Biological Forum – An International Journal **14(1): 1179-1183(2022)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Study on Bio-physical Impact by Adoption of Climate Resilient Technologies in Agriculture

Peddi Naga Harsha Vardhan[1]*, Prabhat Kumar Pal[2], Deepa Roy[3] and Sabita Mondal[3]
[1]Research Scholar, Department of Agricultural Extension,
Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, (West Bengal), India.
[2]Professor, Department of Agricultural Extension,
Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, (West Bengal), India.
[3]Assistant Professor, Department of Agricultural Extension,
Uttar Banga Krishi Viswavidyalaya, Pundibari, Coochbehar, (West Bengal), India.

(Corresponding author: Peddi Naga Harsha Vardhan)*
(Received 16 November 2021, Accepted 20 January, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Climate change became an important area of concern for India to ensure food and nutritional security for growing population. The impact of climate change on India is more vulnerable in view of the high population depending on agriculture. Evolving climate resilient agricultural technologies would increase farm production and productivity. Continuous management of natural and manmade resources constitute an integral part of sustaining agriculture in the era of climate change. National Innovations on Climate Resilient Agriculture (NICRA) is a network project of the Indian Council of Agricultural Research (ICAR) launched with the aim to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research, technology demonstration, capacity building and sponsored/competitive Grants. This study was concentrated on the biophysical impact of climate resilient technologies The study was conducted in two districts i.e., Coochbehar and Malda in two NICRA KVKs in which one adopted and one non adopted village adjacent to adopted villages (as control area) were selected. The respondents from both KVK adopted and non-adopted villages shown that the Mean impact score of adopted and non-adopted villages are 0.47 and 0.24 respectively. This shows that there was Bio-physical impact of adoption of climate-resilient technology in agriculture in KVK adopted than in the KVK non adopted village.

Keywords: Climate Change, Bio-physical impact, KVK, Adopted, Non adopted.

INTRODUCTION

Agriculture is the dominated sector of Indian economy. Agriculture is a crucial sector of Indian economy as it contributes about 20.19 percent of GDP (Balkrishna *et al*., 2021). The progress of the nation is therefore, directly linked with advancement in agriculture. India is one of the most vulnerable countries in the world when it comes to climate change. According to a report of the India Meteorological Department (IMD) in 2013, 18 states and two Union Territories have been observing a significant warming trend. According to estimates, India could witness a temperature rise of over 4°C by the last quarter of the century. The Intergovernmental Panel on Climate Change's (IPCC's) assessment report in 2014 says that both rice and wheat could see drops in yield by 7-10 per cent and in maize up to 50 per cent by 2030. According to a study by the Agricultural Economics Research Review published in 2014, rice and wheat yields could witness decline of over 15 and 20 per cent respectively by 2100. The need for adaptation to climatic exigencies has been starkly evident over the years. Since 1995, more than 0.3 million farmers have committed suicide. In the worst-hit regions, the biggest reason has been crippling indebtedness fuelled by successive crop failures.

Climate change is the most threatening phenomena and addressing it is the biggest challenge for civilized society now-a-days. According to (Iswoyo *et al.,* 2018) Climate change has become a disaster to agriculture and farmers in general. However, there have been many efforts for adaptive agriculture which farmers can learn and implement. India experiences hardest hit from it being an agriculturally dependent economy. In addition to direct effects on crops, climate change is likely to impact natural resources like soil and water. Increased rainfall intensity in some regions would cause more soil erosion leading to land degradation. Developing appropriate and feasible climate smart and resilient agriculture practices are perceived to increase food security and income (Gwambene *et al*., 2015).

There is strong need to integrate climate change issues in agricultural policy, strategies and programs; improve knowledge generation, technology, R & D and information dissemination structure at all levels (Jatish *et al.,* 2018). Farmers will not adopt climate-resilient crops solely on the basis of environmental-adaptation qualities. Development and breeding programmes must consider farmer and market trait preferences (Acevedo *et al*., 2020). Hence national innovation on climate resilient agriculture (NICRA) is a noble concept developed by ICAR. The main objective is to enhance the resilience of Indian agriculture covering crops, livestock and fisheries to climatic variability and climate change through development and application of improved production and risk management technologies (Srinivas *et al*., 2014). The i*n-situ* water management practices improved the infiltration capacity and water holding capacity of the soil, which resulted in higher crop-water availability. NICRA were established in 100 district of the country. The project in terms of new and improved varieties of crops, livestock breeds management practices that help in adaptation, mitigation and inputs for policy making to main stream climate resilient agriculture in the developmental planning. With the Adoption of Climate Resilient Technologies farmers can be benefited to some extent from the Impact of climate change. Ganesh and Rahman, (2018) Reported that the impact of NICRA was visible through the migration and annual income data where it was clearly shown that 90 per cent migration were reduced and farmers income increases up to 66.66 per cent. Adopting of improved technologies may bring positive effect on socio-economic conditions of the farmers. Jasna *et al.,* (2014) concluded that the impact of demonstrated climate resilient reported an encouraging output on both social as well as economic aspect of the village.

MATERIALS AND METHODS:

A study was conducted to know the bio-physical characteristics of both climate resilient technologies adopted farmers and Non- Adopted farmers involved in Coochbehar district and Malda District of West Bengal in 2017-2019. Two KVKs were selected from the two districts which are implementing NICRA project. Two villages were selected from each KVK zone. One is the KVK adopted village and another is KVK Non-adopted village which is adjacent to the adopted village. The villages were selected purposively. From each village 30 respondents were selected randomly. Total 120 respondents were taken for the research work. The scale composed of with responses improved no change and deteriorated with corresponding score 1, 0 and -1 respectively. Impact score of a technology was calculated by

$$\text{Impact score for a technology} = \frac{\%\text{ farmers expressed improvement - }\%\text{ farmers expressed deterioration}}{\text{No. of farmers}}$$

RESULTS AND DISCUSSION

Data from Table 1 represents the change in bio-physical aspects of farm in last five years because of adopting climate resilient technologies. In case of Storage capacity of ponds/water reservoirs, 20% of adopters reported that there is improvement while 80% of adopter farmers reported that there is no change in storage capacity of ponds. 43.33% of adopting farmers reported that there is improvement in ground water table while 56.67% of adopters told that there is no change in ground water table.

While considering the water availability for irrigation in dry spell, majority of adopters i.e. 60% observed that there is improvement. While 40% of adopters observed that there is no change. In case of irrigated area of your farm 61.67% of adopters reported that there is improvement, while 38.33% of adopters reported that there is no change in irrigated area of your farm. 51.67% of adopters reported that there is improvement and 48.33% of adopters reported that there is no change in the farm area.

In case of cultivation in Rabi season, 68.33% of adopters observed that there is improvement while 31.67% of adopters observed that there is no change in cultivation in Rabi season. 58.33% of adopters reported that there is improvement and 41.67% of adopters reported that there is no change in case of cultivation in pre-kharif season.

While considering the water holding capacity of soil due to organic mulching 48.33% of adopters observed the improvement while 50% of adopters observed that there is no change and 1.67% of adopters observed the water holding capacity of soil due to organic mulching had deteriorated.

In case of crop diversity in farm 83.33% of adopters reported that there is improvement and only 16.67% of adopters reported that there is no change in crop diversity of farm. 36.67% of adopters found improvement and 53.33% of adopters found that there is no change and 10.00% of adopters found deteriorated in case of fodder availability for animals.

In case of animal husbandry practices 50.00% of adopters reported that there is improvement, 43.33% of adopters found that there is no change and 6.67% of adopters reported that there is deterioration in animal husbandry practices. 1.67% of adopters reported that there is improvement, 96.66% of adopters observed that there is no change and 1.67% of adopters found that there is deterioration in poultry and duckery practices.

In case of water availability in all seasons for fish cultivation 10% of adopters found it is improved while 90% of adopters observed that there is no change. While taking fish cultivation in your farm adopters of 13.33% observed there is improvement while 86.67% of adopters found that there is no change in fish cultivation.

In case of using farm implements through custom hiring centre, 66.67% of adopters found it is improved and 33.33% of adopters that there is no change. 98.33% of adopters reported that there is improvement and 1.67%

of adopters reported that there is no change in yield of crops. Medhi *et al.* (2018) reported that Yields of all the crops demonstrated at NICRA farms found measurable difference with increase in yields. This might be due to implementation of climate resilient improved varieties tied with better water and healthy soil management practices.

In case of farm income, majority of adopters 96.67% found it is improved while 3.33% of adopters found that there is no change. Rao and Malkharjuna (2017) proved that the bold initiatives of NICRA helped the farmers in improving their economic status. 45% of adopters found that there is improvement and 55% of adopters found that there is no change in case of water conveyance loss due to PVC irrigation channel.

While considering irrigation requirement of crop due to mulching 48.33% of adopters found it has improved while 50.00% of adopters found it has not changed while 1.67% of adopters found it deteriorated.

In case of Advancement of Rabi season due to short duration varieties in kharif rice 51.67% adopters reported the improvement while 48.33% of adopters reported the no change. 33.33% of adopters observed that there is improvement and 66.67% of adopters found that there is no change in disease and pest incidence.

While considering the labour cost due to zero tillage 80.00% of adopters reported the improvement and 20% of adopters reported that there is no change. Majority of adopters i.e. 61.67% reported that there is improvement and 38.33% of adopters reported that there is no change in nutrient management through soil testing.

In case of livelihood diversity through mushroom cultivation 1.67% of adopters reported that there is improvement while 98.33 % of adopters reported no change.

In case of improvement in animal health due to health camp 50.00% of adopters reported improvement while 50% of adopters reported that there is no change. 5% of adopters observed that there is improvement and 95% of adopters found that there is no change in seed availability from village seed bank.

While considering the milk yield 85% of adopters found that there is improvement and 15% of adopters observed that there is no change in milk yield. 20% of adopters reported that there is improvement and 20% of adopters reported that there is no change in case of fish yield.

Adopters in case of storage capacity of ponds/water reservoirs, Ground water table, water availability for irrigation in dry spell, Irrigated area of your farm, Areas brought under cultivation, Cultivation in rabi season, Cultivation in pre-kharif season, Crop diversity in farm, Water availability in all season for fish cultivation, Fish cultivation in your farm, Use of farm implements through Custom hiring centre, Yield of crops, Income from farm, Water conveyance loss due to PVC irrigation channel, Advancement of rabi season due to short duration varieties in kharif rice, Disease and pest incidence, Labour cost due to Zero tillage, Nutrient management through soil testing, Livelihood diversity through mushroom cultivation, Improvement in animal health due to health camp, Seed availability from village seed bank, Milk yield, Fish yield have not reported deterioration.

While for the other village's i.e. non-adopted villages (Table 1) the biophysical impact in case of Storage capacity of ponds/water reservoirs, 8.33% of farmers reported that there is improvement while 91.67% of other villager's farmers reported that there is no change in storage capacity of ponds. 10% of non adopting farmers reported that there is improvement in ground water table while 90% of other villagers told that there is no change in ground water table.

When considering the water availability for irrigation in dry spell majority of other villagers i.e. 26.67% observed there is improvement while 71.66% of other villagers observed there is no change and 1.67% of other villagers found it is deteriorated.

In case of irrigated area of your farm none of other villagers reported that there is improvement, while 100% of other villagers reported that there is no change in irrigated area of your farm. None of other villagers reported that there is improvement and 100% of other villagers reported that there is no change in area brought under cultivation.

In case of cultivation in Rabi season 38.33% of other villagers observed that there is improvement while 61.67% of other villagers observed that there is no change in cultivation in Rabi season. 26.67% of other villagers reported that there is improvement and 73.33% of other villagers reported that there is no change in case of cultivation in pre-kharif season.

While considering the water holding capacity of soil due to organic mulching 21.67% of other villagers observed the improvement while 78.33% of other villagers observed that there is no change.

In case of crop diversity in farm 80% of other villagers reported that there is improvement and only 20% of other villagers reported that there is no change in crop diversity of farm. 6.67% of other villagers found improvement and 90% of other villagers found that there is no change and 3.33% of other villagers found deteriorated in case of fodder availability for animals.

In case of animal husbandry practices 18.33% of other villagers reported that there is improvement, 73.34% of other villagers found that there is no change and 8.33% of other villagers reported that there is deterioration in animal husbandry practices.

In case of water availability in all seasons for fish cultivation, 8.33% of other villagers found it is improved while 91.67% of other villagers observed that there is no change. While talking about fish cultivation in your farm other villagers of 6.67% observed there is improvement while 93.33% of other villagers found that there is no change in fish cultivation.

In case of using farm implements through custom hiring centre 13.33% of other villagers found it is improved and 86.67% of other villagers that there is no change. 80% of other villagers reported that there is improvement and 20% of other villagers reported that there is no change in yield of crops.

Table 1: Perceived bio-physical impact of adoption of climate-resilient technology.

Sr. No.	Indicators of change	Adopted Villages				Other villages			
		Improved (%)	No Change (%)	Deterio-rated (%)	Impact score	Improved (%)	No Change (%)	Deterio-rated (%)	Impact score
1.	Storage capacity of ponds/water reservoirs	20.00	80.00	0.00	**0.20**	8.33	91.67	0.00	**0.08**
2.	Ground water table	43.33	56.67	0.00	**0.43**	10.00	90.00	0.00	**0.10**
3.	Water availability for irrigation in dry spell	60.00	40.00	0.00	**0.60**	26.67	71.66	1.67	**0.25**
4.	Irrigated area of your farm	61.67	38.33	0.00	**0.62**	0.00	100.00	0.00	**0.00**
5.	Areas brought under cultivation	51.67	48.33	0.00	**0.52**	0.00	100.00	0.00	**0.00**
6.	Cultivation in rabi season	68.33	31.67	0.00	**0.68**	38.33	61.67	0.00	**0.38**
7.	Cultivation in pre-kharif season	58.33	41.67	0.00	**0.58**	26.67	73.33	0.00	**0.27**
8.	Water-holding capacity of soil due to organic manuring	48.33	50.00	1.67	**0.47**	21.67	78.33	0.00	**0.22**
9.	Crop diversity in farm	83.33	16.67	0.00	**0.83**	80.00	20.00	0.00	**0.80**
10.	Fodder availability for animals	36.67	53.33	10.00	**0.27**	6.67	90.00	3.33	**0.03**
11.	Animal husbandry practices	50.00	43.33	6.67	**0.43**	18.33	73.34	8.33	**0.10**
12.	Poultry & Duckery practices	1.67	96.66	1.67	**0.00**	0.00	100.00	0.00	**0.00**
13.	Water availability in all season for fish cultivation	10.00	90.00	0.00	**0.10**	8.33	91.67	0.00	**0.08**
14.	Fish cultivation in your farm	13.33	86.67	0.00	**0.13**	6.67	93.33	0.00	**0.07**
15.	Use of farm implements through Custom hiring centre	66.67	33.33	0.00	**0.67**	13.33	86.67	0.00	**0.13**
16.	Yield of crops	98.33	1.67	0.00	**0.98**	80.00	20.00	0.00	**0.80**
17.	Income from farm	96.67	3.33	0.00	**0.97**	86.67	13.33	0.00	**0.87**
18.	Water conveyance loss due to PVC irrigation channel	45.00	55.00	0.00	**0.45**	1.67	98.33	0.00	**0.02**
19.	Irrigation requirement of crop due to mulching	48.33	50.00	1.67	**0.47**	50.00	50.00	0.00	**0.50**
20.	Advancement of season due to short duration varieties	51.67	48.33	0.00	**0.52**	50.00	50.00	0.00	**0.50**
21.	Disease and pest incidence	33.33	66.67	0.00	**0.33**	55.00	45.00	0.00	**0.55**
22.	Labour cost due to Zero tillage	80.00	20.00	0.00	**0.80**	53.33	46.67	0.00	**0.53**
23.	Nutrient management through soil testing	61.67	38.33	0.00	**0.62**	5.00	95.00	0.00	**0.05**
24.	Livelihood diversity through mushroom cultivation	1.67	98.33	0.00	**0.02**	0.00	100.00	0.00	**0.00**
25.	Improvement in animal health due to health camp	50.00	50.00	0.00	**0.50**	1.67	98.33	0.00	**0.02**
26.	Seed availability from village seed bank	5.00	95.00	0.00	**0.05**	0.00	100.00	0.00	**0.00**
27.	Milk yield	85.00	15.00	0.00	**0.85**	28.33	71.67	0.00	**0.28**
28.	Fish yield	20.00	80.00	0.00	**0.20**	10.00	90.00	0.00	**0.10**
Mean impact score		**0.47**				**0.24**			
Paired t-test value		**5.62****							

In case of farm income majority of other villagers i.e. 86.67% found it is improved while 13.33% of other villagers found that there is no change. 1.67% of other villagers found that there is improvement in case of water conveyance loss due to PVC irrigation channel and 98.33% villagers reported that they are no change. While considering irrigation requirement of crop due to mulching 50% of other villagers found it had improved and 50% of villagers reported that there is no change.

In case of Advancement of Rabi season due to short duration varieties in kharif rice, 50% other villagers reported the improvement while 50% of other villagers reported the no change. 55% of adopters observed that there is improvement and 45% of other villagers found that there is no change in disease and pest incidence. While considering the labour cost due to zero tillage 53.33% of other villagers reported the improvement and 46.67% of villagers reported that there is no change. In case of improvement in animal health due to health camp 1.67% of other villagers reported improvement and 98.33% reported no change.

In case of seed availability from village seed bank 100% of non adopters reported that there is no change. While considering the milk yield 28.33% of other villagers found that there is improvement and 71.67% of other villagers observed that there is no change in milk yield. 10% of other villagers reported that there is improvement in case of fish yield and 90% reported no change.

Other villagers in case of Storage capacity of ponds/water reservoirs, Ground water table, Irrigated area of your farm, Areas brought under cultivation, Cultivation in rabi season, Cultivation in pre-kharif season, Water-holding capacity of soil due to organic manuring, Crop diversity in farm, Poultry & Duckery practices, Water availability in all season for fish cultivation, Fish cultivation in your farm, Use of farm implements through Custom hiring centre, Yield of crops, Income from farm, Water conveyance loss due to PVC irrigation channel, irrigation requirement of crop due to mulching, Advancement of rabi season due to short duration varieties in kharif rice, Disease and pest incidence, Labour cost due to Zero tillage, Nutrient management through soil testing, Livelihood diversity through mushroom cultivation, Improvement in animal health due to health camp, Seed availability from village seed bank, Milk yield, Fish yield have not reported deterioration. In case of Irrigated area of your farm, Areas brought under cultivation, Poultry & Duckery practices, Livelihood diversity through mushroom cultivation, Seed availability from village seed bank other villagers had reported that there is no improvement.

Considering the Impact score, yield of crops reported more with 0.98 and next to that income from farm, milk yield found more impact score with 0.97 and 0.85 respectively and low impact score was observed in case of poultry & duckery, Livelihood diversity through mushroom cultivation and water availability in all

season for fish cultivation i.e. 0.00, 0.02 and 0.10 respectively among adopted village. In case of non adopted village income from farm, yield of crops and crop diversity reported more impact score i.e. 0.87, 0.80 and 0.80 respectively and in Irrigated area of your farm, areas brought under cultivation, livelihood diversity through mushroom cultivation and seed availability from village seed bank the impact score was found 0.00.

Mean impact score of adopted villages and other villages were 0.47 and 0.24 respectively and paired t-test value (5.62) which is significant at 1% level. This indicates that the perceived impact of adoption of climate resilient technologies was significantly higher in KVK-adopted village in bio-physical aspects of farm than the other village's i.e. Non-adopted village.

CONCLUSION

Considering the bio physical impact due to adoption of climate resilient technologies adopters have more mean impact score when compared with non adopters' i.e. Adopters have 0.47 mean score and non adopters have 0.24 mean score. The bio physical impact of adoption of climate resilient technologies is also significantly higher in KVK adopted villages than non adopted villages.

FUTURE SCOPE

Technologies that have made better bio physical changes can be implemented in other areas. And technologies that have not impacted can be used in better way with the help of scientists.

Acknowledgement. Authors are thankful to the Head, Department of Agricultural Extension, Uttar Banga Krishi Viswavidyalaya, Pundibari, West Bengal for providing necessary facilities for conducting the research studies.

Conflict of interest. None.

REFERENCES

Acevedo, M., Pixley, K., Zinyengere, N., Meng, S., Tufan, H., Cichy, K., Bizikova, L., Isaacs, K., Kopel, K. G., & Porciello, J. (2020). A scoping review of adoption of climate resilient crops by small scale producer in low and middle income countries. *Nature plants, 6*: 1231-1241.

Balkrishna, A., Phour, M., Thapliyal, M. & Arya, V. (2021). Current Status of Indian Agriculture: Problems, Challenges and Solution. *Biological Forum – An International Journal, 13*(3): 361-374.

Ganesh, D. & Rahman, F. H. (2018). Adoption and Discontinuation of Innovative Agricultural Technology by the Farmers of NICRA Village in Cooch Behar District. *Indian Research Journal of Extension Education, 18*(3): 6-10.

Gwambene, B., Saria, J. A., Jiwaji, N. T., Pauline, N. M., Msofe, N. K., Mussa, K. R., Tegeje, J. A., Messo, I., Mwanga, S. S., & Shija, S. M. Y. (2015). Smallholder farmers practices and understanding of climate change and climate smart agriculture in southern highlands of Tanzania. *Journal of resource development and management, 13*: 37-47.

Iswoyo, H., Stoeber, S., Kaimuddin, Yassi, A., Dermawan, R., & Ramba, T. (2018). Empowering upland farmers to become more resilient towards climate change-experiences from Toraja, Indonesia. IOP Conference Series: Earth and Environmental Science, p. 1-11.

Jasna, V. K., Sukanya, S., Burman, R. R., Padaria, R. N. & Sharma, J. P. (2014). Socio Economic Impact of Climate Resilient Technologies. *International Journal of Agriculture and Food Science Technology, 5*(3): 185-190.

Jatish, C. B., Choudhury, A. K., Miah, M. M. U., Maniruzzaman, M., Ahmed, F., Akhter, S., Rahman, M. M., Aziz, M. A., Hamid, M. A., Wais, K., & Kalra, N. (2018). Climate change concerns in Bangladesh Agriculture. Haya: *The Saudi Journal of Life sciences, 3*(3): 329-338.

Medhi, S., Islam, M., Barua, U., Sarma, M., Das, M. G., Syiemlieh, E. C., Bordoloi, P. & Mukhim, B. (2018). Impact of Climate Resilient Practices under NICRA Project in Ri Bhoi District of Meghalaya. *Economic Affairs, 63*(3): 653-664.

Rao, M. S., & Malkharjuna, R. N. (2017). Impact of Farm Pond Technology on Economic Development of the Farmers in Khammam District of Andhra Pradesh. *Bulletin of Environment, Pharmacology and Life Sciences, 6*(1): 510-511.

Srinivasa, R. Ch., Rejani, R. & Prasanna, K. (2014). Climate Resilient Water Management Practices for Improving Water Use Efficiency and Sustaining Crop Productivity. National Workshop Climate Adapt Project Climate Change & Water: Improving WUE, p: 9-30.

How to cite this article: Peddi Naga Harsha Vardhan, Prabhat Kumar Pal, Deepa Roy and Sabita Mondal (2022). Study on Bio-physical Impact by Adoption of Climate Resilient Technologies in Agriculture. *Biological Forum – An International Journal*, *14*(1): 1179-1183.