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Knowledge of Extension Professionals regarding Impact of Climate Change in Agriculture

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ABSTRACT

Empirical study conducted on extension professionals of 19 KVKs under administrative control of CCSHAU Hisar indicated that overall knowledge of extension scientists was found low to moderate which indicate that they were not completely abreast of implications of climate change in agriculture. Vast majority had good knowledge in relation to impact of temperature on crop growth and effect on physio-chemical system of plant. Majority was found well aware of the fact that rise in soil temperature increases rate of volatilization and denitrification, affects the soil microbial activities and soil temperature affects the soil biomass/organic carbon. Vast majority was found familiar with aspects such as water pollution affects physio-chemical activities in plant and also creates nutrient deficiency in plant and it leads to suppress the soil microbial activities. Knowledge of impact of climate change on biodiversity indicated that they had knowledge of extinction/ near extinction of certain plants/ fruits/trees/animals/birds species and emergence of new insect-pests/ diseases whereas only 56.00 percent of them had knowledge that climate change have resulted in suitability for growth of certain new crop plants/ fruits/trees/animals/birds species. Necessary efforts should be made to build the capacity of these extension scientists on impact of climate change especially in harnessing the increased CO_2 level and C- sequestration processes and climate resilient species of plants and animal for promotion of remunerative agriculture.

Key words: Climate change, knowledge, impact, sustainability, temperature, pollution, biodiversity.

INTRODUCTION

Global climate changes are unique research challenges to present day agriculture. The impact of these climate changes like drought, floods and severe storms and high temperature on agriculture are already witnessed, yet sizable gaps remain in our knowledge regarding implications on agriculture as a result of short as well as long-term changes in climate. Despite some projected increase in photosynthesis caused by higher CO_2 concentration, rising temperature will have a far greater detrimental effect, resulting in reduced crop productivity. Higher temperature eventually reduces yields of desirable crops while encouraging weed and pest infestation. Changes in precipitation pattern may increase crop failures on short-run and production decline in long run. Food production may benefit from a warmer climate, the increased potential for droughts, floods and heat wave will pose challenges for farmers. Additionally, the enduring changes in water supply, soil moisture, could make it less feasible to continue crop production. GHG concentration is regarded as main reason of climate degradation. Environmental friendly and good quality agricultural production management can reduce the green house gases and have the potential to lower down the ill effects of climate change. The adoption of agro forestry practices incorporating trees and shrubs into ongoing farm operations, represent a potentially large GHG's sink. Further some new technologies may also be developed and adopted to overcome the effect of climate change. The technologies like zero tillage, micro irrigation technique, poly house technology to grow the vegetable in adverse climate, water conservation, GM crops, use of solar and wind energy, laser land leveler, updated agro-metrological information, heat and drought resistant crops, adoption of ground water recharge technique and adoption of crop simulation model have the potential to reduce the effect of climate change. However, challenge lies in promoting and adopting relevant information up to grass root level. Significance of role played by scientists involved in frontline extension through KVKs in assessment and refinement of situation and location specific technologies for sustainable development of agriculture and also catalytic force for field functionaries and farmers, it becomes imperative to abreast their knowledge regarding recent advances in technology

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generation and dissemination. Their knowledge on the issue has to go a long in shaping the frontline extension programme. Keeping these all in view, a study on knowledge of extension scientists on impact of climate change was undertaken.

METHODOLOGY

To collect the primary data on knowledge of extension professionals on impact of climate change, the respondents were selected with multistage sampling. Zone -1 comprising of five states (Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir and Punjab) was purposively selected and from the selected zone Haryana state was selected purposively having direct access of the investigators. Further, all extension professionals working in 19 KVKs under administrative control of CCSHAU, Hisar were taken as the respondents for the study. A total of 75 respondents' data complete in all respect was considered for analysis and reporting. The data were collected with the help of well structured and pre-tested interview schedule. The schedule consisted of four major aspects of impact viz; temperature, rainfall, water pollution, carbon dioxide concentration and biodiversity. Each aspect of the impact was further divided into four different sub aspects namely; crop growth, crop yield, produce quality and soil health. Each sub aspect was further divided into statements relevant to impact for responding in terms of either known or not known. The data were analyzed with frequency and percentage.

RESULTS AND DISCUSSION

The result of the investigation and corresponding discussion has been presented as follows;

Table 1: Knowledge of extension professionals regarding impact of temperature

n=75

Aspect	Frequency	Percentage
Crop growth		
High temperature results in stunted growth	54	72.00
Temperature affects the physio-chemical system of plant	75	100.00
Temperature affects seed germination rate/ mortality of seedlings	69	92.00
High temperature increases respiratory rate of the plants	69	92.00
Temperature have effects on water use efficiency of crop plants	75	100.00
High temperature in winter season is harmful for vegetative growth of wheat plants	60	80.00
Temperature also affects reproductive phase of crop plants	75	100.00
Very low temperature in winter season suppress the growth of crop plant	63	84.00
Low temperature in winter result into cold injury of plant tissue	57	76.00
High temperature promotes fast growth of weeds which suppress the crop growth	39	52.00
Sudden variation in temperature along with humidity favour insect/pest infestation	66	88.00
Crop yield		
High temperature decreases yield of crop	63	84.00
Low temperature decreases yield of crop	54	72.00
Crop produce quality		
Increases the quality of crop produce/fruits/vegetables etc.	42	56.00
Decreases the quality of crop produce/fruits/vegetables etc.	36	48.00
Affects grain size and shape of crop produce/fruits/vegetables etc.	63	84.00
Nutritional value/taste/color of crop produce/fruits/vegetables etc change.	63	84.00
Soil health		
Rise in soil temperature will increase rate of volatilization and de nitrification	69	92.00
Soil temperature affects soil pH	36	48.00
Temperature affects soil electric conductivity	45	60.00
Soil temperature affect the soil microbial activities	66	88.00
Soil temperature affects soil biomass/organic carbon	63	84.00
Soil temperature affects availability of soil nutrients	54	72.00

Data in Table 1 present knowledge of extension scientists on impact of temperature on crop growth and reveals that all the respondents were abreast about the affects of temperature on physio-chemical system of plant, water use efficiency of crop plants, affect on reproductive phase of crop plants and its affects on seed germination rate/ mortality of seedlings. Majority of the respondents (92.00%)were knowledgeable about 'high temperature increases respiratory rate of the plants'followed by 'very low temperature in winter season suppress the growth of crop plant' (84.00%), 'high temperature in winter season is harmful for vegetative growth of wheat plants' (80.00%), 'low temperature in winter result into cold injury of plant tissue' (76.00%), 'high temperature results in stunted growth' (72.00%) and 'high temperature promotes fast growth of weeds which suppress the crop growth' (52.00%) . In case of crop yield, majority (84 %) was having knowledge regarding 'high temperature decreases yield of crop' (terminal heat effect in wheat) and 'low temperature also decreases yield of certain crops' (frost injury in Indian mustard{Brassica juncea}, papaya{ Carica Papaya} and winter vegetables). The crop produce quality was influenced by temperature in the form of change in nutritional value/taste/color of crop produce/fruits/vegetables etc. and grain size and shape etc., which was known by most of the extension professionals. Regarding the impact on soil health, the respondents were familiar about the facts that rise in soil temperature increase rate of volatilization and de nitrification, soil temperature affects the soil microbial activities and soil biomass /organic carbon as the major impacts of temperature on soil health. Findings are in conformity with findings of Boomiraj *et al.* (2010) who reported that mustard is much sensitive to climatic variables and hence climate could have significant effect

on its production. Findings are in agreement with the study of Bahuguna et al. (2012) who reported significant impact of mild temperature stress on reproductive dynamics followed by reduced yield. Findings get full support from the study of Sejian (2013) who reported that heat stress affects impacts on pastures and forage crop production and quality. Rani *et al.* (2013) also reported that in the context of climate change, temperature is one of the most important environmental factors influencing the rice crop growth, development, and yield. The duration of each phenological stage having direct impact on yield is influenced by temperature.

The data in Table 2 regarding knowledge of extension professionals regarding impact of rainfall on agriculture indicates that in relation to crop growth, majority (84.00%) agreed that high rainfall increases the crop growth while in case of crop yield 96.00 per cent agreed that rainfall increases crop yield and unseasonal rainfall results in loss of crop yield (76.00%). The crop produce quality is increased by rainfall was agreed by majority of respondents (76.00%). A huge majority of extension scientists was familiar with factors such as heavy rainfall leads to soil erosion, rainfall is helpful for leaching down the harmful chemicals followed by increases soil organic matter (76.00%) whereas they had knowledge that rainfall increases water holding capacity of soil (64.00%) and heavy rainfall enhance the acidic nature of soil due to leaching of base (56.00 %) were major effects of rainfall on soil health. Findings get strength from the study of Srivastava *et al.* (2010) who reported that climate change projected to reduce monsoon sorghum grain yield to the tune of 14 per cent in central zone and south western zone and by 2 per cent in south central zone by 2020.

Table 2: Knowledge of extension professionals regarding impact of rainfall

n=75

Aspect	Frequency	Percentage
Crop growth		
High rainfall increases crop growth.	63	84.00
Low rainfall decreases crop growth	48	64.00
Crop yield		
Rainfall increases crop yield	72	96.00
Unseasoned rainfall results in loss in crop yield	57	76.00
Crop produce quality		
Rainfall increases quality of crop produce/fruits/vegetables etc.	57	76.00
Rainfall does not affects quality of crop plants produce/fruits/vegetables	30	40.00
Soil health		
Rainfall is helpful for leaching down the harmful chemicals	69	92.00
Rainfall increases water holding capacity of soil	48	64.00
Rainfall also increase soil organic matter	57	76.00
Acid rainfall is harmful for soil health	69	92.00
Heavy rainfall leads to soil erosion	72	96.00
Heavy rainfall enhance the acidic nature of soil due to leaching of base	42	56.00

Pertaining to knowledge of extension professionals on impact of CO_2, table 3 depicts that sub aspects of effect on crop growth, familiarity with the fact that high CO_2 concentration is beneficial for plant growth was by majority (68 %) and high CO_2 level is important for seed germination in winter season was by 52 per cent. Knowledge of impact on crop yield measured in term of 'whether CO_2 level is responsible for increase/ decrease of crop yield', majority (52 %) agreed. Majority (60 %) agreed about the facts such as CO_2 concentration affects crop produce /fruit/vegetables quality in the form of shape, size and nutritional values. Majority of respondents (60.00%) had knowledge of factors such as elevated CO_2 increase C: N ratio, CO_2 concentration affect soil aeration (52.00%) and elevation of CO_2 increase the organic carbon in soil (52%) were major impacts on soil health. Lesser percentage of respondents were having knowledge on aspects such as CO_2 affect the soil microbial activities (40.00%), CO_2 concentration affect the soil electro conductivity (40.00%) and CO_2 concentration affects the pH value of soil (44.00%). It implies that there is need to enhance the knowledge of respondents on effective utilization of CO_2 through C_4 plants and C- sequestration processes for climate smart agriculture. Findings are in agreement with Boomiraj *et al*. (2010) who reported crops sensitivity to climatic variables especially carbon dioxide and significant effect on production.

Table 3: Knowledge of extension professionals on impact of CO_2 concentration

n=75

Aspect	Frequency	Percentage
Crop growth		
High CO_2 concentration is beneficial for plant growth	51	68.00
High CO_2 level is important for seed germination in winter season	39	52.00
High CO_2 concentration is harmful for C_3 plant	30	40.00
Elevated CO_2 reduce the crop growth by increasing crop-weed competition	24	32.00
High CO_2 concentration increase the vegetative growth	33	44.00
High atmospheric CO_2 concentration may lead to a decline in food quality	30	40.00
Crop yield		
CO_2 level is responsible for increase/ decrease of crop yield	39	52.00
Quality of crop produce /fruit/vegetables		
CO_2concentration affects crop produce /fruit/vegetables quality in the form of shape, size and nutritional values	45	60.00
Soil health		
Elevation of CO_2 increase the organic carbon in soil	39	52.00
CO_2 concentration affects the pH value of soil	33	44.00
CO_2 concentration affect soil aeration	39	52.00
CO_2 concentration affect the soil electro conductivity	30	40.00
CO_2 affect the soil microbial activities	30	40.00
Elevated CO_2 increase C: N ratio	45	60.00

Data regarding knowledge of extension scientists on impact of water pollution presented in Table 4 clearly shows that in relation to impact on crop growth, 84.00 per cent respondents expressed that water pollution decreases seed germination rate, affects physio-chemical activities in plant and also it creates nutrient deficiency in plant which causes slow growth of plant. In case of impact on quality of crop produce/ fruits/ vegetables, vast majority had knowledge that water pollution increases toxicity level in crop produce/ fruits/ vegetables and it also affects grain size and taste of crop produce/ fruits/ vegetables followed by it affect the nutrient value in crop produce/ fruits/ vegetables (80.00%). All had knowledge about factors such as polluted water increases toxic material in soil and polluted water change chemical properties of soil (100.00%), whereas 92% were knowing that water pollution leads to suppress the soil microbial activities and decreases soil fertility, followed by water pollution increases nutrient deficiency in soil (84.00%), water pollution increases harmful bacteria/virus in soil, affects the pH value of soil, affect the soil biomass and decreases C: N ratio (80.00%) which were major impacts of water pollution on soil health.

Table 4: Knowledge of extension professionals regarding impact of water pollution

n=75

Aspect	Frequency	Percentage
Crop growth		
Water pollution decreases seed germination rate	63	84.00
Water pollution affects physio -chemical activities in plant	63	84.00
Water pollution creates nutrient deficiency in plant which causes slow growth	63	84.00
Water pollution suppress the growth hormone	54	72.00
Quality of crop produce/ fruits/ vegetables		
Water pollution affect the nutrient value in crop produce/ fruits/ vegetables	60	80.00
Water pollution increases toxicity level in crop produce/ fruits/ vegetables	72	96.00
Water po llution affect grain size and ta ste of crop produce/ fruits/ vegetables	72	96.00
Soil health		
Polluted water increases toxic material in soil	75	100.00
Polluted water decreases soil fertility	69	92.00
Polluted water change chemical properties of soil	75	100.00
Water pollution increases nutrient deficiency in soil	63	84.00
Water pollution increases harmful bacteria/virus in soil	60	80.00
Water pollution affects the pH value of soil	60	80.00
Water pollution affects soil electrical conductivity	57	76.00
Water pollution leads to suppress the soil microbial activities	69	92.00
Water pollution affect the soil biomass	60	80.00
Water pollution decreases C: N ratio	60	80.00

Table 5 narrate the knowledge of extension professionals pertaining to impact of climate change on biodiversity in which it was found that majority (76.00%) were knowing that climate change have resulted in extinction/ near extinction of certain plants/ fruits/trees/animals/birds species whereas 72 per cent were knowing that it have resulted in emergence of new insect-pests/ diseases(mealy bug in cotton, CLCV in BT cotton). Only 56 per cent of them had knowledge that climate change have resulted in suitability for growth of certain new crop plants/ fruits/trees/animals/birds species which is the matter of concern that they were not well versed with climate resilient agriculture. Similar findings were reported by Diwivedi and Kumar. (2012) who reported that global climate changes have lead to the loss of biological resources.

Table 5: Knowledge of extension professionals regarding impact on biodiversity

n=75

Aspect	Frequency	Percentage
Climate change have resulted in extinction/ near extinction of certain plants/ fruits/trees/animals/birds species	57	76.00
Climate change have resulted in suitability for growth of certain new crop plants/ fruits/trees/animals/birds species	42	56.00
Climate change have resulted in emergence of new insect-pests/ diseases	54	72.00

Data pertaining to overall knowledge of extension professionals on impact of climate change in agriculture presented in Table 6 narrate that maximum percentage (42.67%) belonged to low knowledge status followed by 29.33 per cent to high category and 28.00 per cent to medium level of knowledge on impact of climate change.

It can be inferred that overall knowledge was low to moderate and hardly 30.00 per cent had high knowledge on impact of climate change in agriculture which is the major challenge for stable, sustainable and profitable agriculture in changing climate scenario since it is linked to food security and poverty as reported by Barnwal *and Koji* (2013) in their study of rice yield vulnerability to climate change in Andhra Pradesh state of India.

Similar results were reported by Ravi *et al* 2015 whereas respondents were having lesser knowledge regarding crop planning, crop protection and crop production in relation to climatic changes.

As such, necessary efforts are required to build the capacity of these frontline stake holders on impact of climate change since they are regarded as knowledge resource and technical back stopping points at district level to facilitate the situation and location specific sustainable development of agriculture.

Table 6: Overall knowledge of professionals regarding impact of climate change in agriculture

n=75

Knowledge status	Score range	Frequency	Percentage
Low	18-52	32	42. 67
Medium	53-64	21	28.00
High	65-69	22	29.33

Overall knowledge of extension scientists on impact of climate change in agriculture was low to moderate and hardly one third of the respondents had high knowledge on the issue of impact of climate change on various facets of agriculture. It is of great concern for stable, sustainable and profitable agriculture in changing climate scenario. Majority of the respondents had knowledge in relation to impact of temperature on crop growth, quality of crop produce/fruits/vegetables, crop yield and soil health degradation but the impact on biodiversity was possessed by lesser number of respondents. Although the emergence of new insect-pests/ diseases like mealy bug in cotton, CLCV in BT cotton were known but poor knowledge on suitability for growth of certain new crop plants/ fruits/trees/animals/birds species is the matter of concern in respect of promotion of climate resilient agriculture. Tailored efforts need to be made to enhance the capacity of these frontline extension professionals and sensitize them on impact of climate change especially in harnessing the increased CO_2 level and C- sequestration processes and climate resilient species of plants and animal for promotion of climate smart agriculture since they are responsible for running the knowledge resource and technical back stopping district farm science centres mandated with the situation and location specific sustainable development of agriculture.

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