	-	6	-	10
Hog raising	-	-	5	8.3
None	15	14	15	73.3
TOTAL	20	20	20	100
Average monthly income (pesos)				
Less than 5000	7	8	3	30
6000-10000	10	7	13	50
11000-15000	2	3	3	13.3
16000 and above	1	2	1	6.7
TOTAL	20	20	20	100

Weather Data

Table 2 shows average rainfall and temperature. Data shows that year 2000 and 2009 experience heavy rainfall. The highest temperature was experienced in 2010 with temperature ranging from 23.4'C to 32.7'C. Year 2000 occurs the lowest temperature (23.5 to 31.5).

Table 2. Data on annual rainfall relative humidity and temperature from 1990-2010 (Dagupan, PAGASA Station)

YEARS	AVERAGE ANNUAL RAINFALL (mm)	MEAN RELATIVE HUMIDITY (%)	TEMPERATURE	
			MAXIMUM	MINIMUM
2000	3327.2	83.3	31.5	23.5
2001	2071	81.8	31.9	23.7
2002	2730	83.4	31.9	22.9
2003	3500	83.8	31.6	22
2004	2814.09	84.3	31.8	21.9
2005	1622.1	82.7	32.4	23.8
2006	2304	82.1	32.3	23
2007	1942	81.1	32.2	22.8
2008	2157	82	32.1	22.8
2009	3306.1	82.4	31.9	22.6
2010	2187.6	81.5	32.7	23.4

Awareness and Perception on Climate Change

All the respondents mentioned that they were aware on the changes of climate that is happening in their locality. This implies that on climate change is not new to these farmers. On their perception (88%), majority of the respondent mentioned that was abrupt changes in weather condition, occurrence of super typhoons and abrupt changes in temperature. Others mentioned seasonal changes in climate, like dry season becomes drier and wet season becomes wetter.

Table 3. Respondents' awareness and perception of climate change

PARTICULAR	FREQUENCY	PERCEPTION
Awareness	60	100
TOTAL	60	100
Perception		
Abrupt changes in temperature	49	82
Occurrence of super typhoons	51	85
Abrupt changes in weather condition	53	88
Changes in season like prolonged dry and wet season	37	62
La Nina	8	13
EL Nino	7	12

*Multiple responses

Changes in Agro-Ecological Profile

Table 4 shows that landscape of the farm, all the respondents were farming in flat terrain which is commonly referred to as lowland. Most (91.67%) of the respondents the farms easily get flooded during rainy season. On the other hand, during the dry season,20% responded that the soil easily dries up, 20% observed decreased in supply of irrigation water, and 20% said soil becomes acidic. Most (98.33%) believed that the changes on the landscape of the farm was due to weather changes, 68.33 % believed that it was due to change in soil structure from porous to compact while 50% believed due to the occurrence of El Nino and La Nina. This implies that landscape of farm did not change but it is the soil structure that changed.

Table 4. Observation on landscape of their farms

PARTICULAR	FREQUENCY	PERCENTAGE
Landscape of the farm		
flat terrain	60	100
TOTAL	60	100
Observed changes in landscape from 1990-present		
irrigated field became unirrigated	2	3.33
farm easily get flooded	55	91.67
farm/soil easily get dry	12	20.00
decrease supply of water	12	20.00
low water holding capacity	2	3.33
changes in soil type and texture	9	15.00
unirrigated field became irrigated	8	13.33
fertile became acidic	12	20.00
Causes of changes in landscapes		
weather conditions	59	98.33
La Nina	30	50
El Nino	30	50

*Multiple responses

Cropping pattern. Table 5 shows the main crops planted by farmers. Aside from rice farmers plant corn, thus corn is the rotation crop. Most (90%) plant corn after rice in 1990-2000. In year 2001-2010 farmers plant rice 2x-rice after rice. These is due to the presence of irrigation facilities which is a project of the National Irrigation Administration (NIA). All of the respondents are now practicing monocropping (rice-rice) due to the presence of irrigation facilities established.

Table 5. Crops grown by respondents

CROPS GROWN	1990-2000		2001-2010	
	F	(%)	F	(%)
Rice-corn	54	90	-	-
Rice-rice	6	10	60	100
TOTAL	60	100	60	100

Changes in the Variety of Crop Grown from 1990-2010

Table 6 shows that all of the respondents were using different varieties of rice. All believed that using different varieties would increase yield of the crop. Other reasons for using other varieties include: provision and recommendation of some varieties by the Department of Agriculture (68.33%), 66.67% used varieties which are adaptable to weather/climate changes, 33.33% used varieties which were resistant to pest and diseases and only 5% used those varieties that were easy to manage.

Table 6. Variety of rice crop grown by respondents

PARTICULAR	FREQUENCY	PERCENTAGE
Changes in variety	60	100
TOTAL	60	100
Reason in change of variety of crops		
higher yield	60	100
Resistance to pest and diseases	20	33.33
easy to manage	3	5
adopted to weather changes	40	66.67
adopted to climate change	40	66.67
DA subsidy	41	68.33

*Multiple responses

Changes in Production/Cultural Management Practices

In 1990-2000, most (88.30%) of the respondents practiced manual regular weeding, and 11.70% weeds only twice per cropping. However, from 2001-2010, weeds became more prevalent and this resulted to changes in the frequency of weeding per cropping. Hence, instead of manual weeding farmers use weedicide. This implies that application of chemicals was used to minimize labor used during weeding and reduce exposure to intense heat from the sun.

There were also changes with regard to pest management. In 1990-2000, no spraying activity was done to control the golden snail but from 2001-2010, 81.7% of the respondents were now using spray twice per cropping while 18.3% spray once per cropping.

In 1990-2000, 90% of the respondents were dependent on rain for irrigation while only 10% irrigate their crop using the water pump. However, in 2001-2010, 58.3% of the respondents had access to irrigation at least for one cropping, while 41.7% mentioned that they irrigate their crops twice. Change in the frequency of irrigation was due to greater availability of irrigation water with the developments made by NIA.

As regards to soil fertilizer application, in 1990-2000, no fertilizer was applied, however from 2001-2010 all of the respondents mentioned that they need to apply inorganic fertilizer in order to increase fertility of the soil. Soil nutrient depletion was due to the long years of cultivation and the practice of monocropping in the area.

With regards to harvesting practices, in 1990-2000, most (90%) of the respondents harvest rice once a year, because they practice one cropping only. Farmers nowadays have two cropping per rice for corn. In terms of packaging all of the respondents used sacks of rice as with 50 kgs capacity.

Table 7. Production/cultural management

ACTIVITIES	1990-2000		2001-2010	
	F	(%)	F	(%)
Weeding				
Once	-	-	60	100
Twice	7	11.7	-	-
Regular	53	88.3	-	-
TOTAL	60	100	60	100
Spraying (pest)				
Once	-	-	11	18.3
Twice	-	-	49	81.7
TOTAL	60	100	60	100
Irrigation				
None	54	90	-	-
Once	6	10	35	58.3
Twice	-	-	25	41.7
TOTAL	60	100	60	100
Fertilizer Application				
Basal	-	-	60	100
TOTAL	60	100	60	100
Side Dressing				
Once	-	-	19	31.7
Twice	-	-	41	68.3
TOTAL	60	100	60	100

Table 7. Continued …

Harvesting				
Once	54	90	-	-
Twice	6	10	60	100
TOTAL	60	100	60	100
Packaging				
By sack	60	100	60	100
TOTAL	60	100	60	100

Changes in the application of fertilizer. Table 8 shows that 75% of the respondents mentioned that there was change as regards to fertilizer application while 15% said they there was no change. Most (73.3%) mentioned that they have increased the amount rate of fertilizer applied on soil by 1-3 bags while 1.7% increased by 4-6 bags. However, in terms of the changes on the kind of fertilizer applied, there was no change, the farmers still use the same kind of fertilizer.

Application of Pesticide

In terms of application of pesticide, All the respondents mentioned that they are now using pesticide to control pest.

Table 9 shows that in 1990-2000, control of pest is done by manual picking both for golden snail and weeds. However, from 2001-2010 respondents were now using pesticides due to increase number of golden snails particularly during the wet season. This implies that farmers resort to the use of chemicals to control pest and diseases.

Table 8. Changes on the application of fertilizers

PARTICULAR	FREQUENCY	PERCENTAGE
Change on fertilizer application		
There are changes	45	75
No changes	15	25
TOTAL	60	100
Nature on changes on the application of fertilizer Amount on the change of rate of application		
increase from 1-3 bags	44	73.3
increase from 4-6 bags	1	1.7
Changes in the application of insecticides and pesticides		
There are changes	60	100
TOTAL	60	100

Marketable and Non- Marketable Yield

Table 10 shows that the average marketable yield/cavan during first cropping in 1990-2000 were much higher than the first cropping of year 2001-2010, because farmer mentioned that in 1990-2000 there was enough rain and no calamities that will affects their crops, while 2001-2010 they encountered super typhoons that would flood their crops, particularly at the flowering stage of rice. However, second cropping from 1990-2000 were much lower yield because water sources were not enough to irrigate their crops and it was a dry season period. While second cropping of year 2001-2010 have higher yield due to the presence of (NIA).

As regards to the non-marketable yield first cropping in 1990-2000, the average of non-marketable yield have much lower than the average non-marketable yield in 2001-2010 due to the strong winds and super typhoons. However the second cropping in 2001-2010 the non-marketable yield was much lower, due to the presence of (NIA).

Table 9. Application of insecticide/pesticide

PESTICIDE/INSECTICIDE	1990-2000		2001-2010	
	WEIGHTED MEAN		WEIGHTED MEAN	
	WET	DRY	WET	DRY
Surekill	1	1	2.75	1
Shatter	1	1	2.8	1
Bayonet	1	1	3	1
Savage	1	1	3.3	1
Kuhol booster	1	1	3	1
Nominee	1	1	4	1.8
Postherb	1	1	3.92	2
2-4D	1	1	4	2
Machite	1	1	3.75	1
Grasstop	1	1	4	1.7

Legend: 0 – 1.0 -none
1.1 – 2.0 -low
2.1 – 3.0 -moderate
3.1 – 4.0 -high

Table 10. Changes in yield of crops

AREA	AVERAGE MARKETABLE YIELD/CAVAN (1990-2000)		AVERAGE MARKETABLE YIELD/CAVAN (2001-2010)		AVERAGE NON MARKETABLE YIELD/CAVAN (1990-2000)		AVERAGE NON MARKETABLE YIELD/CAVAN (2001-2010)	
	1ST CROP	2ND CROP	1ST CROP	2ND CROP	1ST CROP	2ND CROP	1ST CROP	2ND CROP
0.5	57	50	35	61	1	10	21	1.12
0.6-1	105	92.5	47.6	112.6	2.7	17.5	57.3	1.2
1.1-1.5	148.3	150	68.3	148.3	3.8	20	8.2	1.6
1.6-2.0	194.4	165	100.6	195.6	4	25	95	1.6
2.1-2.5	205.7		115.7	205.7	4.4	0	90	1
2.6-3.0	243.3		141.7	243.3	3	0	101.7	1

Source of Irrigation

The sources of irrigation were the rain, irrigation canal, water pump and National Irrigation Administration (NIA) as presented in Table 11. There were 60 who source their irrigation from the rain, 57 from the irrigation canal, 51 from the water pump and 60 from the NIA.

Changes in the source of irrigation from 1990 to present. As shown in table 11, all the respondents observed there were changes in the source of irrigation from 1990 to present. There reasons were irrigation canal dried up so farm became rainfed, unirrigated became irrigated and rainfed to irrigation canal.

Table 11.Source of irrigation

PARTICULAR	FREQUENCY	PERCENTAGE
Source of irrigation		
Rainfed	60	100
Irrigation canal	57	95
Water pump	51	85
NIA	60	100
Are there changes in the source of irrigation		
There are changes	60	100
Reason on change of source of irrigation		
I irrigation canal dried-up so farm became rainfed	16	27
Unirrigated became irrigated	50	83
Rainfed to irrigated canal	19	32

*Multiple responses

Incidence of Pest and Diseases. Table 12 shows that from 1990-2000 Incidence of pests and diseases were observed by the farmers, according to them there were changes compare to 2001-2010. Pests are most highly during wet season in the year 2001-2010 particularly the golden snail. This implies that the major problems of farmers are the golden snail. However, in terms of diseases, incidence was low in 2001-2010 due to the presence of inorganic fertilizers.

Table 12. Observation on the incidence of pest

PEST AND DISEASES	1990-2000		2001-2010	
	MEAN		MEAN	
	WET	DRY	WET	DRY
Pest				
Rats	1.92	1.28	2.78	1.63
Golden snail	2.15	1.7	4	3.53
Rice birds	2	3	2	3.33
Diseases				
Bakanae	2.95	2.97	1.2	1.15
Rice blast	3	4	2	1.83
Leaf blight	3.07	2	2	1
Tungro	3.55	2.77	2.57	1.82
Leaf spot	3.45	2	2	1

Legend: 0 – 1.0 -none
1.1 – 2.0 -low
2.1 – 3.0 -moderate
3.1 – 4.0 -high

Control Measures for Pest

Table 13 shows that all the respondents were using chemicals to kill the golden snail and to control weeds. All respondent change variety of crops, 72% used manual picking (this is only done when incidence is low) and 40% biological control using duck to control the pest, because ducks eat those pest especially the golden snail.

All the respondents changed or adjusted their cropping period due to the climatic change, 95% planned and implement production program and 75% of the respondents shift their crops from organic to inorganic practices.

Table 13. Control measures of pest

PARTICULAR	FREQUENCY	PERCENTAGE
Control measures of pest		
Use of chemical	60	100
Biological control	24	40
Manual picking	43	72
Strategies/coping mechanism employed by farmers		
Change/adjust cropping period	60	100
Plan production program and implement	57	95
Shift to inorganic production	45	75
Change variety of crp	60	100

*Multiple responses

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The study was conducted to determine the effects of climate change in rice cultivation in on the following aspects; changes in production practices and incidence of pests and diseases. The study also identified the adaptation strategies employed by the farmers. This study was conducted in three barangays in MangaldanPangasinan namely: Buenlag, David, and Landas. Total of 60 respondents. This study was conducted on October, 2011.

The profile of the respondents revealed that most of the respondents were male, age ranging from 41-60 years old, married, attained at least high school and catholic believer.

Majority of the rice farmers interviewed had long years of experience in cultivating their land, and incomes are dependent on their rice production. All of the respondents were aware on the changes of climate that is happening in their locality. All the respondents were farming in flat terrain which is commonly referred to as lowland, and they were now practicing monocropping due to the presence of NIA. In terms of changes in the variety of crop grown result shows that all of the respondents were using different varieties of rice.

Changes in production or cultural management practices, farmers weeding is done through the use of weedicide to minimize labor used during weeding and exposure to intense heat from the sun. There were also changes with regard to pest management. In 1990-2000, no spraying activity was done to control the golden snail but in 2001-2010 the respondents were now using chemicals.. In terms of marketable yield, the first cropping in 1990-2000 had a much higher yield than the first cropping of year 2001-2010. Most farmers adjusted cropping period as a strategy to cope up with climate change.

Conclusions

Based on the findings of the study the following conclusions are made: most of the respondents were applying inorganic fertilizers to increase fertility of the soil. Due to the increase in the incidence of pest and diseases farmers now used chemicals to control these pests. The higher incidence of pests and diseases was influenced by environmental factors such as temperature, relative humidity, wind velocity, rainfall and soil conditions such as the reduction in soil nutrients. The major problems faced by farmers on rice production were calamities and damages brought about by insect pest and diseases which is believed to be a factor of climate change. However, the coping mechanism employed by farmers is the use of chemical inputs in farming which has more a negative effect or more contributing to the problems in climate change.

Recommendations

Since conventional or chemical farming has an adverse effect to climatic conditions (contributory to climate change) farmers should minimize the use of chemicals in farming. Farmers should practice organic farming. Farmers should fallow the land or practice crop rotation in order to improve and regain the fertility of the soil. To minimize the damage caused by insect pests and diseases, the farmers should try to find other methods of controlling pests specially using biological control methods and not to be dependent on chemicals as there is a tendency that the insect pests become more resistant to the chemicals.

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