BIBLIOGRAPHY

TAFALENG, GEORGE E. APRIL 2012. Vulnerable Assessment on the Effect of Climate Change in the Production of Chrysanthemum in Ambiong, La Trinidad, Benguet. Benguet State University, La Trinidad, Benguet.

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ABSTRACT

The study was conducted to determine the effect of climate change on the production of chrysanthemum in Ambiong, La Trinidad, Benguet. Data were gathered from the farmers of Ambiong and at PAG-ASA (Baguio City).

The finding shows that temperature is getting warmer based from the weather data where the minimum temperature increased. The increased utilization of chemicals by the farmers contributes to climate change. On the other hand, climate has effects on the farmer's production. All of the farmers are aware of climate change.

The production management was influenced by some factors such as climate change, the farmer's own preferences, pest and diseases and economic factors. An effective strategy/coping mechanism was to plan and implement production program.

It is therefore recommended that respondents who are engaged in farming are encourage to decrease utilization of chemicals because this is one of the reasons contributing to the climate change. It is recommended that farmers should revisit traditional production practices to reduce effect of global warming and pollution to air and soil.

INTRODUCTION

Rationale

Chrysanthemum (*Chrysanthemum morifoliom)* is a member of the Compositae family and the first cultivated species was first reported to have originated in China about 2,000 years ago (Langshans, 1964).

Chrysanthemums grow well in areas where the average day and night are relatively low. It requires adequate water supply throughout the cropping season. Demand for water increase as it reaches maturity, but this is reduced as it reaches flowering stage (Ladilad, 1981).

Chrysanthemum production is now a blossoming industry in the country with a promising export potential. It is in demand the whole year round with good market price especially during peak periods. Chrysanthemum growers, however, could not always met the demand at times when prices are high due to the delay of flowering even when proper care and management are provided or with poor scheduling of planting season. Furthermore, the desired flower size and stem lengths are not met, resulting to lower price of the cut flowers, causing growers to grow them in greenhouse or open field with artificial lighting. The poor quality and delayed flowering do not vary due to poor management but may be attributed to climate change.

Agricultural sector is most affected by climate change, so far. The sharpest fall in agricultural productions are experienced during strong El Niño events and after occurrence of severe tropical cyclones. Decreases 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).

The blossoming industry of chrysanthemum production is also affected by the change in climate. This study therefore will be conducted to look into the effects of climate change in chrysanthemum production in Ambiong, La Trinidad, Benguet.

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 can 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 Ambiong on climate change?
4. What are the effects of climate change on the following aspects?

a. Changes in the agro-ecological 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 of crops.

5. What are the strategies/coping mechanisms employed by farmers?

Objectives of the Study

The study has 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 Ambiong on climate change.

4. Determine the effect of climate change on the following aspects:

    a. Changes in the agro-ecological 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 of crops.

5. Determine the strategies/coping mechanism employed by farmers.

Scope and Delimitation

The study focused on the effect of climate change on chrysanthemum production in Ambiong, La Trinidad, Benguet.

REVIEW OF LITERATURE

Chrysanthemum and its Characteristics

Chrysanthemum (*chrysanthemum morifoliom)* belongs to the family Compositae. It is as a photoperiodically sensitive plant having a critical day length of 13 to 13 ½ hours. To initiate flower buds, the day length must be approximately 14 ½, but in the development of floral buds, the day length should be 13 ½ long (Langshan, 1964).The name chrysanthemum is derived from Greek words-chrysos (gold) and anthos (a flower) meaning literally, a golden flower. It is a perennial plant and blossoms perpetually but is locally grown as annual crop. Chrysanthemum are classified according to the types of blooms such as large exhibition, incurve, decorative, single, pompous, cascades, spider, guilled, anemone, cushion, button, reflex, spoon and needle point. It could be grown as cut flowers, potted or planted in containers intended for exhibition and for competition in garden shows. Propagation of this crops could be by shoot tip cuttings, stem cuttings, suckers, and by tissue culture.

Some species of chrysanthemum may have been cultivated in the Philippines for a long time but were only commercially introduced in 1972 at the Mountain State Agricultural College, La Trinidad, Benguet. They gain popularity because of their variety of colors, shapes and long keeping quality (Ladilad, 1980).

Chrysanthemum is also noted for its medicinal values, and one species of pyrethrum, is cultivated as a source of biological insecticide. However, this crop is commonly grown as cutflower crop. Its attractive flower comes in different colors, forms and shapes making it a perfect material for flower arrangement. Flower types of chrysanthemum are single, cascade, anemone (with center cushion), pompon (globular) decorative, spider, incurved, daisy and large exhibition.

Adaptability of Chrysanthemum to Local Conditions

Janick (1972) stated that climate, the summation of area's weather, which involves temperature, moisture and light effect are factors whose actions and interactions must be considered in physical environment of plants. These determine when, where and what plants will grow.

All plants having primary meristem and all species of plants that have roots are readily capable of being propagated by cuttings. However, he stressed that in propagation by cuttings, one should consider the age and maturity of plant tissues that serve as propagates. He further stated that soft and immature cuttings are prone to transpiration and more susceptible to decay, but mature plants will give satisfactory result.

Climate Change Defined

Climate change is defined by Asian Development Bank (ADB) as the variation in the Earth's global climate or regional climates over time scales ranging from decades to millions of years. Changes maybe driven by internal processes, external forces or, most recently, by human activities. Pulse Asian describes climate change as "any long term significant change in the average weather that a given region experience." 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 forests, technology and industry (ABS-CBN, 2010).

Climate Change in the Philippines and its Impact

The Philippines, as a developing country and a biodiversity hotspot, is highly vulnerable to climate change impacts.

The country has experienced temperature spikes brought about by climate change. It has been observed that warming is experienced most in the northern and southern regions of the country, while in Metro Manila has warmed less than most parts. In addition, the regions that have warmed the most (Northern Luzon and Mindanao) have also dried the most. Largest precipitation trends are about 10% during the 20th century. Hot days and hot nights have become more frequent (Presidential Task Force on Climate Change, Undated). The Philippine's rich biodiversity is one of the most vulnerable to climate change primarily due to the fact that most of the species are very sensitive to even a slight change of temperature. Dr. Comiso, a contributing author to the report on climate change of Nobel winner Inter-Governmental Panel on Climate Change, stated that even a fraction of a degree to 1 degree change in temperature, a lot of species would go extinct. Furthermore, the country is one of the world's top biodiversity hotspot. This is mainly due to increasing human population and resources demand, habitat destruction and unsustainable development. Climate change would intensify the high rate of species extinction and current degradation of the Philippine's ecosystem.

Climate Change and Agriculture

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 stages 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.

Planting time and growing season have been changing due to erratic patterns of precipitation. Farmers, particularly those who depend on rainfall for water supply, have to take more risks in growing crops. When hit by El Niño in the middle of the growing season, the shortage of water will impair crop growth and consequently reduce its potential yield. During the El Niño period, crops become more vulnerable to pest attacks and diseases. La Niña years bring heavy rain, causing massive runoff, severe erosion of fertile soils, and inundation of agricultural areas and (adequate) aquaculture farms (ADB, 2009).

Climate Change and its Impact

Climate change would adversely affect food security, fresh water supply, rural and urban settlements and their infrastructure, even if emissions would curb 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 key-stone species. These would have various feedback effects not only the natural system but also the communities (notably indigenous communities) that depend on biodiversity for their existence (EPA, Undated; FAO, 2006; Wikipedia, Undated).

Southeast Asia, in particular is vulnerable to the impacts of climate change. Though this region is one of the most dynamic, fast-growing regions in the world, but with long coast-lines, high concentration of population and economic activity in coastal areas, reliance on agriculture as source of livelihood for a large segment of the population, especially those living in poverty, and dependence on natural resources and forestry to derive development, it is highly vulnerable to the harsh impact of climate change (ADB, 2009).

Concept and Vulnerability

Vulnerability from the "food security" angle was defined in FAO's publication on the state of food security in the world (FAO, 1999) as the presence of factors that place people at risk of becoming food insecure or malnourished. This definition includes longer vulnerability of individuals or households rather than that of regions or economic sectors. The potential impact of climate change on food security will be observed on crops which are near their maximum temperature tolerances resulting in decreased yields even with small changes in climate especially in Africa and Latin America where agricultural production is projected to decrease by thirty percent in the next century which increase the risk of hunger in the tropics and subtropics where many of the world's poorest live (IPCC, 2001).

Vulnerability to climate change differs between countries, regions, economic sectors, social groups and individuals (Bohle, 1994).This is due partly to the fact that (1) changes in temperature and precipitation will occur unevenly (2) climate change impacts will be unevenly distributed around the globe and (3) resources and wealth are unevenly distributed. It is therefore established that adaptive capacity and vulnerability will vary (IPCC, 2001). Many regions and countries will have difficulty responding to climate change so adaptation to climate change studies should start with social and economic vulnerability (Handmer*et.al*, 1999).

METHODOLOGY

Locale and Time of the Study

The study was conducted in Ambiong, La Trinidad, Benguet. The study was conducted from October to November 2011.

Respondents of the Study

A 40 chrysanthemum farmers served as the source of data. The respondents were purposively.

Data Gathering Procedure

The study made use of primary and secondary data. Primary data was gathered through survey and interview. A transect walk was also done in the study area to describe the micro niche and landscape of the area and observe some changes which may be validated with the respondents through key informant interview. Data was validated on the collection period of questionnaire. Secondary data was taken from Philippine Atmospheric, Geophysical and Astronomical Services Administration (Baguio City).

Data to be Gathered

The data gathered were the weather changes for the past 20 years, physical features, production methods, planting practices and awareness and knowledge of farmers in climate change.

Data Analysis

The data collected were analyzed using trend analysis, frequency and descriptive analysis and other appropriate statistical tools.

RESULTS AND DISCUSSION

Profile of the Respondents

The profile of the respondents were presented in Table 1 as to their age, gender, marital status, religion, educational background and number of years engaged in farming.

Age. Eleven (27.5%) of the chrysanthemum growers were on age bracket of 41-50 years old. There were 9 (22.5%) respondents who were on each of the age bracket 20-30, nine (22.5%) were 31-40 and 9 (22.5%) are 51-60 years old. Only one respondent was on 61-70 years old. This implies that the chrysanthemum growers were generally on their middle ages. Mean age was 42 years.

Gender.Finding shows that out of the 40 respondents, 62.5% were males and 37.5% were females. Since farming is in line with men work, it is expected that majority is male.

Marital status. Out of the 40 respondents, most (90%) were married. There were 3 singles and one widowed.

Religion. Most (77.5%) of the respondents were Catholic. Four were Episcopalian and 2 were Protestant. There was one Iglesia Ni Cristo, one Jehovah's Witnesses and also one Baptist. This implies that the respondents were predominant by catholic.

Occupation. All the respondents were farmers.

Educational background. Less than half (47.5%) of the respondents were high school level and 20% were college undergraduate. Seventeen and half percent were elementary level and 12.5% were college graduate. Only one took up a vocational course. From these result, it is shows that the level of education is low, which validates the claim that characteristics of farming that is carried out by low educated individuals.

Number of years engaged in farming. Half of the chrysanthemum producers were engaged in production for 16-20 years old. Twenty two and half percent were engaged for 21-25 years old, 17.5 were engaged for 26 years and above. Only 3 were engaged for 11-15 years and one for less than 5 years.

This implies that most of the chrysanthemum producers were already knowledgeable in production of chrysanthemum because of their experience.

Table 1. Profile of respondents

PARTICULAR	FREQUENCY	PERCENTAGE
Age		
20-30	9	22.5
31-40	9	22.5
41-50	11	27.5
51-61	9	22.5
61-70	2	5
TOTAL	40	100
Mean age= 42		
Gender		
Male	25	62.5
Female	15	37.5
TOTAL	40	100
Marital Status		
Single	3	7.5
Married	36	90
Widowed	1	2.5
TOTAL	40	100
Religion		
Catholic	31	77.5

Table 1. Continued…

PARTICULAR	FREQUENCY	PERCENTAGE
Protestant	2	5
Baptist	1	2.5
Iglesia Ni Cristo	1	2.5
Anglican	4	10
Jehovah's witnesses	1	2.5
TOTAL	40	100
Occupation		
Farming	40	100
Educational Background		
Elementary	7	17.5
High school	19	47.5
College under graduate	8	20
College graduate	5	12.5
Vocational	1	2.5
TOTAL	40	100
Years engaged in farming		
less than 5	1	2.5
11-15	3	7.5
16-20	20	50
21-25	9	22.5
26 and above	7	17.5
TOTAL	40	100

Changes in the Weather

There were changes in temperature based on the weather data gathered from PAG-ASA of Baguio City. The increase in temperature 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, there were already changes like increase and decrease in the incidence of pest and diseases. 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.

Table 2. Weather data (1900-2010)

YEAR	RELATIVE HUMIDITY (%)	MAXIMUM TEMPERATURE(^{0}C)	MINIMUM TEMPERATURE(^{0}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
1999	85.75	23.63	12.32	14.73
2000	85.83	23.88	17.98	6.53

Table 2. Continued...

YEAR	RELATIVE HUMIDITY (%)	MAXIMUM TEMPERATURE(^{0}C)	MINIMUM TEMPERATURE(^{0}C)	RAINFALL AMOUNT (MMS)
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. Table 3 presented that all the respondents were aware of climate change. Most (82.5%) of the respondents were aware of the abrupt changes in temperature. Forty two and half percent were aware of the occurrence of super typhoon; 72.5% were aware in abrupt changes in weather condition and 22.5% were aware of changes in season like prolong drying and wet season. There were 11 who's aware of La Niña and 9 were aware of El Niño.

This shows that majority were aware in abrupt changes in temperature and in weather conditions.

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	33	82.5
Occurrence of supper typhoon	17	42.5
Abrupt changes in weather condition	29	72.5
Changes in season like prolong drying and wet season	9	22.5
La Niña	11	27.5
El Niño	9	22.5

*Multiple responses

Changes in Agro-Ecological Profile

Presented in Table 4 and 5 were the changes in agro-ecological profile. These includes landscape of the farm, changes in farm landscape from 1990 to present and the causes of these changes in landscape.

Landscape of the farm. There were 16 terraced irrigated farms, 15 terraced unirrigated farms and 9 flat terrains.

Changes in farm landscape from 1990 to present. Table 5 presented the changes in farm landscapes from 1990 to present. The most observed change was the decreased supply of water. Thirteen farms easily get flooded and another 13 farms easily get dry. There were 4

irrigated fields that became unirrigated. Another 4 farms had soil with low water holding capacity. Only one sloping area became flat.

There were also observed changes in the soil type and texture of some farms. Two had loamed soil that became sandy. Another farms had soil that became compacted. There were two farms with soil that became acidic.

Causes of these changes in landscape. The most observed cause of the changes in the farm landscape is weather conditions. Other causes were soil structure changed from porous to compact (17.5%); El Niño (15%); La Niña (10%) and landslide of neighboring farm (7.5%). Supply of water became scarce because the source (spring/river) dried-up. Continuous use of the soil and effect of pesticides and commercial fertilizers were other source for the changes.

This implies that not only the changes in weather conditions but the chemicals used by farmers causes the changes on the landscape of the farm.

Table 4. Landscapes of the farm

PARTICULAR	FREQUENCY	PERCENTAGE
Landscape of the farm		
Terraced irrigated	16	40
Terraced unirrigated	15	37.5
Flat terrain	9	22.5
TOTAL	40	100

Table 5. Changes in agro-ecological profile

PARTICULAR	FREQUENCY	PERCENTAGE
Changes in farm landscapes from 1990 to present		
Sloping area became flat	1	2.5
Irrigated filed became unirrigated	4	10
Farm easily get flooded	13	32.5
Farm/soil easily get dry	13	32.5
Decrease supply of water	31	77.5
Low water holding capacity of the soil	4	10
Changes in the soil type and texture, What?		
loam to sandy	2	5
became acidic	2	5
Compacted	4	10
Causes of this changes in farm landscape		
Weather conditions	36	90
Landslide of neighbor farm	3	7.5
Soil structure change from porous to compacted	7	17.5
Soil erosion	2	5
Supply of water became scarce because the Source (spring/river) dried up	14	35
Landslide in the farm	3	7.5
La Niña	4	10
El Niño	6	15
Continuous use of the soil	5	12.5
Effect of pesticides and commercial fertilizer	5	12.5

*Multiple responses

Crops grown in 1990-2010. Table 6 shows the crops grown from 1990 to 2010. Chrysanthemum was the main crop. Most (95%) of the farmers planted chrysanthemum in the year 1990-2010, the other 5% started producing it from either 2001-2010. For pechay, 6 farmers planted it from 1990-2000 and 7 farmers from 2001-2010. Potatoes had been grown by 2 farmers in 1990-2000 and 4 in 2001-2010. Another 3 planted broccoli in 1990-2000 and 2 planted it in 2001-2010. Only one respondent had been growing onion in 2001-2010.

The result implies that chrysanthemum was the main crop. The intercrop vegetables were mainly for the family's consumption.

Number of cropping per year practiced. The respondents had been growing chrysanthemum either 2x or 3x a year. In the year 1990-2000, most (72.5%) of the respondents had grown chrysanthemum 3x a year. Twenty two and half percent had grown it 2x a year. From 2001-2010, 77.5% planted chrysanthemum 3x a year and 20% planted it 2x a year. Only one planted chrysanthemum 1x a year. Pechay, potatoes, and onions were intercrops while broccoli was planted once after chrysanthemum.

Table 7 shows that chrysanthemum can be grown for a maximum of 3x a year.

Table 6. Crops grown in 1990-2010

CROPS	1990-2000		2000-2010	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Chrysanthemum	38	95	40	100
Pechay	6	15	7	17.5
Potatoes	2	5	4	10
Broccoli	3	7.5	2	5
Onions			1	2.5

*Multiple responses

Table 7. Number of cropping per year practiced

CROPS		1990-2000		2000-2010	
		FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Chrysanthemum					
	1x	-	-	1	2.5
	2x	9	22.5	8	20
	3x	29	72.5	31	77.5
Potatoes		2	5	4	10
Pechay		6	15	7	17.5
Broccoli		3	7.5	2	5
Onions		-	-	2	5

Source of irrigation. The sources of irrigation were the rain, the river and spring as presented in Table 8. There were 9 who source their irrigation from the rain, 34 from the river and 34 from the spring.

It is revealed from the table that the river and the spring are the major sources of irrigation.

Changes in the source of irrigation from 1990 to present. As shown in Table 8, most (97.5%) of the respondents observed changes in the source of irrigation from 1990 to present. Only one respondent observed no change. The supply of water from the river and spring became low or scarce. During summer season the spring dried up.

This shows that despite the low water supply from the sources (river and spring), it is still enough to irrigate the farmer's fields.

Table 8. Sources of irrigation

PARTICULAR	FREQUENCY	PERCENTAGE
Source of irrigation		
Rain fed	9	22.5
River	34	85
Spring	34	85
Are there changes in the source of irrigation?		
There are changes	39	97.5
No changes	1	2.5
Changes in the source of irrigation		
Low water supply from the river	33	84.62
Spring dried during summer season	30	76.92
Low water supply from the spring	4	10.26

*Multiple responses

Changes in the variety of chrysanthemum grown from 1990 to 2010. Table 9 shows that 80% of the respondents have changed the variety of chrysanthemum grown while 20% did not change. Most (81.25%) of the reasons for changing the variety was to have higher yield followed by adoptability to weather changes and resistance to pests and diseases. Other reasons were it was adopted to climate change and easier to manage. Two respondents changed to avoid small buds and only one changed to shorten production period. One also changed because it was in demand and for economic reason.

The result implies that majority of the reasons lead to better demand and for economic reason.

Table 9. Changes in the variety of the crops

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in the variety of crops from 1990-2010?		
There are changes	32	80
There no changes	8	20
Reasons for changing the variety of crops grown		
Higher yield	26	81.25
Resistance to pest and diseases	13	40.63
Easy to manage	11	34.38
Adapted to weather changes	16	50
Adapted to climate changes	12	37.5
In demand	1	3.13

To avoid small buds	2	6.25
Shorten production period	1	3.13

*Multiple responses

Changes in the kind of crop grown. In Table 10, it was presented that 22.5% changed the kind of crop they grow while 77.5% did not. Two changed for better yield. Others changed because it has better demand in the market, for crop rotation to avoid soil acidity and because seedlings were not always available. Only one changed to have other source of food.

The results revealed that the most reason for changing the kind of crops is for better yield and better income.

Table 10. Changes in the crops grown

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in the kind of crop grown?		
There are changes	9	22.5
There are no changes	31	77.5
Reasons in changing the kind of crop:		
Better demand in the market	2	22.22
Better yield	2	22.22
Availability of seedlings	2	22.22
To avoid soil acidity	2	22.22
Source of food	1	11.11

Changes in Production/Cultural Management Practices.

The production activities were weeding, spraying, irrigation, artificial lighting in greenhouse or open field, fertilizer application, harvesting practices and packaging. These are presented in Table 11.

Weeding. Weeding was done 2x to 5x the whole cropping period. In the year 1990-2000, one half (50%) of the respondents weeded 3x. The others weeded 2x, 4x and 5x. From 2001-2010, majority (70%) weeded 3x the whole cropping period. Six respondents weeded 2x, 4 weeded 4x and 2 weeded 5x.

This shows that weeding can be done once, twice, thrice, fourth or fifth the whole cropping period. Majority of the respondents do three times.

Spraying. Spraying was done 1x, 2x or 3x a week as presented in Table 9. Majority of the chrysanthemum producers sprayed 2x a week. Some sprayed once a week while others sprayed 3x a week.

The table implies that their frequency of spraying depends on how severe the damage done by the pest.

Irrigation. The respondents irrigated their crops everyday either once or twice. The table shows that majority irrigated 2x a day.

Artificial lighting. In either greenhouse or open field, artificial lighting was done. It is because, chrysanthemum are long day plants.

Table 11 shows that in greenhouse artificial lighting lasted from 10-15 days, 15-20 days or 20-30 days. During the year 1990-2000, some (37.5%) of the farmers preferred to light their greenhouse in 15-20 days. Twelve and a half percent lighted their greenhouse in 20-30 days, 35% lighted their greenhouse in 10-15 days. From 2001-2010, majority (72.5%)

of the respondents lighted their greenhouse in 15-20 days, 20% lighted their greenhouse in 10-15 days and 7.5% preferred 20-30 days.

In open field, some (35%) lighted their field in 10-15 days followed by 32.5% of the respondents who chooses 10 days. The remaining 6 respondents lighted their field in 15-20 days. From 2001-2010, majority (57.5%) of the respondents preferred to light their field in 10-15days, 20% lighted their field in 10days and the other 20% of the respondents lighted their field.

The result implies that the frequency in the lighting has bad or good effects on the chrysanthemum. In greenhouses, the optimum number of days for lighting was 15-20 days while in open field was 10-15 days. If lower than the optimum, the effects on the plant were stunted growth and small buds. This revealed that chrysanthemum growers need to light their crops in open field of 10-15 days and 15-20 days for their greenhouse.

Fertilizer application. Application of fertilizers was done by the respondents only once for basal and side dressing. In the year 1990-2000, most (95%) of the respondents applied fertilizer for basal and 90% applied for side dressing. From 2001-2010, all of the respondents applied fertilizer for basal and 97.5% applied for side dressing.

The table shows that all of the chrysanthemum producers were applying fertilizers in their production.

Harvesting practices. The respondents harvested their crops either by cutting or uprooting the plant. There was a maximum of five times cutting. Uprooting was done if the plants will be replaced immediately. In 1990-2000, most (95%) respondents harvested by cutting and 62.5% harvested by uprooting. From 2001-2010, all of the respondents harvested by cutting and 27 of them also did uprooting.

The result implies that harvesting by cutting was better to have more harvest.

Packaging. The harvested crops were packed in cartoons. The harvests were first bundled by dozens then they are packed for disposal.

The table shows that all of the respondents were using cartoons to packed the bundled flower and deliver to the market destination.

Changes in the application of fertilizers. Out of the 40 respondents, only two changed their application of fertilizers, the rest did not. This was presented in Table 12 and 13.

One increased his application of chicken dung from 5 bags to 8 bags and triple 14 from 10 bags to 12 bags.

Table 11. Changes in the production/cultural management practices

	1990-2000		2000-2010	
ACTIVITIES	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
Weeding				
2x	13	32.5	6	15
3x	20	50	28	70
4x	4	10	4	10
5x	1	2.5	2	5
Spraying				
1x/week	8	20	7	17.5
2x/week	25	62.5	23	57.5
3x/week	5	12.5	10	25
Irrigation				
1x	6	15	4	10
2x	32	80	36	90
Artificial lighting				
Greenhouse				
10-15 days	16	35	8	20
15-20 days	19	47.5	29	72.5
20-30 days	5	12.5	6	15
Open field				
10 days	13	32.5	8	20
10-15 days	18	45	23	57.5
15-20 days	6	15	8	20
20-30 days	1	2.5	1	2.5
Fertilizer application				
Basal				

1x	38	95	40	100
Side dressing				
1x	36	90	39	97.5
Harvesting practices				
cutting	38	95	40	100
uprooting	25	62.5	27	67.5
Packaging				
dozens	38	95	40	100
bundles	25	62.5	27	67.5

Table 12. Changes in the application of fertilizers

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in the application of fertilizers?		
There are changes	2	5
There are no changes	38	95
TOTAL	40	100
What are the changes?		
Increase in application	2	100

Table 13. Changes on the volume of application of fertilizer

PARTICULAR				
Fertilizer	1900-2000		2000-2010	
	KIND	VOLUME	KIND	VOLUME
Chicken dung	Chicken dung	5 bags	Chicken dung	8 bags
Triple 14	Complete	10 bags	Complete	12 bags

Changes in the application of insecticide and pesticide. Table 14 presented the changes in the application of insecticide and pesticides. In this table, it shows that there were 20% of the respondents who changed their application of insecticide and pesticide while 80% did not. In 1990-2000, ascend, norcal, siga, karate, selectron and hyfer were applied low during wet season. In the dry season, selectron and ascend were applied moderately. Norcal were applied low during wet season and moderately applied during dry season while the others applied at low rate. Magnum, manager, triggered, antracol, D-10, matador, torogi, bida, volt, furadan, tamaron, bigshot, sumicidin were applied moderately during wet and dry season.

In 2001-2010, magnum, manager, triggered, antracol, ascend, D-10, matador, bida, tamaron, hyfer, bigshot, volt, autokill, sumicidin were applied moderately during wet and dry season (Table 15). Siga and selectron were applied low during wet season and moderately applied during dry season. Norcal and torogi were applied moderately during wet season and applied high in dry season. Karate was applied low during wet and dry season. Padan were applied moderate in wet season but low during dry season.

The results shows farmers used chemicals in controlling pest and diseases of chrysanthemum.

Table 14. Changes in the application of insecticides and pesticides

PARTICULAR	FREQUENCY	PERCENTAGE
Are there changes in application of pesticide and insecticides?		
There are	8	20
There are no changes	32	80
TOTAL	40	100

Table 15. Pesticides and insecticides used

NAME OF PESTICIDES AND INSECTICIDES	1990-2000		2001-2010	
	WET(MEAN)	DRY(MEAN)	WET(MEAN)	DRY(MEAN)
Magnum	2.8	2.7	2.77	2.77
Manager	2.3	2.75	2.5	2.75
Triggered	3	3	3	3
Antracol	2.2	2.39	2.26	2.74
Ascend	2	2.2	2.17	2.33
Norcal	2	4	3	4
D-10	2.4	2.53	2.6	2.8
Matador	2.37	2.53	2.45	2.7
Torogi	2.33	2.67	2.57	3.28
Bida	2.2	2.5	2.36	2.82
Siga	2	2	2	2.17
Tamaron	2.5	2.5	2.38	2.63
Padan	4	2.5	2.5	2
Autokill	4	2.5	2.5	3
Karate	2	2	2	2
Selectron	2	3	2	3
Hyfer	2	2	2.33	2.67
Bigshot	3	3	3	3
Volt	3	3	3	3
Sumucidin	3	3	3	3
Furodan	3	3		

Legend: 0-1 none 1.1-2 low 2.1-3 moderate 3.1-4 high

Observation on the incidence of pests and diseases. Table 16 presents the observation on the incidence of pest and diseases. In 1990-2000, trips, leaf miner, mites and aphids were moderate during the wet and dry season. In 2001-2010, incidence was moderate to high. Cutworms were moderate during the wet and became high during dry season since 1990-2010. During 1990-2010, stem borer were low during wet season and became moderate during dry season. Spider mites were low in wet season but high in dry season since 1990-2010, while bugs were low during wet and dry season in 1990 to 2010.

Since 1990-2010, incidence of bulutong blight was moderate during wet and dry season. In 1990-2000, blackspot and blade leg were low during wet and dry season and low to moderate in 2001-2010, from low to moderate. Fusarium was moderate in 2001-2010 during wet and dry season. In 1990-2000, "liklik" were high both on wet and dry season from 2001-2010, from low to high.

This implies that even wet and dry season the incidence of pest and diseases damaging crops in open field or in greenhouse were observed.

Control measures of pests. Table 17 shows how the farmers control the pests. All of them were using chemicals. Four respondents used biological control and five did manual picking. Manual picking is only possible in area is small and incidence is low.

The result implies that the most effective way to control the pests is to use chemicals.

Changes in yield. In Table 18, the changes in the yield of chrysanthemum are presented. In the average marketable yield, for the first cropping, there were 2,544 dozens for 1,300 sq.m area, in 1990-2000. This increased to 2,604 dozens in 2000-2010. For the second cropping, the average yield was 2,678 dozens in 1990-2000 but it decreased to 2389 during 2000-

2010. In the third cropping 2,721 dozens were the average yield in 1990-2000 but it was decreased to 2,539 in 2000-2010.

Table 16. Observation on the incidence of pest and diseases

NAME OF PESTS AND DISEASES	1990-2000		2001-2010	
	WET(MEAN)	DRY(MEAN)	WET(MEAN)	DRY(MEAN)
Pest				
Trips	2.5	3.03	2.83	3.46
Leaf miner	2.67	3.03	2.8	3.49
Mites	2.67	3	2.89	3.5
Aphids	2.43	2.86	2.67	3.57
Cutworms	2.5	3.1	2.5	3.6
Stem borer	2	2.5	2	3
Spider mites	2	3.5	2	3.5
Bugs	2	2	2	2
Diseases				
Bulutong	2.4	2.5	2.5	2.27
Blight	2.1	2.1	2.16	2.5
Blackspot	2	2	2	2.5
Possarium			2.6	2.8
Blade leg	2	2	2	2.5
“ liklik “	4	3	2	4

LEGEND: 0-1-none 1.1-2-low 2.1-3-moderate 3.1-4-high

Table 17. Control measures of pest

PARTICULAR	FREQUENCY	PERCENTAGE
Use of chemicals	39	97.5
Biological control	4	10
Manual picking	5	12.5

*Multiple responses

In this table, it shows the averages changes of non-marketable yield of chrysanthemum for 300m^2 area. The average non-marketable yield for the first cropping was 229.82 dozens in 1990-200. This increased to 232.5 dozens in 2000-2010.

Strategies/coping mechanisms employed by farmers. In Table 19, the strategies or coping mechanisms employed by farmers are presented. Out of the 40 respondents, 80% planned and implement production program. Sixty percent changed or adjusted their cropping period and 42.5% changed the variety of the chrysanthemum planted. Another 13 respondents shifted to greenhouse production and 9 changed their crops.

This shows that to have a better or higher yield, production should be well planned and implemented.

Table 18. Changes in the yield of chrysanthemum

AVERAGE MARKETABLE YIELD (BUNDLES)						
LAND AREA (m^2)	FIRST CROPPING		SECOND CROPPING		THIRD CROPPING	
	1990-2000	2000-2010	1990-2000	2000-2010	1990-2000	2000-2010
300(m^2)	2544	2604	2678	2389	2721	2539
AVERAGE NON-MARKETABLE YIELD (BUNDLES)						
300(m^2)	229.82	232.5	226.07	229.28	210	223.93

Table 19. Strategies/coping mechanism employed by farmers

PARTICULAR	FREQUENCY	PERCENTAGE
Changed or adjusted cropping period	24	60
Planned production program implemented	32	80
Changed crops	3	7.5
Shifted to organic production	1	2.5
Changed variety of crops	27	42.5
Shifted to greenhouse production	13	32.5

*Multiple responses

SUMMARY, CONCLUSION AND RECOMMENDATION

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 Ambiong 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 chrysanthemum farmers who served as the respondents. The study made use of primary and secondary data. A transect walk was also done in the study area to observe some changes. Secondary data was taken from PAG-ASA (Baguio City and BSU Agricultural-Meteorological Research Station). The data collected were tabulated and analyzed.

From the weather data, it is shown that there is an increased on the minimum temperature from 1990-2010. This shows that it's getting warmer.

The chrysanthemum growers were generally in their middle age. Out of the 40 respondents, 62.5% were males and 37.5% were females. The farmers had been farming for quite a long time.

One hundred percent of the farmers were aware of climate change. Most of them were aware of the abrupt changes in temperature and in weather conditions.

There were 16 terraced irrigated farms, 15 terraced unirrigated and 9 flat terrain. From these farms, changes were observed. The majority observed change is the decreased supply of water and the most cause is weather conditions.

Chrysanthemum can be planted either once, twice or thrice a year. Some vegetables were planted as an intercrop. In the year 1990-2000, most (72.5%) of the respondents had grown chrysanthemum 3x a year. In 2001-2010, 77.5% planted it 3x a year and 20% it 2x a year. The river and the spring were the major sources of irrigation. Some changes were observed by 97.5% respondents was the source of irrigation from 1990 to present. Most of the change is low water supply from the river followed by spring dried up during summer season.

Out of the 40 respondents, 80% have changed the variety of chrysanthemum they grow. Most of the reason in changing the variety was to have higher yield followed by adaptability to weather changes and resistance to pests and diseases. There were also changes in the kind of crop grown by only 9 farmers.

Weeding, spraying, irrigation, artificial lighting in greenhouse or open field, fertilizer application, harvesting and packing was done as the production management practices. Weeding was done 2x to 5x the whole cropping period. Majority sprayed 2x a week. The farmers irrigate their crops twice a day.

Artificial lighting was practiced in either greenhouse or open field because chrysanthemum requires more day light. In greenhouse, the optimum number of days for lighting was 15-20 days while in open field was 10-15 days.

Application of fertilizers was done once for basal and side dressing. All of the farmers were using fertilizers in their production. The farmers harvest their crops either by cutting or uprooting the plant. There was a maximum of 5x cutting. The respondents preferred cutting than uprooting to gather more harvest. The harvest crops were packed in cartoons. The harvests were first bundled by dozens before packing.

Out of the 40 respondents, only two changed their application of fertilizers.

Majority respondents increase application of insecticides and pesticides as the pest and diseases also increased. Even in wet or dry season, pests and diseases were present

The average marketable yield in 1990-2000 increased continuously from the first cropping to the third cropping. In 2000-2010, the yield decreased in the second cropping.

The average non-marketable yield in 1990-2000continuously decreased from the first to the last cropping.

Most (80%) respondents planned production program and implemented it to cope up with climate change followed by adjustment in the cropping period.

Conclusion

The following conclusions were drawn based on the results of the study:

Temperature is getting warmer based from the weather data where the minimum temperature increased. The increased utilization of chemicals by the farmers contributes to climate change. On the other hand, climate has effects on the farmer's production.

All of the farmers were aware of climate change, however, were not aware of the adverse effect of their production practices to climate change.

The production management was influenced by some factors such as climate change, the farmer's own preferences, pest and diseases and economic factors.

An strategy/coping mechanism employed by farmers was to plan and implement production program.

Recommendation

Chemical inputs in farming contributes to climate change problems thus, it is recommended that farmers should reduce utilization of chemical inputs. Massive information dissemination should be done by government and non-government organization about climate change and its adverse effect to the environment. It is recommended that farmers should revisit traditional production practices to reduce effect of global warming and pollution to air and soil.

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