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RESEARCH ARTICLE :

Attitude of extension personals towards services provided by them for climate change mitigation: A case study of Haryana, India

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SUMMARY : Climate change is the burning issue all over the world and it affects almost every sector directly or indirectly. Agriculture is highly sensitive to climatic variability and weather extremes.The impacts of climate on agriculture are already seen, yet sizable gaps remain between scientific agriculture knowledge and its implication at farm level to tackle with current issue. A study was conducted to explore the services provided by extension personal specially agriculture development officers and horticulture development officers (A.D.O, H.D.O) working state agriculture department regarding to mitigate the climate change effect in agriculture, because they are main stack holder and work at grass root level with farmers. Results showed that maximum extension personnel's suggests adoption of suitable agronomic practices such as growing crop according local climatic condition, crop rotations, growing of soil nature based crop and best weed management. Whereas, advise for lowering CO_2 emission from agriculture and introduction of new cultivation methods were poor. It implies that extension personals must be well acquainted with knowledge on climate change to effectively transfer knowledge to the farmers and field functionaries. Government should organize trainings which needs to be imparted by leading institutes working on climate change to the extension personnel working in SAD.

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BACKGROUND AND OBJECTIVES

Climate change according to United Nations Framework Convention on Climate Change (UNFCCC) is "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods".

Global warming is increase in temperature due emission of green house gases resulted increase global atmospheric temperature over a long period of time. The rise of temperature caused by the accumulation of green house gases namely carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbon (IPCC, 2001). Global mean temperature has been increased by 0.85^0C since 1880 is likely

increase by 3.7 to 4.5^{0}C 2100 AD (IPCC, 2014). Other factors which contribute in global warming are uncontrolled deforestation, industrialization, high use of insecticide and fertilizer in agriculture sector. A study predicted that average temperature during this century may rise by 2-4 to 4.5^{0}C due to doubling the CO_2 levels caused by human activities (Connor, 2006). Whereas, CO_2 emissions from fossil fuel combustion and industrial process contributed about 76 per cent of total green house gas emission increase during 1976 to 2010 (IPPC, 2014). These caused destructive effect on famer's community as well as nation economy. The future of climate change will affect developing nation critically than developed one. Everyone must understand the depth of climate change issue and should try to minimize it. Agriculture development officers expected are the main stack holder and work at grass root level with farmer community to guide how the farmer should tackle with climate change.

The application of scientific agriculture knowledge and good agricultural practices are best substitute to minimize the effect of climate change for sustainable development of agriculture. Extension services are responsible for serving more than one billion small-scale farmers in the world (Singh *et al*., 2016). Realizing the importance of extension personal (ADO, HDO) in transfer of agricultural knowledge and skill to farmers, keeping all these in a view a study on attitude of extension personals towards services provided for climate change mitigation was under taken.

RESOURCES AND METHODS

The study was conducted at Rewari, Bhiwani, Karnal and Kurukshetra districts in Haryana state of India. Extension personnel working as A.D.O. (Agriculture development officer) and H.D.O. (Horticulture development officer) in state agriculture department, Haryana constituted the population for the study. A multi-stage random sampling technique was used to select respondents, thus, two agricultural zones (Northern and Southern) were randomly selected. The data were collected with the help of well structured and pre-tested interview schedule. The data were analyzed and tabulated after applying the statistical techniques like frequency and percentage.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Mitigation management based on agronomic practices:

Management of agronomic practice refers co-ordination of all practices from sowing to harvesting with time and skill in a best way to boost up the agricultural production for sustainable development. It was revealed from the data (Table 1) that some of the officers 36.25 per cent suggested that mitigation of CO_2 emission from agricultural activities such as adoption of conservation

Table 1: Mitigation management based on agronomic practices **(n=80)**

Particulars	Frequency	Percentage
Suggest for mitigation of CO_2 emission from agriculture activities	29	36.25
Promote to enhance line spacing, crop diversity, and crop intensity	59	73.75
Suggest to farmer to adjust timing of farm operation to reduce the risk of crop damage in changed climate	66	82.50
Suggest growing crop according to your local climatic condition	76	95.00
Suggest adopting crop rotation to increase the production in changed climate	74	92.50
Suggest to grow trees on boundary of flied to lower the effect of high speed	51	63.75
To adopt best agronomic practice should be followed to lower the effect of climate change	69	86.25
Best weed management practice to increase the production in changed climate	71	88.75
Growing soil nature based crop to limit effect climate change	73	91.25
Disperse information on natural resources conservation management practice regarding soil, water, wind, forest etc	44	55.00
Suggest best irrigation practice in changed climate	70	87.50
About implementation of new cultivation methods like ridges, terrace, planting hole	37	46.25
About intercropping to lower the insect/pest infestation due to climate change	62	77.50

agriculture practices will lower down atmospheric CO_2 concentration thereby lowering the impact of climate change. It was further observed from the data that enhancing line spacing, crop intensity and crop diversity was promoted as climate change strategy by 73.25 per cent of the officers. About 82.50 per cent of the officers suggested adopting to adjust timing of farm operation to reduce the risk of crop damage. And the maximum number 95.00 per cent of the officers suggest selection of growing crop according to their local area while, 92.50 perc ent of the officers suggested to adopt crop rotation. Similar findings have been reported by Hine and Pretty (2008) who found that due to crop rotation in North Rift and western region of Kenya maize yield increased to 3,4 t/n and bean yield increased 258kg/h. Whereas, the suggestion of growing tree on boundary as a mitigation strategy was given by 63.75 per cent of the respondents. A perusal of data (Table 1) indicated that 86.25 per cent of the officers considered that adoption of the best agronomic practices was better option. It was found from the data that 88.75 per cent of the respondents told that they suggested for the best weed managements. Moreover, 91.25 per cent of the respondents told that they suggested to growing soil nature based crop to limit effect climate change while the suggestion of dispersal of information on natural resource was more suitable major was recommended by 55 per cent of the respondents. Best irrigation practices were also advocated by 87.50 per cent of the officers. Data from (Table 1) also indicated that only 46.25 per cent of the officers emphasized on implementation of new cultivation methods like ridges, terrace, planting hole were suitable measures and intercropping to lower the insect/pest infestation due to climate change to harvest more yield in present day situation was advocated by 77.50 per cent of the respondents. Agro forestry systems can be better climate change mitigation option than ocean and other terrestrial options, because of the secondary environmental benefits such as food security and secured land tenure, increasing farm income, restoring and maintaining above ground and below ground biodiversity, maintaining watershed hydrology and soil conservation. Similar finding by Kalra *et al.* (2007) observed that climate change has emerged as the most prominent of the global environment issues and there is a need to evaluate its impact on agriculture. Crop simulation such as WTGROWS, INFOCROP, ORYZA models have been widely used for land use planning, agri.-production estimates, impact of climate change and environmental impact analysis and adoption of agronomic management options can sustain agricultural productivity under climate change. Findings are in conformity with the researches of Srinivas and Sridevi (2005) who found that world's soils, cultivated as well as unmanaged, are important sources of greenhouse gases and trace gas species such as CO_2, CH_4, N_2O and NO_2 that cause global climate change. Based on current knowledge, about 25 per cent of the global annual emissions of CO_2, half the global annual emissions of CH_4 and N_2O and 30 per cent of the global annual emissions of nitrous oxide and NH_3 are believed to originate from soils. Soils are also potential sinks for the greenhouse gases and if managed effectively, can play a significant role in averting climate change.

Mitigation management based opon natural recourses:

It was revealed from data presented in (Table 2)

Table 2: Mitigation management based upon natural recourses **(n=80)**

Particulars	Frequency	Percentage
Suggest for organic farming to mitigate the effect of climate change	77	96.25
About agro forestry to lowering the effect of climate change	49	61.25
Social forestry to lowering the effect of climate change	22	27.50
Role of biological agent to control insect/pest in crop	17	21.25
Role of conservation of natural resource to lower the effect of climate change	54	67.50
Bio insecticide instead of chemical insecticide to lower the effect of climate	74	92.50
Rain water harvesting for using it in adverse climate change like drought condition	57	71.25
Promote crop and livestock diversification	66	82.50
Promote agro biodiversity to avoid monoculture and reducing the risk of crop failure in changed climate	75	93.75
About agri. produce preservation and post harvest losses	63	78.75

that majority 96.25 per cent of officers recommended organic farming to mitigate the effect of climate change followed by agro-forestry to lowering the effect of climate change 61.25 per cent. Some of the respondent (27.50%) suggested about social forestry to lowering the effect of climate change and few of them (21.25%) emphasized on the role of biological agent to control insect/pest in crop in present changing situation. About 67.50 per cent respondents also advocate farmers about the role of conservation of natural resources to lower the adverse effect of climate change. It was further observed from data that 92.50 per cent of the respondents that nominate applying bio insecticide instead of chemical insecticide to lower effect of changing climate. A perusal of data (Table 2) indicated that 88.75 per cent of the respondents advised farmers to apply organic manure to maintain balance between soil and environment which help in maintaining the CO_2 fluxes. It was observed that 71.25 per cent of them suggested the rain water harvesting for better results. Similarly 82.50 per cent of the respondents promote crop and livestock diversification in mitigating adverse climatic variability. Moreover, maximum officers (93.75%) promoted the agro biodiversity to avoid monoculture and 78.75 per cent of them suggested farmers to encourage secondary agriculture and minimization of post harvest losses to cope up with adverse climatic conditions. It was observed that maximum respondents suggested to go for organic farming, use of bio-insecticides instead of chemical insecticide, application of organic manure, promotion of agro-biodiversity because carbon sinks are ecosystems, store carbon dioxide in water, sediment, wood, roots, leaves and the soil. Many ecosystems have natural mitigation processes, such as carbon sequestration and storage. Appropriate management of carbon sinks is necessary to maintain this ecosystem service. The results also concur with of Tripathi and Sharda (2011) in India who found that positive outcome of soil and water conservation measures implemented on watershed basis both under drought and abnormal rainfall conditions. Simple measures like strengthening of field bunds, contour bunding, trenching, vegetative barriers, agro-forestry, water harvesting and afforestation of denuded land along with other engineering and biological measures are found to be suitable options to mitigate the adverse impacts of climate changeIn another study by Kamta and Gill (2009) also support that organic agriculture is a production system that avoids or largely excludes the use of synthetic compound fertilizers, pesticides, growth regulators and livestock-feed additives and strategies needed to promote organic farming in India include adequate research and extension support by the government, quantification of role of organic agriculture in improving the resource sustainability and in mitigating the climate change by the researchers, acknowledgement of organic agriculture as an effective mechanism to reduce greenhouse gases and sequester carbon, recognition of organic agriculture in Kyoto Protocol carbon credit mechanisms, organic market development, mission-mode programmes for on-farm demonstrations. Similar opinion was put forward by Sarkar and Padaria (2010) where in his study, reported that people devised different techniques or practices *viz.*, soil management, application of organic manures and irrigation in the field of agriculture to overcome the adverse impact of climate change in their farming. Most of these technologies practiced were related to solve the increasing problem of soil salinity due to climate change. Findings by Mishra *et al*. (2012) support this finding who observed that regional assessments of change in soil organic carbon (SOC) stocks due to land-use change are essential for supporting policy and management decisions related to greenhouse gases emissions and mitigation through carbon sequestration in soils.

Conclusion and recommendations:

Climate change is a major threat in present situation and work carried out have describes the key role of transfer of technology though extension personals. Work was carried out at village level and was able to identify the root cause of non-adoption of mitigation strategies. It was clearly evident from study that anthropogenic activities results in alteration of environmental balance at large scale. In present day situation climate change severely affect the agricultural enterprise. The key role of extension functioning in agricultural adaptation to climate change was in retraining of extension staff to acquire the new knowledge and skills (capacity) in climate risk management. These will of course reduce the anthropogenic causes and hence, the effects/impacts of climate change. Also, there is need for increased research and innovation in agriculture to find out more sustainable ways of adaptation to climate change. Extension personnel suggestions are quite effective in

mitigating the adverse effect of climate change if successfully adapted by farmers and help to cope up with the present scenario of climate variability where climate change threatens agricultural production. In the light of the finding of the study, the following recommendations are made that extension strategies should brace upto the new challenges posed by climate change by retraining its staff, mounting awareness programmes and disseminating proven measures to boost the adaptive/resilience capacities of farmers and moreover government participation through translocation of funds will act as milestone for adaptation and mitigation strategies that will support extension efforts and deliver new technologies, information and education.

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