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INTEGRATION OF CLIMATE SMART AGRICULTURE (CSA) PRACTICES HELPS TO BUILD RESILIENCE IN COASTAL COMMUNITIES OF BHITARKANIKA, ODISHA LEADING TO INCREASED LIVELIHOOD SECURITY

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ABSTRACT

Bhitarkanika of Odisha has been identified as one of the most vulnerable blocks in India to climate induced natural disaster characterized by occasional saline water inundation to the agriculture field of this coastal communities who almost rely on monsoon dependent mono-cropping of paddy. The area though is bestowed with adequate rainfall, inadequate rain-water harvesting structures and knowledge-gap regarding less water demanding agriculture cause the agriculture lands remaining unproductive in post monsoon seasons. As a mitigating strategy, CSA was introduced experimentally by the NEWS under a community development programme with thirty two farmers of four villages namely, Dangamal, Badaadia, Kamalpur and Trilochanpur under Rajnagar block of Kendapara district in 2016-2017. Farmers selected through a robust survey were capacitated by handholding about SLT of paddy, multi-cropping with horticulture choosing leguminous plant for natural biological fixation in soil, good agriculture practice using bio-pesticide and bio-fertilizer instead of chemical intensive present practice. They were also supported with material inputs for producing vermicompost, procuring bio-pesticides, seeds etc. The practices came out with a countable result. Eighteen farmers adopted water saving SLT paddy cultivation. Twenty eight farmers adopted vegetable cultivation which increased vegetable cultivation by 11.77 % enhancing their household income by 11.33% in that project period and also increased area and productivity of different vegetables and paddy, increased water use efficiency in the line of resource conservation technology. The average BC ratio in case of vegetable cultivation adopting good practice in selected demo plots were found 22:1 against 9.58:1 for the non-demo plots adhering traditional practices. Thus, the outcome of the project may be instrumental to this coastal community for livelihood augmentation if this climate smart agriculture practices standardized are extended in IFS mode in a more improvised way using all available resources in this area converging govt. schemes related to livelihood.

INTRODUCTION

Agriculture with its allied sectors constitute the mainstay of livelihood in India. Seventy percent of rural Indian households still depends primarily on agriculture to earn their livelihood among which eighty two percent are small and marginal (FAO). Climate change is an alarming issue which has been adversely affecting agriculture globally. Coastal areas are witnessing the wrath of climate induced flows and fury significantly. The Indian coasts are no exception of that. The mangrove eco-system of Bhitarkanika National Park is regularly being exposed to such natural disasters which in turn, cause inundation of adjacent agriculture lands with sea water damaging its monsoon dependent mono-crop, paddy. The area receives an annual rainfall of 1670mm but due to lack of adequate rainwater harvesting water bodies it almost comes to no use for agriculture in post monsoon season. Since freshwater aquaculture in this area fetches insignificant return, saline water is entered by the farmers in most of these existing freshwater ponds for doing brackish water aquaculture there to realize comparatively higher price realization. But, this practice turn this rain harvested freshwater unfavourable for agriculture. Lack of knowledge regarding less water demanding agri.-horticulture practice is another causative factor for not adopting the same in Rabi season. As a result, agriculture lands remain unproductive mostly except rainy season. The crops they use to cultivate except paddy are potato and onion and that is mainly to realize the govt. subsidy available for the same. They were unaware of the situation specific scope for diversification of their cultivation with more adverse climatic condition tolerant vegetables. In the above context, to wean over this constrained situation and augment the livelihood of this coastal community, NEWS introduced an area-specific CSA model with thirty two practicing farmers including three women of four

villages named Dangamal, Badaadia, Trilochanpur and Kamalpur under Dangamal Gram Pachayat of Kendapara district in the year 2016-17 under funding support of IUCN-MFF initiative of Small Grant Project. The project spanned over a period of one year. The model included introduction of SLT of paddyin Kharif season, multi-cropping, diversification of horticulture(vegetable) with agro-ecologically suitable species including leguminous plant, production of vermi-compost as bio-fertilizer, liquid compost (miracle solution), use of bio-pesticidesand other bio-agents or bio-inoculants for seed treatment and disease control, capacity building by training for good agriculture practice and handholding during implementation. The selected farmers were also supported with material input as far as possible for adopting this new practice. The detail methodology and results of this successful package of practice are being described here under.

MATERIALS AND METHODS

The farmers of Bhitarkanika don't have practical knowledge of organic farming and climate smart agricultural practices for sustainable livelihoods and conservation of ecology.

The experiment was conducted in 64.6 decimal lands in 2016 and 499.5 decimal in 2017 with thirty two farmers of four villages of Dangamal Gram Panchayat of Kendrapara district from July, 2016 to August 2017. The farmers were selected through a standard survey using PRA tools. The survey included FGD, socio-economic mapping of the farmers. Capacity building of the selected farmers were then done through training about SLT, horticulture, production of vermi-compost, using of bio-pesticide & bio-agents, seed segregation and seed treatment. Then individual resource specific plan was made for each farmer and accordingly they were handhold

Fig. 1. Vermicompost in mosquito net

Fig. 2. Liquid fertilizer (Miracle solution)

Fig. 3. Preparation of Bio-pesticides

Fig. 4. Bio-inoculants

Fig. 5. SLT with Azolla

Fig. 6. Diversified Cropping

during activity implementation. SLT was done in 440 decimal lands, vegetable cultivation were done in 124.1 decimal lands comprising the species 17.

SLT, vermicompost, bio-pesticides, seed segregation, seed treatment, liquid compost and bio-inoculants were done following standard management practice.

Data collected regarding the background information of the respondents were scored. Individual variables were then subjected to descriptive statistics *viz*. Mean, SE and Student's t-tests to compare the means between CSA and Non-CSA applications. Quantitative analysis was done by using the software: MS Excel and SPSS.

RESULTS

In Kharif Season 2016, due to late start of the project, only 3 farmers opted for single line transplantation (fig. 5) in 6 decimal of land but in Kharif season 2017, 18 farmers have opted for such cultivation in 434 decimal of land. In winter season 26 farmers did vegetable cultivation (diversified cropping) in 58.6 decimal lands whereas in Kharif season 2017, 28 farmers cultivated vegetables (fig. 6) in 65.5 decimal of land. The project area of vegetable cultivation increased by 11.77 percent in one seasonbrought significant economic gain enhancing annual household income by 11.13 percent, providing better employability opportunity and health condition. This gain was realized due to lowering of input cost in agriculture and horticulture activities by producing vermicompost (fig. 1), liquid fertiliser (fig. 2),bio-pesticides (fig. 3) and bio-inoculants (fig. 4) with locally available resources and not using any chemical pesticides and fertilizer *etc*. In monsoon season, area of vegetable cultivation was normally decreased due to paddy cultivation in agricultural field but farmers get profit from CSA farming by using aerial spaces, roof tops especially with bitter gourd, ridge gourd, pumpkin *etc*. thereby increasing the *effective* cultivable area.

Table 1. Result of Student's t-Test for minimum no. of panicle, maximum no. of panicle and yield status of paddy:

No. of Panicle and Production Status	Plot	Mean ± SE	t
Minimum_Panicle	Demo Plot	27.94 ± 1.30	4.60**
	Non-demo Plot	21.32 ± 0.62	
Maximim_Panicle	Demo Plot	33.11 ± 1.22	5.58**
	Non-demo Plot	25.42 ± 0.64	
Yield	Demo Plot	21.28 ± 0.61	4.93**
	Non-demo Plot	16.77 ± 0.67	

**P<0.01

On an average after 45 days, 28 and 33 numbers of minimum and maximum panicles were noted respectively in demo plots in comparison to 21 and 35 numbers of minimum and maximum panicles in non-demo plots of Kharif 2016. Mean yield of paddy when observed it was revealed that demo plot could produce 21.28 quintal per acre of paddy than 16.77 quintal per acre in non-demo plot. Student's t-tests showed significant increase in mean number of minimum panicle, number maximum panicle and yield in demo plot over non demo plot.

The benefit cost ratio has been calculated considering the production as benefit and all the related input as cost. It has been transformed into monetary value by multiplying with the average selling cost of the produce in local markets for non-demo (i.e. non CSA farming) and demo (CSA farming) plots. Due to organic inputs, the price realization of the demo plot produce was a bit higher even in the local market. Seed procurement, pesticide, fertilizers, and labour engagement (external), irrigation have been taken into account as input cost.

From the quantitative analysis of the data obtained it was observed that overall production status of vegetable increased by 19.13 percent. This enhancement was realized due to lowering of input cost in horticulture activities by producing bio fertilizers and bio-pesticides with locally available resources and maintaining zero use of chemical pesticides and fertilizer. Overall Benefit: Cost (B:C) ratio describes that if a farmer spent INR1.00 in a demo plot for production purpose he received INR22.00 after selling of produce by using vermicompost, liquid manure and bio-pesticide etc. However in non-demo plot if a farmer spent INR1.00 for production purpose he received INR9.58 after selling of produce by using chemical fertilizer and pesticide.

Use of water at Rabi season has been reduced significantly at 1% level of significance due to introduction of Climate Smart Agriculture practices successfully at farmers' field level.

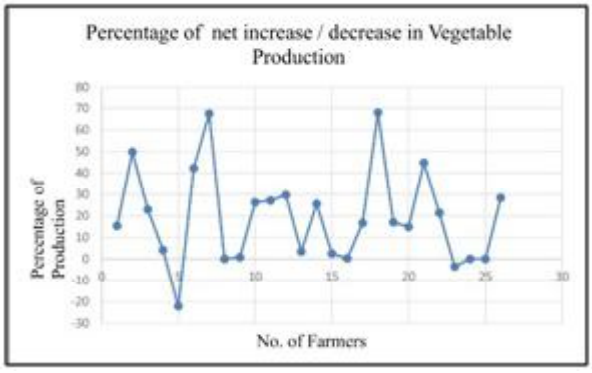

Fig. 7. Percent net increase/ decrease in vegetable production after adopting CSA

DISCUSSION

Seed segregation and seed treatment done by farmers under CSA practices. They went for single line transplantation in paddy cultivation because it was less labourious and de-weeding helps to turn the weeds into manures for the crop. NEWS team linked farmers to Govt. Scheme and ensured their benefit of INR500.00 per acre by practicing single line transplantation, an improved technology of paddy production.Farmers practiced vegetables like bitter gourd, radish (red and white), amaranth, beetroot, chili, nautia saga (red), pumpkin, khosla saga, carrot, ridge gourd, cucumber, ladies finger, broad beans, kalmi saga *etc*. and mustard seed after intervention of CSA practices along with onion and potato

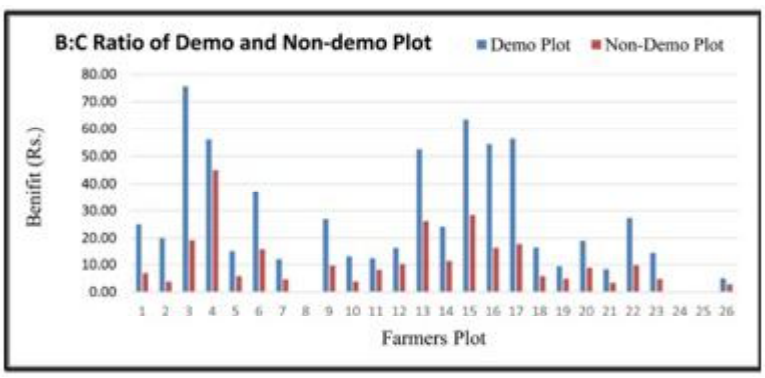

Fig. 8. B:C Ratio of Demo and Non-demo Plot

Table 2. Result of Paired t-Test of water usage:

Water usage	Mean ± SE
Before	119.96 ± 5.43
After	60.48 ± 2.85
t	12.63**

as common farmers' practice to achieve government subsidy. Farmers face constraints to harvest Rabi yield as there are frequent crop raids by deer and wild boar. So with the help of Scientist of ICAR-CIFA, Bhubaneswar, farmers produced fish liquid as protective measure of crops.

CSA practice resulted increase in area of vegetable cultivation and production of different vegetables, increased productivity of paddy, development of linkage with Govt. Schemes, increased water use efficiency in the line of resource conservation technology and enhanced livelihood security of the farmers.

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