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## Investigating the influence of climate change on crop and livestock: A case study of Bidar and Raichur districts of Karnataka

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### Abstract

The study assessed the influence of climate change on crop and livestock as expressed by farmers and adaptation measured followed by them under changing condition. Simple random sampling technique was employed to select 120 respondents comprising equal number of respondents from Bidar and Raichur districts. The primary data required for the study were collected by structured interview schedule administered on 120 farmers randomly selected from the Bidar and Raichur districts of Karnataka. Descriptive analyses of data were carried out using frequency counts, percentages, means and tables. In Bidar district 85.00 per cent of the farmers expressed that income from crop production is adversely affected due to climate change and 81.67 per cent of the Raichur farmers agreed with the same. 80.00 and 70.00 per cent of Bidar and Raichur farmers respectively expressed that there is decrease in crop yield due to climate change. In Bidar district 81.67 per cent (63.33% in Raichur district) opined there is increase in outbreak of livestock diseases in changing climate and 61.67 per cent (53.33% in Raichur district) felt that there is reduction in milk yield of dairy animals. Adaptation measures initiated by the farmers to mitigate the influence of climate change were change in sowing dates, drought escaping mechanism, shifted from long duration to short duration varieties and crop diversification. Some of the farmers have increased the quantity of fertilizer application while some have increased the number of irrigations given. The study reveals that most of the farmers are aware of climate change and its influence on crop and livestock and took up the adaptation measures.

**Keywords:** Climate change, crop, livestock

### 1. Introduction

Climate change impacts and associated vulnerability are of concern to developing countries, where large parts of the population depend on climate sensitive sectors like agriculture and forestry for livelihood. By adversely affecting freshwater availability and quality, biodiversity and desertification, climate change tends to disproportionately affect the poorest in the society, exacerbating inequities in access to food, water and health. The capacity to adapt is a function of access to wealth, scientific and technical knowledge, information, skills, infrastructure, institutions and equity and therefore varies among regions and socio-economic groups. Climate change therefore is intrinsically linked to other environmental issues and to the challenge of sustainable development.

Scientific evidence about the seriousness of the climate threat to agriculture is now unambiguous, although the exact magnitude is uncertain because of the complex interactions and feedback processes in the ecosystem and in the economy. The Fourth Assessment Report by the Inter- Governmental Panel on Climate Change (IPCC) in 2007, projects for India an acceleration of warming above that observed in the 20th century, a decrease in precipitation, and an increase in the occurrence of extreme weather events. Climate change is expected to have adverse effects on agriculture, the eradication of poverty, food security, and the water supply (Anonymous, 2007). In particular, the rural farmers, whose livelihoods depend on agriculture, are likely to bear the brunt of adverse impacts. Under such circumstances, adaptation could be one of the better options available for developing countries to counter the heavy burden of climate change. There are various studies in the literature which reflects that with adaptation the risk to climate change can be reduced or minimized to a greater extent and without adaptation it can be harmful for the agricultural sector (Smit and Wandel, 2006, Reidsma *et al.* 2010, Deressa *et al.* 2011). In agriculture adaptation is evolutionary (Nelson 2007) and farmers do adapt to reduce their vulnerability to climate change.

The adoption and successful implementation of new technology and husbandry practices and farmers' adaptation to changes in their ecosystems depend on their tendency to perceive and react favorably towards changes in climate and environment.

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The lack of enough knowledge about climate changes and the impact on agricultural production is a setback to long term sustainable agriculture in most developing countries (Kemausor *et al.*, 2011). If farmers are to cooperate in devising mitigation and adaptation strategies, they should at least be aware of climate change and their causes and effects. This paper presents the results of a survey to determine influence of climate change on crop and livestock as expressed by the farmers and adaptation measures taken up by them. The standardized structure schedule was used to collect the data through personal interview technique.

## 2. Methodology

### 2.1.a: Overview of the study area

The research was conducted in Bidar and Raichur districts of Karnataka. From Bidar district, Bidar and Basavakalyana were purposively selected based on highest (998mm) and lowest (821mm) annual normal rainfall respectively. Similarly, from Raichur district, Raichur and Devadurga are selected based on highest (688mm) and lowest (640mm) annual normal rainfall. From Bidar taluka, Gadagi and Shrimandala, from Basavakalayana taluka, Khanapurwadi and Neelakantawadi were randomly selected. From Raichur taluka

Merchatal and Garaldini were randomly selected and from Devadurga taluka, Gabbur and Sunkeshwarahal were randomly selected.

### 2.1.b: Selection of respondents

From each village, fifteen farmers were selected randomly. Thus, the total sample size constitutes 120 respondents for the study. The required information was obtained from sample respondents by personal interview method with the help of structured interview schedule. Frequency, percentages and means were used to analyze the data and presented in tabular form.

## 3. Results

### 3.1: Influence of climate change on crop and livestock as expressed by respondents

#### 3.1.a: Influence of climate change on crop and livestock as expressed by respondents in Bidar district

It is noticed from Table 1 that majority (80.00%) of the respondents felt that there is decrease in the crop yield due to climate change. Farmers reported that droughts, increased temperature and erratic and unpredictable rainfalls led to crop losses and reduction in crop yield.

**Table 1:** Influence of climate change on crop and livestock as expressed by farmers (Bidar district) (n<sub>1</sub>= 60)

S. No	Statements	Expressed		Not expressed	
		F	P	F	P
1	There is decrease in the crop yield due to climate change	48	80.00	12	20.00
2	Income from crop production is adversely affected due to climate change	51	85.00	9	15.00
3	Cost of cultivation has increased due to changes in the climate	42	70.00	18	30.00
4	There is more weed infestation due climate change (leads to competition for space, nutrients etc)	36	60.00	24	40.00
5	There is more pest and disease incidence due to climate change	48	80.00	12	20.00
6	Non availability of adequate soil moisture for various crops due to occurrence of frequent drought	47	78.33	13	21.67
7	There is decrease in cropping intensity and gross cropped area due to climate change over the years	22	36.67	38	63.33
8	Farmers dependency on external inputs like pesticides and agricultural chemicals to manage the disease outbreak in different crops is more in changing climate	36	60.00	24	40.00
9	There is increase in outbreak of livestock diseases in changing climate	49	81.67	11	18.33
10	Death of livestock due to shortage of feed and fodder	28	46.67	32	53.33
11	Death of livestock due to lack of availability of drinking water	24	40.00	36	60.00
12	Death of livestock due to unknown diseases	10	16.66	50	83.33
13	There is reduction in milk yield of dairy animals due to climate change	37	61.67	23	38.33
14	Problem of acclimatization of new breed even in slightly changed climate	10	16.66	50	83.33
15	Maintenance cost of livestock increases as increase in incidence of diseases	44	73.33	16	26.66
16	Reduction in usage of livestock for discharge of agriculture operations	40	66.67	20	33.33

F = Frequency P = Percentage

85.00 per cent of the respondents felt that, income from crop production is adversely affected due to climate change as farmers expressed that they mainly depend on crop output for their income and livelihoods, occurrence of bad seasons due to lack of rainfall, extreme temperature, drought etc reduced their income. Similarly, it was clearly indicated that 70.00 per cent of respondents opined that cost of cultivation has increased due to changes in the climate. Farmers reported that due to increase in use of fertilizers, chemical sprays, increase in the use of other inputs their cost of cultivation has increased. Also 60.00 per cent of them felt that there is more weed infestation due climate change as they perceived that increased dose of fertilizers, irrigations given, plant protection chemicals sprayed against pest and diseases in changing climate benefited the weeds also. Above results were similar with the findings of Ogalleh *et al.*, (2012).

It was also evident from the table that 78.33 per cent of the respondents felt that adequate soil moisture not available for various crops due to occurrence of frequent drought as the

farmers reported that droughts reduce the water in the soil, which has negative impact on soil fertility, crop growth and yield. 63.33 per cent did not felt that cropping intensity and gross cropped area decreased due to climate change over the years. Reason coated by farmers was that, they are growing same number of crops in a year or have taken up two crops annually. While 36.67 per cent felt that it has decreased. Farmers opined that due to inadequate soil moisture and erratic rain they are unable to take up second crop in the year as like they used to take previously. Also 60.00 per cent of the respondents felt that farmer's dependency on external inputs to manage the disease outbreak is more in changing climate. Farmers reported that due to the changes in temperature and rainfall crops are affected severely by pest and disease outbreak and forced to take up frequent chemical spray to manage them. Above results were in line with the findings of Ogalleh *et al.* (2012).

In case of Influence of climate change on livestock, majority (81.67%) of the respondents opined that there is increase in

outbreak of livestock diseases in changing climate. They felt that increase in disease and insect-pests infestation may be due the changes in rainfall pattern, temperature, sunshine hours, wind direction, humidity and wind velocity. More than half (53.33%) of the respondents did not felt the death of livestock due to shortage of feed and fodder. Even 60.00 per cent of the respondents did not felt the death of livestock due to lack of availability of drinking water. Farmers opined that livestock was better adapted to droughts than crops and that there was the possibility of arranging feed and fodder from other areas and scarcity of water was not to the extent of death of livestock. So the farmers were able to save the livestock from droughts and changing climate. Majority (83.33%) of the respondents not felt that, there is death of livestock due to unknown diseases as they expressed that they did not witness any unknown diseases in livestock. More than half (61.67%) of the respondents felt that there is reduction in milk yield of dairy animals due to climate change. As they opined that due to increasing temperature and reduced rainfall dairy animals faced the shortage of fodder and also water. Even if there was no death there was reduction in their productivity. Considerable majority (83.33%) of the respondents did not felt the problem of acclimatization of new breed even in slightly changed climate as they reasoned that they did not

possess any new breeds so they did not felt the problem. Most (73.33%) of the respondents felt that maintenance cost of livestock increases as increase in incidence of diseases, while rest (26.66%) did not. They expressed that they need to clean the shed, isolate the diseased animals, get them treated etc, which increases their maintenance cost. Rest did not feel the same, as they said that, they did not come across any such diseases. 66.67 per cent of the respondents felt that there was reduction in usage of livestock for discharge of agriculture operations for draft purpose. They opined that mechanization was the better option than maintaining the livestock, while rest expressed that because of their poor financial condition they continued with livestock for discharge of agricultural operations for draft purpose. The above results were like the results of Kant *et al.*, (2015).

### 3.1.b: Influence of climate change on crop and livestock as expressed by respondents in Raichur district

With respect to influence of climate change on crops, it is evident from Table 2 that, majority (70.00%) of the Raichur respondents felt that there was decreases in the crop yield due to climate changes. They expressed that they witnessed reduction in crop yield due to occurrence of less amount of rainfall. While rest (30.00%) of the others did not felt.

**Table 2:** Influence of climate change on crop and livestock as expressed by farmers (Raichur district) (n= 60)

S. No	Statements	Expressed		Not expressed	
		F	P	F	P
1	There is decrease in the crop yield due to climate change	42	70.00	18	30.00
2	Income from crop production is adversely affected due to climate change	49	81.66	11	18.33
3	Cost of cultivation has increased due to changes in the climate	36	60.00	24	40.00
4	There is more weed infestation due change in climate (leads to competition with crops for space, nutrients etc.)	38	63.33	22	36.67
5	There is more pest and disease incidence due to climate change	42	70.00	18	30.00
6	Non availability of adequate soil moisture for various crops due to occurrence of agricultural drought	52	86.66	8	13.33
7	There is decrease in cropping intensity and gross cropped area due to climate change over the years	34	56.66	26	43.33
8	Farmers dependency on external inputs like pesticides and agricultural chemicals to manage the disease outbreak in different crops is more in changing climate	48	80.00	12	20.00
9	There is increase in outbreak of livestock diseases in changing climate	38	63.33	22	36.67
10	Death of livestock due to shortage of feed and fodder	24	40.00	36	60.00
11	Death of livestock due to lack of availability of drinking water	28	46.67	32	53.33
12	Death of livestock due to unknown diseases	17	28.33	43	71.67
13	There is reduction in milk yield of dairy animals due to climate change	32	53.33	28	46.66
14	Problem of acclimatization of new breed even in slightly changed climate	7	11.67	53	88.33
15	Maintenance cost of livestock increases as increase in incidence of diseases	40	66.67	20	33.33
16	Reduction in usage of livestock for discharge of agriculture operations	51	85.00	9	15.00

F = Frequency P = Percentage

The reason may be due to better farming and irrigation facilities available with them. Considerable majority (81.67%) of the respondents felt that income from crop production is adversely affected due to climate change. Farmers opined that they are going to lose their agricultural soil fertility and crop cultivation opportunity due to drought hazards which affected their income as they neither produce enough for sale nor for their own food. This means that their earning capacity is impaired, and their income is adversely affected. Even 60.00 per cent of them felt that cost of cultivation has increased due to changes in the climate. Farmers reported that due to increase in use of fertilizers, chemical sprays, increase in the use of other inputs their cost of cultivation has increased. Rest of the 40 per cent expressed that cost of cultivation remained same as like before. 63.33 per cent of the respondents felt that there is more weed infestation due change in climate. They opined that changing climate is favorable to weed growth even more input use due to changing climate also favored

weed growth. Above results were similar with the findings of Ogalleh *et al.*, (2012).

It was also evident from the table that 78.33 per cent of the respondents felt that adequate soil moisture not available for various crops due to occurrence of frequent drought. Reason may be that there is lack of availability of water in the agricultural field, then it is converted into barren soil owing to soil moisture storage, followed by 21.67 per cent with opposite opinion may be due to the availability of irrigation facilities due to which they did not experience the soil moisture shortage. Similar findings were reported by Rakib *et al.* (2014). Even more than half (56.66%) of the respondents felt that there is decrease in cropping intensity and gross cropped area. Farmers opined that due to inadequate soil moisture and erratic rain they are unable to take up second crop in the year and also sometimes field is kept barren due to non-occurrence of rains. Remaining (43.33%) had opposite opinion as they expressed that they took up single crop every

year and followed the same. Further majority (80.00%) of the respondents felt that farmer's dependency on external inputs to manage the disease outbreak is more in changing climate. This may be because of the reason that, farmers spray more pesticides and fungicides to protect the crops.

In case of influence of climate change on livestock, 63.33 per cent of the respondents felt that there is increase in outbreak of livestock diseases in changing climate. They felt that increase in disease and insect-pests infestation may be due to the change in rainfall pattern, temperature, sunshine hours, wind direction, humidity and wind velocity. While 36.67 per cent had opposite opinion may be because of the reason that they did not possess livestock. 60.00 per cent of the respondents did not felt the death of livestock due to shortage of feed and fodder and more than half (53.33%) of the respondents not felt that there is death of livestock due to lack of drinking. Reason may be that livestock was better adapted to droughts than crops and that there was the possibility of arranging feed and fodder from other areas and scarcity of water was not to the extent of death of livestock. So, the farmers were able to save livestock from droughts and changing climate. While remaining were of the opposite opinion because of the reason that frequent droughts and dry spells caused the death of the livestock. Even most (90.00%) of them did not felt the death of livestock due to unknown diseases as they expressed that they did not witness any unknown diseases in livestock. More than half (53.33%) of the respondents felt that there is reduction in milk yield of dairy animals. As they reasoned that due to increasing temperature and reduced rainfall dairy animals faced the shortage of feed and fodder and also water. Even if there was no death there was reduction in their productivity. While rest (46.66%) did not felt that there is reduction in milk yield of dairy animals as they opined that dairy animal's milk yield was same as before. Considerable majority (88.33%) of the respondents did not felt the problem of acclimatization of new breed even in slightly changed climate as they did not buy any new breeds. 66.67 per cent of the respondents felt that maintenance cost of livestock increases as increase in incidence of diseases They expressed that they need to clean the shed, isolate the diseased animals, get them treated etc which increases their maintenance cost. Rest didn't feel the same as they said that they did not come across any such diseases. Majority (85.00%) of the respondents felt that, there was reduction in usage of livestock for discharge of agriculture operations for draft purpose. They opined that mechanization was the better option than maintaining the livestock while rest expressed that because of their poor financial condition they continued with livestock, for

discharge of agricultural operations. The above results were like the report of Kant *et al.* (2015).

### 3.2 Adaptation measures followed by farmers under changing condition

#### 3.2.1 Adaptation measures initiated by respondents to mitigate the influence of climate change (Bidar district)

It was observed from the table 3 that, respondents in Bidar have initiated many adaptation measures to mitigate the influence of climate change. Majority (86.66%) of the respondents have taken up crop diversification as the major adaptation strategy to cope up with changing climate. Adopting crop diversification implies that farmers believe that different crops are influenced differently by climate factors; growing a variety of crops at the same time and in the same plot may be seen to be a strategy to reduce the risk of crop failure. Results were similar to the findings of Van *et al.* (2015). 73.33 per cent of the respondents who initiated farm diversification and integrated farming system as a major adaptation strategy. Reason was that, farm diversification includes rearing of livestock, livestock is used as safety net during crisis; livestock helps to cushion income changes due market instabilities. livestock products act as additional source of income for the farmers. Growing vegetables, perennial crops also added to the income of the farmers. Remaining per cent of the respondents did not take up farm diversification and integrated farming system may be because of lack of knowledge and non-availability of adequate resources. 46.66 per cent of the respondents went for changes in the sowing dates. Reason was that farmers did not prefer to sow crops if the soil moisture was insufficient. While remaining did not changed the sowing dates as they had irrigation facilities and followed same planting dates like before. 43.33 per cent of the respondents shifted from long duration to short duration varieties. They opined that short seasons signifies less rain and crops that take a short time to mature were cultivated. Similar results were found in Ogalleh *et al.* (2012). Table also depicted that 35.00 per cent of the respondents took up drought escaping mechanism. They reported that they cultivated drought tolerant crops and went for seed socking and seed treatment process as drought escaping mechanism. 31.67 per cent initiated taking up of agro forestry practices. Reason may be that it helps in preventing soil erosion and additional source of income. 23.33 per cent went for constructing farm pond as adaptation measures to mitigate climate change influence. Respondents expressed that farm ponds helps to mitigate the problem of deficit water availability to crops and helps in maintaining the soil moisture.

**Table 3:** Adaptation measures initiated by respondents to mitigate the influence of climate change (Bidar district) (n<sub>1</sub>= 60)

S. No	Adaptation measures	Initiated		Not initiated	
		Frequency	Percentage	Frequency	Percentage
1	Shifted from long duration to short duration varieties	26	43.33	34	56.66
2	Changes in crops (crop diversification)	52	86.66	8	13.33
3	Farm diversification and integrated farming system	44	73.33	16	26.66
4	Changes in sowing dates	28	46.66	32	53.33
5	Use of efficient irrigation methods	6	10.00	54	90.00
6	Construction of farm pond	14	23.33	46	76.66
7	Taking up of agro forestry practices	19	31.67	41	68.33
8	Green house farming	0	0.00	60	100.00
9	Drought escaping mechanism	21	35.00	39	65.00
10	Others	0	0.00	60	100.00

Only 10.00 per cent used efficient irrigation methods as adaptation strategy. Farmer's preference for use of modern irrigation practices such as sprinkler, drip irrigation was low due to high cost associated with them. While none of the respondents used greenhouse farming as adaptation measure due to the heavy cost and maintenance problem associated with them.

### 3.2.2. Adaptation measures initiated by respondents to mitigate the influence of climate change (Raichur district)

Table 4 indicated that more than half (58.33%) of the respondents went for changing sowing dates as a adaptation measure to climate change. Adjusting planting dates was the most popular adaptive measure identified as it is low cost, simple to apply and considered to be effective in reducing climate change impacts. 30.00 per cent who took up drought escaping mechanism. They reported that they went for seed treatment, used drought tolerant crops which helped to combat the adverse effect of drought as their farming was mainly dependent on rain for cultivation of crops. 26.66 per

cent shifted from long duration to short duration varieties. They opined that short seasons signifies less rain and crops that take a short time to mature were cultivated. While 16.66 per cent have taken up farm diversification and integrated farming system may be due to the reason that it acts as the additional source of income even if there was crop failure. 11.67 percent have taken up crop diversification as adaptation measure. Reason may that even if there is failure of one crop, income will be generated from other crops grown. But majority did not take up crop diversification as the significant limitation of diversification is that it is costly in terms of the income opportunities that farmers forego, i.e., switching of crop can be expensive, making crop diversification typically less profitable than specialization. Only few per cent have taken up construction of farm pond (8.33%) and agro forestry practices (5.00%) due to the lack of awareness of benefits and the unimportance they felt about it. While none of them taken up efficient irrigation method and green house farming as adaptation strategies as the reason may be that due to high maintenance cost associated with them.

**Table 4:** Adaptation measures initiated by respondents to mitigate the influence of climate change (Raichur district) (n<sub>2</sub>= 60)

S. No	Adaptation measures	Initiated		Not initiated	
		Frequency	Percentage	frequency	Percentage
1	Shifted from long duration to short duration varieties	16	26.66	44	73.33
2	Changes in crops (crop diversification)	7	11.66	53	88.33
3	Farm diversification and integrated farming system	10	16.66	50	83.33
4	Changes in sowing dates	35	58.33	25	41.66
5	Use of efficient irrigation methods	0	0.00	60	100.00
6	Construction of farm pond	5	8.33	55	91.67
7	Taking up of agro forestry practices	3	5.00	57	95.00
8	Green house farming	0	0.00	60	100.00
9	Drought escaping mechanism	18	30.00	42	70.00
10	Others	0	0.00	60	100.00

### 3.2.3. Trend analysis of Adaptation measures followed by respondents to mitigate climate change influence (Bidar district)

A curiosity took at table 5 showed that most (65.00%) of the respondents did not make any changes in spacing between the rows or plants as a measure to climate change reason may be that there will be decrease in yield if number of plants grown per ha reduced, followed by 26.66 per cent who increased the spacing as they opined that due to decreased rainfall there is competition between the plants for water, nutrients, so increased spacing will help in better growth of the plants. whereas only 8.33 per cent decreased the spacing may be the reason that more number of crops results in more yield. 68.33 per cent of the respondents used same quantity of seeds/cuttings as they did not change the spacing between the rows or plants, while 20.00 per cent decreased the quantity of seeds as certain per cent of the people increased the spacing which reduced the quantity of seeds required followed by 11.66 per cent who increased the quantity as they preferred to go for thinning when required and also decreased spacing

more quantity of seeds for sowing. Table also depicted that, most (63.33%) of the respondents have increased the fertilizer application as an adaptation measure as they reasoned that there is loss of nutrients from the soil due to increasing temperature and decreasing rainfall which demands more fertilizer application whereas 30 per cent did not go for any changes and only 6.66 per cent decreased the quantity of fertilizer application as the cost of fertilizers is high.

With regards to irrigation, 60.00 percent of the respondents did not increase the number of irrigations given as there were no proper irrigation facilities available with them whereas 40.00 per cent have increased it as they relate to better irrigation sources. In the same way, 60.00 percent of them did not make changes in number of times plant protection chemicals sprayed as the plant protection are costly by followed 35.00 per cent increased as they witnessed more pest attack in changing climate and had better financial condition and only 5.00 per cent decreased the spray of chemicals. Above results were in line of findings of Shankara (2010).

**Table 5:** Trend analysis of adaptation measures followed by respondents to mitigate climate change influence (Bidar district) (n<sub>1</sub>=60)

S. No	Adaptation measures	Changes taken up		
		Increased	Decreased	No change
1	Spacing between the rows/plants	16 (26.66)	5 (8.33)	39 (65.00)
2	Quantity of seeds/cuttings used	7 (11.66)	12 (20.00)	41 (68.33)
3	Quantity of fertilizer application	38 (63.33)	4 (6.66)	18 (30.00)
4	Number of irrigation given	24 (40.00)	0 (0.00)	36 (60.00)
5	Number of times plant protection chemicals sprayed	21 (35.00)	3 (5.00)	36 (60.00)

\*Parenthesis indicates percentiles

**Table 6:** Trend analysis of adaptation measures followed by respondents to mitigate climate change influence (Raichur district) (n<sub>2</sub> = 60)

S. No	Adaptation measures	Changes taken up		
		Increased	Decreased	No change
1	Spacing between the rows/plants	14 (23.33)	8 (13.33)	38 (63.34)
2	Quantity of seeds/cuttings used	10 (16.66)	16 (26.66)	34 (56.67)
3	Quantity of fertilizer application	34 (56.66)	3 (5.00)	23 (38.33)
4	Number of irrigation given	14 (23.33)	0 (0.00)	46 (76.67)
5	Number of times plant protection chemicals sprayed	28 (46.67)	2 (3.33)	30 (50.00)

\*Parenthesis indicates percentiles

### 3.2.4. Trend analysis of adaptation measures followed by respondents to mitigate climate change influence (Raichur district)

From the Table 6, trend was observed that, 63.34 per cent of the Raichur respondents had kept same spacing between the rows/plants, reason may be that there will be decrease in yield if number of plants grown per ha reduced, while 23.33 percent had increased as they opined that due to decreased rainfall there is competition between the plants for water, nutrients, so increased spacing will help in better growth of the plants and 13.33 percent had decreased the spacing may be the reason that more number of crops results in more yield. Even there was no change in the quantity of the seeds used for sowing by more than half (56.67%) of the respondents may the reason that variation may decrease the yield followed by 26.66 percent who decreased the quantity of seeds in order to reduce the competition between the crops for water and nutrients and only 16.66 per cent had increased in order to go for thinning if required. While 56.66 percent of the respondents increased the quantity of fertilizer in order to provide better nutrient facilities to the crops followed by 38.33 per cent who didn't make any changes and only few (5.00%) had decreased the quantity of fertilizers used due to heavy cost involved in it. With respect to number of irrigations given majority (76.67%) of the respondents had not made any changes due to inadequate irrigation facilities, while rest of the farmers (23.33%) had increased the number of irrigations given as they were having better irrigation facilities with them. half (50.00%) of the respondents did not go for any changes in number of times plant protection chemicals sprayed as it increases their cost of cultivation followed by 46.67 percent who increased the spray, as they observed more pest incidence while only 3.33 percent had decreased the sprays.

### 3.2.5. Other adaptation strategies followed by farmers to mitigate climate change influence in Bidar District

It is evident from Table 7 that more than half of the respondents took up soil conservation as a major adaptation strategy as farmers opined that they are adapting to variations in rainfall through planting herbaceous and woody plants along farm contours to conserve soil fertility. These practices were also coupled with crop rotation, mixed cropping and mulching in an effort to reduce vulnerability to climate and to increase crop yields and farm income. Only 22.33 per of the farmers were involved in rainwater water harvesting. Farmers expressed that rainwater harvesting can offer a partial solution to the issue of climate change. Farmers have taken up construction of farm ponds to conserve rainwater. While majority did not go for rain water harvesting as the farmers attributed their lack of harnessing rainwater to inadequate finances. 16.67 per cent of the farmers or their family members migrated to other areas as they reported that adequate income was not generating in farming for their livelihood. Reduced investment in farm was opted by only

10.00 per cent as the farmers expressed that they solely depend on farming and it is only source of income. The findings were in accordance with the findings of Molua (2002).

**Table 7:** Other Adaptation strategies to mitigate climate change influence (Bidar district) (n<sub>1</sub> = 60)

S. No	Adaptation measures	Followed		Not followed	
		F	%	F	%
1	Rainwater harvesting	14	23.33	46	76.67
2	Migration to other areas	10	16.67	50	83.33
3	Reduced investment in the farm	6	10.00	54	90.00
4	Soil conservation	33	55.00	27	45.00
5	Others	0	0.00	60	100.00

F = Frequency % = Percentage

**Table 8:** Other Adaptation strategies to mitigate climate change influence (Raichur district) (n<sub>2</sub> = 60)

S. No	Adaptation measures	Followed		Not followed	
		F	%	F	%
1	Rainwater harvesting	5	8.33	55	91.67
2	Migration to other areas	13	21.67	47	78.33
3	Reduced investment in the farm	5	8.33	55	91.67
4	Soil conservation	16	26.67	44	73.33
5	Others	0	0.00	60	100.00

F = Frequency % = Percentage

### 5.5.6. Other adaptation strategies followed by farmers to mitigate climate change influence in Raichur District

It is reported from Table that 8 per cent of the respondents adapted soil conservation practices. Farmers reported they took up soil conservation practices such as construction of bunds, planting trees along the bund, crop rotation and mulching. 21.67 percent of the farmers or their family members migrated to other areas for their livelihood as they could not depend solely on farming because of reduced and erratic rainfall and increasing temperature which has adversely affected agricultural productivity. 8.33 percent of the respondents reduced investment in farming as the farming was their main source of income. While only 8.33 percent took up rain water harvesting as the expressed that they were experiencing drought and very minimal rainfall in the areas, so rain water harvesting was a difficult task. Over all table depicts that majority of the farmers did not take up the adaptation measures because of the constraints such as lack of finance, lack of technical knowledge and skills and less risk bearing ability of the farmers. The above results were in line with the findings of Mburu *et al.*, (2015).

## 4. Conclusion

This study was aimed at ascertaining the influence of climate change on crop and livestock as expressed by farmers and to know the adaptation measures taken by them to cope up with the change. It is established from this study that farmers were aware of influence of climate change and its impacts on food

crop production and livestock. Results showed that majority of the farmers expressed that income from crop production is adversely affected due to climate change, there is decrease in crop yield due to climate change, there is increase in outbreak of livestock diseases in changing climate and most of them felt that there is reduction in milk yield of dairy animals, death of livestock due to shortage of feed, fodder and availability of drinking water. Adaptation measures initiated by the farmers were change in sowing dates, drought escaping mechanism, shifted from long duration to short duration varieties and crop diversification. Some of the farmers have increased the quantity of fertilizer application while some have increased the number of irrigations given. Based on results obtained in this study one can conclude that most of the farmers are aware of climate change and its influence on crop and livestock and took up the adaptation measures.

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