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SOCIO-ECONOMIC EMPOWERMENT AND SUSTAINABLE LIVELIHOOD SECURITY OF TRIBAL FARMERS THROUGH TECHNOLOGICAL INTERVENTION: AN IMPACT ANALYSIS

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ABSTRACT

The study was conducted at ICAR- Agricultural Technology Application Research Institute, Zone-VI, Guwahati in collaboration with other 7 ICAR-ATARIs and its KVKs. The objectives of the study were to assess the impact of technology interventions on socio-economic growth and attaining of livelihood security among the tribal farmers by keeping 2016 as base year. The study revealed that there is a change in production pattern during this period from 2016 to 2021. The rice area increased 14 percent in Eastern Plateau & Hill Region and Wheat area 12.4 percent in Western Himalayan Region in adopted villages as compare to non-adopted villages. The area under sorghum (4.0%) and Barley (7.3%) increased in Western Dry Region (Rajasthan) respectively. The highest changes in cropping intensity were observed in East Coast Plains and Hills Region with Simpson Index 0.95. The highest area decreased by 17.8 percent under mono-cropping in East Coast Plains and Hills Region followed by 16.6 percent in Western Plateau and Hills Region. Among, the adopted villages, the highest changes in Agriculture + Horticulture based farming system (36.6%) was observed in Eastern Himalaya Region i.e. North East India (Meghalaya, Mizoram Manipur, Sikkim, Arunachal Pradesh, Nagaland, Tripura, Assam). As per livestock production is concerned, the highest changes among the local cattle was observed in Eastern Coast Plain and Hill Region (6.9%) followed by Eastern Plateau & Hill Region (6.6%) . The highest changes in the income level of tribal farmers have been observed in Western Plateau & Hill Region (0.77%), followed by East Coast Plain & Hill Region (0.73%) as compare to non-adopted villages. The average net income in non-adopted areas was Rs. 61286.84 per ha/year with benefit-cost (BC) ratio 1.2, whereas, in adopted areas was Rs. 98874.00 with BC ratio 2.04. The difference of farm income was Rs. 37587.16 per ha/year. It was found that, there is a significant contribution of technology intervention in adopted villages which enhanced the income level of farmer as compared to non-adopted areas. However, the farmers were also facing marketing constraints followed by economic.

Key words: Farming, Technology Intervention, Tribal farmer, Sustainable Livelihood

Introduction

The agricultural crop production system is changing gradually globally due to the advancement of technology, climate change, scarcity of resources, need and demand of the people. India has significant contribution in global food production system such as cereal, millets, vegetable and animal husbandry. The role of tribal farmer of India

in global production is inseparable. The tribal are known as 'Adivasis' which literal meaning is 'Indigenous People'. The tribal population of India constitute about 8.9 percent of the total population in India and spread mostly in the hilly terrain across the country (Population Census 2011). Approximately 550 tribes in India and mostly found in the state of North Eastern region, Jammu

Major Crops	WHR		WDR		EP&HR		ECP&HR		EHR		WP&HR		CP&HR	
	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV
Rice	0.0	0.0	0.0	0.0	6.0	14.0	4.0	13.9	8.0	18.0	6.0	9.7	2.0	6.8
Wheat	4.8	12.4	0.0	5.0	11.0	12.0	0.0	0.0	0.0	0.0	5.0	8.0	2.4	5.9
Maize	0.7	1.6	2.8	3.4	3.5	4.4	2.6	8.0	3.4	43.0	2.3	5.8	0.8	1.1
Barley	2.9	10.1	3.3	8.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.3	0.7	2.2
Sorghum	0.0	0.0	1.3	4.0	2.1	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.9	2.9
Bajra	0.0	0.0	3.5	7.3	0.0	1.6	0.0	0.0	0.0	0.0	0.9	2.8	0.5	3.1
Mean	1.4	4.0	1.8	4.6	3.7	5.3	1.1	3.6	1.9	10.1	2.8	5.1	1.2	3.6
SD	2.0	5.6	1.6	2.9	4.2	6.1	1.7	5.9	3.2	17.6	2.1	3.1	0.7	2.2
SE	0.8	2.3	0.6	1.1	1.7	2.5	0.7	2.4	1.3	7.1	0.8	1.3	0.3	0.9

AV=Adopted Village, NA= Non-Adopted Village, WHR=Western Himalayan Region, WDR=Western Dry Region, EP+HR= Eastern Plateau and Hill Region, ECP&HR= East Coast Plain and Hill Region, EHR=Eastern Himalayan Region, WP&HR, Western Plateau and Hill Region and CP&HR= Central Plateau and Hill Region.

Materials and Methods

The study was conducted at ICAR-ATARI, Zone-VI, Guwahati in collaboration with other 7 ICAR ATARIs (Ludhiana, Jodhpur, Patna, Kolkata, Umiam, Pune and Jabalpur) and its KVK where Tribal Sub-Plan Programme component is carrying out. These ICAR-ATARIs KVK falls in 7 agro-climatic zones are Western Himalayan Region (WHR), Western Dry Region (WDR), Eastern Plateau & Hill Region (EP & HR), East Coast Plain & Hill Region (ECP & HR), Eastern Himalayan Region (HER), Western Plateau & Hill Region (WP & HR). Himachal Pradesh, Jammu & Kashmir, and Ladakh falls under the Western Himalayan Region, Rajasthan in Western Dry Region, Jharkhand and part of Bihar in Eastern Plateau & Hill Region, West Bengal and part of Odisha in East Coast Plains and Hills Region, North Eastern States in Eastern Himalayan Region, Maharashtra, and Gujarat in Western Plateau and Hill Region, and Madhya Pradesh and part of Chhattisgarh in Central Plateau & Hill Region respectively. There are

Pulses and Oilseed	WHR		WDR		EP&HR		ECP&HR		EHR		WP&HR		CP&HR	
	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV
Soyabean	0.0	0.0	2.5	8.4	0.0	4.9	0.0	0.0	0.3	0.8	4.6	12.4	3.2	13.0
Gram	0.0	0.0	2.6	7.5	3.8	6.5	0.0	0.0	0.4	0.5	4.9	10.7	2.5	10.3
Peas	9.4	11.7	2.0	4.0	2.2	4.5	0.0	0.0	0.97	1.8	3.3	7.8	3.1	5.9
Lentil	0.0	0.4	1.0	1.5	5.0	8.0	0.0	0.0	0.73	2.1	2.5	6.8	3.3	5.3
Mustard	0.0	0.0	5.4	9	9.0	15.0	0.0	0.0	9.0	18.0	0.0	0.0	1.4	1.8
Groundnut	0.0	0.0	3.6	8.9	3.2	9.6	2.7	9.4	0.0	0.0	2.2	5.6	1.6	4.6
Rajmah	0.0	0.0	2.2	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.1	0.3	1.0
Mean	1.3	1.7	2.7	5.9	3.3	6.9	0.3	1.3	1.6	3.3	2.6	6.3	2.2	5.9
SD	3.5	4.4	1.4	3.2	3.1	4.6	1.0	3.5	3.2	6.5	1.8	4.5	1.1	4.3
SE	0.5	0.6	1.0	2.2	1.2	2.6	0.1	0.5	0.6	1.2	0.9	2.4	0.8	2.2

AV=Adopted Village, NA= Non-Adopted Village, WHR=Western Himalayan Region, WDR=Western Dry Region, EP+HR= Eastern Plateau and Hill Region, ECP&HR= East Coast Plain and Hill Region, EHR=Eastern Himalayan Region, WP&HR, Western Plateau and Hill Region and CP&HR= Central Plateau and Hill Region.

Table 3: Change in area (%) of cropping pattern in adopted and non-adopted villages (2016-2021) (n=1840).

Fruits and Vegetables	WHR		WDR		EP&HR		ECP&HR		EHR		WP&HR		CP&HR	
	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV
Potato	4.0	7.2	2.1	2.8	9.0	13.0	0.7	2.7	0.7	7.3	0.6	3.3	0.0	1.2
Tomato	0.0	0.0	0.4	1.4	4.0	5.9	0.8	1.8	0.5	7.5	0.8	2.5	0.8	1.8
Cauliflower	0.2	8.1	0.7	2.4	2.0	4.2	2.0	3.5	0.6	4.3	0.5	2.9	0.6	1.6
Cabbage	0.0	0.0	0.5	5.3	2.0	3.7	1.0	2.2	0.3	2.4	1.0	1.3	0.4	1.4
Apple	1.1	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Banana	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
Pineapple	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	0.0	0.0	0.0	0.0
Citrus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	0.0	0.0	0.0	0.0
Mean	0.7	2.3	0.4	1.4	2.1	3.3	0.5	1.2	0.2	5.6	0.3	1.2	0.2	0.7
SD	1.3	3.4	0.7	1.9	3.1	4.5	0.7	1.4	0.3	4.8	0.4	1.4	0.3	0.8
SE	0.2	0.8	0.1	0.5	0.7	1.1	0.2	0.4	0.1	2.0	0.1	0.4	0.08	0.2

AV=Adopted Village, NA= Non-Adopted Village, WHR=Western Himalayan Region, WDR=Western Dry Region, EP+HR= Eastern Plateau and Hill Region, ECP&HR= East Coast Plain and Hill Region, EHR=Eastern Himalayan Region, WP&HR, Western Plateau and Hill Region and CP&HR= Central Plateau and Hill Region.

94 KVKs under tribal district where schedule tribe population is more than 25 percent according to the Population Census 2011. Out of that 92 KVK under different ICAR ATARI administration was selected where Tribal Sub-Plan Programme is running since 2016. These 92 KVKs were selected for the study purpose. Further, two villages (one adopted and one non-adopted by KVK) were selected purposively from each KVK for conducting the survey. From each village (adopted and non-adopted), 20 beneficiaries were selected. Therefore, total sample size was 3680 respondents (adopted 1840 and non-adopted 1840) in number were taken for the study. The parameters studied in this research were Cropping Intensity (CI) to know the number of crops grown from the same field during one agricultural year, Crop Diversification (CD) to understand the, Cropping Pattern, Farming System, Net Income, Benefits Cost ratio, changes of expenditure pattern, consumption pattern, livestock production, milk productivity, milk availability, changes in education level, household assets, extent of adoption of technology and constraints. These parameters studied simultaneously in

Table 4: Changes of Cropping Intensity (2016-2021).

Agro-Climatic Zones	NA (%)	A (%)	D (%)
WHR (n=160)	4.0	21.0	17.0
WDR (n=160)	10.6	18.0	7.4
EP&HR (n=200)	19.0	26.0	7.0
ECP&HR (n=160)	1.0	31.4	30.4
EHR (n=760)	7.0	14.0	7.0
WP&HR (n=180)	2.0	23.0	21.0
CP&HR (n=220)	9.0	16.0	6.0
Mean (N=1840)	7.51	21.3	13.7
SD	6.18	6.0	9.4
SE	2.84	8.0	5.2

NA: Non-Adopted(%); A: Adopted(%); D: Differences(%)

adopted and non-adopted areas by keeping base year 2016 and data collection was done in the year of 2021. The data collection was done through a structured interview schedule developed by ICAR-ATARI, Guwahati in consultation with experts from other zonal ATARIs. The data collection was done through respective tribal district KVK located in different agro-climatic zone under ICAR-ATARI's administration. During data collection, a door to door visit to the farmers in adopted and non-adopted areas was done. The primary data was crossed checked with secondary data in later phase. The collected data were coded, tabulated and analysed by

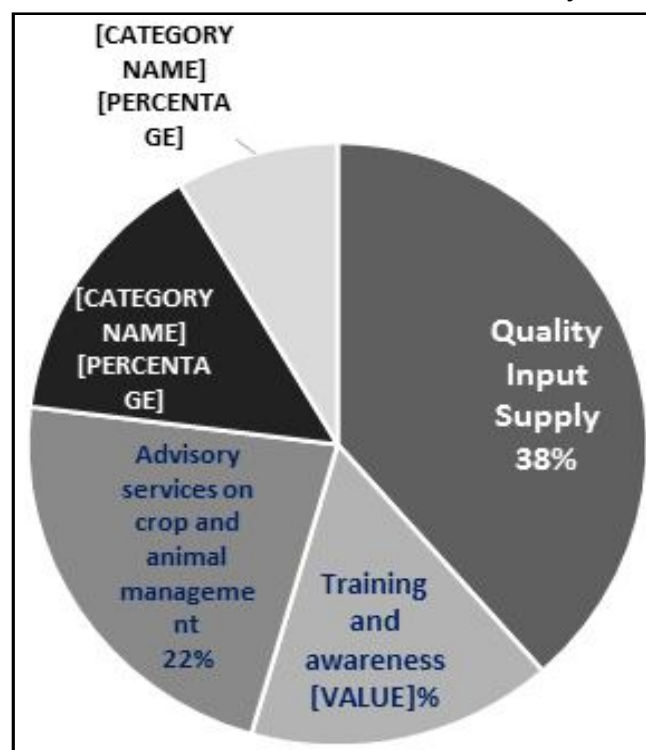
**Fig. 1:** KVKs Technological contribution in Farm Income.

Table 5: Crop Diversification (D) Simpson Index (2016-2021).

Agro-Climatic Zones	NA (%)	A (%)	D (%)
WHR (n=160)	0.20	0.77	0.57
WDR (n=160)	0.34	0.72	0.38
EP&HR (n=200)	0.36	0.86	0.50
ECP&HR (n=160)	0.45	0.95	0.50
EHR (n=760)	0.49	0.89	0.40
WP&HR (n=180)	0.37	0.91	0.54
CP&HR (n=220)	0.48	0.90	0.42
Mean (N=1840)	0.38	0.85	0.47
SD	0.09	0.07	0.06
SE	0.14	0.32	0.17
NA: Non-Adopted(%); A: Adopted(%); D: Differences(%)			

using suitable statistical tool such as mean, median, Simpson index, chi-square, correlation and regression. A logical conclusion has been drawn between non-adopted villages and adopted villages. An operational definition of some of the parameters as below; Cropping pattern refers to the proportion of land under cultivation of different crops at different points of time in a unit area.

The cropping intensity is defined as the number of crops grown in the same field in one agriculture year.

$$\text{Cropping intensity} = \frac{\text{Total Cropped Area}}{\text{Total Sown Area}} \times 100$$

The crop diversification has been measured by using Simpson diversity index

$$D = 1 - (\sum n(n-1) / N(N-1))$$

D=Diversity Index

N= Total Number of individuals collected

n=Number of individuals of a species

A farming system is a mix of farm enterprises such as crop, livestock, aquaculture, agroforestry and fruit crops to which farm family allocates its resources in order to efficiently manage the existing environment for the attainment of the family goal (Lal and Miller, 1990).

$$\text{Net Income} = \text{Total Revenues} - \text{Total Expenses}$$

$$\text{Benefit - Cost Ratio} = \frac{\sum \text{Present Value of Future Benefits}}{\sum \text{Present Value of Future Costs}}$$

Where, R_{ij} = Rank given for i^{th} item by the j^{th} individual
 N_j = Numbers of items ranked by j^{th} individual

Results and Discussion

Changes in Cropping Pattern of Major Cereal Crops

The study revealed that the highest area under rice (14%) has been increased in Eastern Plateau & Hill Region and Wheat (12.4%) in Western Himalayan Region in adopted villages. The state Odisha falls in the Eastern Plateau & Hill Region, whereas Himachal Pradesh,

Table 6: Changes in Cropping System (%) (2016-2021).

Changes in Cropping System	Non-adopted			Adopted		
	Mono	M	I	Mono	M	I
WHR (n=160)	-9.3	6.8	4.3	-16.2	21.8	4.3
WDR (n=160)	-4.3	5.6	2.5	-10.6	10.0	0.0
EP&HR (n=200)	-3.5	6.5	4.0	-9.5	15.0	5.5
ECP&HR (n=160)	-6.4	3.5	2.8	-17.8	22.1	3.5
EHR (n=760)	-2.2	0.7	0.6	-10.1	16.9	4.6
WP&HR (n=180)	-4.4	4.4	2.2	-16.6	20.0	2.2
CP&HR (n=220)	-7.2	-1.8	3.6	-10.0	12.7	5.9
Mean (N=1840)	-5.32	3.67	2.85	-12.97	16.92	3.70
SD	2.43	3.18	1.26	3.69	4.65	2.05
SE	-2.01	1.39	1.08	-4.90	6.40	1.40
M: Multiple; I: Inter						

Jammu & Kashmir and Ladakh in Western Himalayan region. The crop Maize (43%) and Barley (10.1%) increases in both Eastern Himalayan Region and Western Himalayan Region. However, sorghum (4.0%) and bajra (7.3%) area increased in Western Dry Region (Rajasthan) respectively.

The cropping pattern in India shows a bias towards food-grain crops (especially rice and wheat). However, there is found to be a change trend in the cropping pattern in favour of non-food-grain cash crops over time, though the food-grain crops still dominate the cropping pattern of the country.

Changes in Cropping Pattern of Pulses and Oilseed

Pulses and oilseed play an important role in household consumption. The cultivation of the pulses and oilseed is restricted to certain geographic area which was analysed and found that Area under pulses such as soyabean, gram increased 13.0 percent, 10.3 percent in Central Plateau & Hill Region, and pea 11.7 percent in Western Himalayan Region.

The interventions such as Cluster Front Line Demonstration through KVK, Collaborative applied research with State Agricultural Universities, seed hub has significantly contributed to increasing the availability of quality pulse seeds.

Similarly, in case of mustard (18.0%) and groundnut (8.9%), the area increased in adopted villages under Eastern Himalaya Region and Eastern Plateau and Hill Region. However, in case of citrus 14.5 percent area increases under Eastern Himalayan Region. Development of location-specific high-yielding varieties and production packages, plays important role in reducing country's export & mitigating the oilseed requirements.

Table 7: Changes (%) in Farming System (2016-2021).

Farming System	WHR (n-160)		WDR (n-160)		EP&HR (n-200)		ECP&HR (n-140)		EHR (n-760)		WP&HR (n-180)		CP&HR (n-220)	
	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV	NA	AV
Ag	41.8	13.1	48.1	40.6	35.5	23.0	36.4	25.0	41.5	37.6	48.3	30	39.0	29.1
Ho	20.0	15.6	6.8	9.3	16.0	18.5	9.2	10.0	18.4	14.9	20.0	16.7	19.0	17.3
Ag+Ho	24.3	28.1	9.3	10.6	23.5	27.5	20.7	27.1	31.1	36.6	12.7	33.3	14.0	30.0
Ag+AH	7.5	16.8	25.0	30.6	10.0	17.0	10.0	7.8	2.7	3.2	12.2	10.6	6.8	8.18
Ag+Ho+AH	6.2	26.2	10.6	8.7	9.5	10.5	16.4	19.3	4.4	4.8	0	0	11.3	3.64
Ag+AH+P	0	0	0	0	5.5	3.5	7.1	10.7	1.5	2.7	6.6	9.4	9.5	11.8
Mean (N=1840)	14.26	14.26	14.26	14.26	14.29	14.29	14.26	14.27	14.23	14.26	14.26	14.29	14.23	14.29
SD	15.31	10.13	17.46	15.49	11.16	8.63	10.93	8.29	16.75	16.47	16.89	12.82	11.74	10.94
SE	5.82	5.82	5.82	5.82	5.83	5.83	5.82	5.83	5.81	5.82	5.82	5.83	5.81	5.83

Ag=Agriculture, Ho=Horticulture, AH= Animal Husbandry, P=Poultry; AV=Adopted Village, NA= Non-Adopted Village, HR=Western Himalayan Region, WDR=Western Dry Region, EP+HR= Eastern Plateau and Hill Region, ECP&HR= East Coast Plain and Hill Region, EHR=Eastern Himalayan Region, WP&HR, Western Plateau and Hill Region and CP&HR= Central Plateau and Hill Region.

Changes in Cropping Pattern of Fruits and Vegetables

India stand 2nd in production of fruits & vegetables after China. Earlier, the fruits and vegetables were depended on the seasonality. But due to the advancement of production technologies, it can be grown throughout the year. Farmers are becoming more profit oriented by changing the cropping pattern as observed in the Table 3.

Fruits such as apple, pineapple, banana, citrus are grown in specific geographic location. In Western Himalayan Region, the apple fruit contributed a major share followed by citrus and pineapple in Eastern Himalayan Region.

In case of vegetables such as potato, tomato, and cauliflower 13.0 percent, 7.5 percent and 8.1 percent area increase adopted villages under Eastern Plateau & Hill Region, Eastern Himalayan Region, and Western Himalayan Region.

This study is synchronized with the findings of Pratap T. (2020) that new cropping systems are emerging, with 175 different fruit and vegetables cash cropping in both Western and Eastern Himalayan Region.

The availability of resources, high yielding varieties, integrated nutrient management and encouraging government policies have contributed significantly to this sector. However, it has huge potential to increase its presence in untapped markets in the near future.

Changes of Cropping Intensity (%)

Changes of Crop Diversification Index

There is a change in cropping intensity between non-adopted and adopted areas. The highest changes in

cropping pattern was observed in adopted areas of East Coast Plains and Hills Region (31.40%) followed by Eastern Plateau and Hill Region (26.00%). The cropping intensity in 2016 in adopted areas was 143 percent changed to 188 percent in East Coast Plains and Hills Region. The cropping diversity (D) in East Coast Plains and Hills Region is 0.95 followed by Western Plateau and Hills Region is 0.91 respectively. The tribal of state Odisha falls under East Coast Plains and Hills Region and Maharastra & few districts of Madhya Pradesh falls

Table 8: Changes of Net Income and BC ratio (2016-2021).

Agro-Climatic Zone	Non-adopted		Adopted		Changes	
	NI	BCR	NI	BCR	NI	BCR
WHR (n=160)	53965.2	1.4	78013.3	2.0	24048.1	0.6
WDR (n=160)	56956.8	1.6	222871.7	2.2	165914.9	0.6
EP&HR (n=200)	69876.22	1.3	73832.7	1.8	3956.5	0.5
ECP&HR (n=160)	64288.6	1.4	82591.6	2.1	18303.0	0.7
EHR (n=760)	74381.2	1.3	85875.3	1.9	23793.3	0.6
WP&HR (n=180)	52298.8	1.3	67948.3	2.1	11494.1	0.7
CP&HR (n=220)	57240.9	1.5	80984.8	2.2	15649.5	0.7
Average Net Income (N=1840)	61286.8	1.2	98874.0	2.0	37587.1	0.8
SD	8403.9	0.1	54997.2	0.1	57018.3	0.08
SE	23164.2	0.4	37370.8	0.7	14206.6	0.3

NI: Net Income; BCR: BE Ratio

Table 9: Changes in consumption pattern (2016-2021).

Agro-Climatic Zone	Cereal	Veg.	Pulses	Edible Oil
WHR (n=160)	1.4	1.6	0.4	0.2
WDR (n=160)	3.0	1.5	0.0	0.1
EP&HR (n=200)	0.7	1.3	1.0	0.2
ECP&HR (n=160)	0.0	1.0	0	0.1
EHR (n=760)	3.2	0.0	1.4	0.0
WP&HR (n=180)	5.4	0.6	0.9	0.2
CP&HR (n=220)	3.6	0.4	0.4	0.2
Mean (N=1840)	2.4	0.9	0.5	0.1
SD	1.8	0.6	0.5	0.08
SE	0.9	0.3	0.2	0.05

under Western Plateau and Hills Region. The major crops grown in the area are rice, pulses, jute, tobacco, vegetables and oilseed. A similar study was conducted by S.J.K. Annamalai (2018) and found that the average Cropping Intensity of East Coast Plains and Hills Region is 179 percent.

Changes of Cropping System

The Table 6 revealed that in adopted villages, the average mono-cropping area has been decreased more than the non-adopted. The highest area decreased by 17.8 percent under mono-cropping in East Coast Plains and Hills Region followed by 16.6 percent in Western Plateau and Hills Region.

However, the multiple cropping area has been increased by 22.14 percent in East Coast Plains and Hills Region followed by 21.87 percent in Western Himalayan Zone. East Coast Plains and Hills Region has an average annual rainfall 75cm-150 cm possess alluvial soil favour for 20.33 per cent of rice production in the country. Due to that alkalinity, soil degradation, infertility of the soil, less profitable farming arises major challenges. Therefore, discouraging monoculture of rice cultivation and encourage crop diversification; increasing cropping is need of the hour suggested by Anuj Jindal, mentor, NABARD (2017).

Changes of Farming System

The Table 7 probed that Agriculture, Agriculture + Horticulture, Agriculture + Animal Husbandry, Agriculture+ Horticulture +Animal Husbandry, and Agriculture + Animal Husbandry + Poultry are the prominent farming system in the study area. Among, the adopted villages, the highest changes in Agriculture + Horticulture based farming system (36.6%) was observed in Eastern Himalaya Region *i.e.* North East India (Meghalaya, Mizoram Manipur, Sikkim, Arunachal Pradesh, Nagaland, Tripura, Assam). Whereas, 30.6 percent changes in Agriculture + Animal Husbandry based farming system in Western Dry Region (Rajasthan)

Table 10: Changes in Expenditure pattern (2016-2021).

Agro-Climatic Zone	Cereal	Veg.	Pulses	Edible Oil
WHR (n=160)	86.8	92.0	28.0	86.6
WDR (n=160)	78.0	48.0	22.0	52.0
EP&HR (n=200)	43.3	137.8	90.5	87.8
ECP&HR (n=160)	0.0	190.0	0.0	53.4
EHR (n=760)	112.0	0.0	16.0	0.0
WP&HR (n=180)	274.0	120.0	67.0	86.8
CP&HR (n=220)	226.8	127.0	67.0	85.3
Mean (N=1840)	117.2	102.1	41.5	64.5
LSD	98.5	62.4	33.2	32.6
SE	44.3	38.6	15.6	24.4

respectively. In the Eastern Himalayan Region, rice is the dominant crop under agriculture and turmeric, citrus, pineapple, potato, brinjal are the major crop under jhum cultivation in horticulture. In Rajasthan, Rathi, Tharparkar, Hariana in cattle and Murrah buffalo are the major animal and bajra, pearl millets, sorghum and oilseeds are the major crops. Agriculture based farming system is predominant in India. However, as the time passed, the awareness of other sector's such as horticulture, animal husbandry, poultry got momentum and reached to progressive farmers. Even, in small piece of land also, the cultivation of high-value crops, fruits and vegetables were grown. However, the constraints such as marketing, quality seed materials at right time, diseases, climate change, logistic supports and government policies are hindrance.

Changes of Net Income and Benefits-Cost Ratio

The average net income in non-adopted areas was Rs. 61286.84 per ha/year with benefits-cost (BC) ratio 1.2, whereas, in adopted areas was Rs. 98874.00 with BC ratio 2.04. The difference of farm income was Rs. 37587.16 per ha/year. The reasons behind to enhance the average farm income was quality input supply to the selected beneficiaries in the adopted villages which contributed 38.50 percent, advisory services on crop and animal management 22.50 percent, training & awareness 16.00 percent, demonstration 15.00 percent and field visit/exposure 9.0 percent respectively.

The technology support is a prime focus of ICAR-ATARI through which the farming system and farmer's income enhance. It is evident from the data presented above that the KVKs are playing significant role in improving the socio-economic development of the farmer.

The similar study was done by Jamir and Sharma (2018) on Impact on Knowledge Gain, Income and Employment through Intervention of Krishi Vigyan Kendra Training Programmes in Nagaland and reported that 22.50 percent of the tribal farmers were benefits from various

activities of KVK in adopted areas, whereas 14.38 per cent in non-adopted areas.

Changes in consumption pattern from non-adopted to adopted (Kg/month/per family)

The highest changes in consumption of cereal (5.4 kg/month) was found in Western Plateau & Hill Region, Vegetables (1.6 kg/month) in Western Himalayan Region and Pulses (1.4 kg/month) in Eastern Himalayan Region. The consumption of edible oil is almost same. The average consumption of cereal was 45.12 kg/month, vegetable 36.54 kg/month, pulses 4.33 kg/month and edible oil 4.40 litre/month per family in non-adopted areas. However, in adopted areas, average cereal consumption was 47.94 kg/month, vegetable 37.31 kg/month, pulses 4.79 kg/month and edible oil 4.50 litre/month per family. The average size of the family is 5 in number. Among the cereals, rice and wheat is the major stable crop for the farmers of both adopted and non-adopted area. The consumption pattern of the household significantly changed since 1990s. The consumption of cereals has been declined but other food items such as fruits, vegetables, milk, meat, fish has been increased. However, providing food and nutritional security to each and every citizen of the country is far from being resolved (Swaminathan 2006).

Changes in Expenditure pattern from non-adopted to adopted (Rs./month)

The changes of expenditure on food items in different agro-climatic zone was analysed and found that among the cereal, Western Plateau and Hill Region has highest changes (Rs. 274 month/per family) and least in Eastern Plain & Hill region (Rs. 78. month/per family). In case of vegetables, the highest increases in East Cost plain and Hill Region (Rs.190 month/per family). The expenditure increased due to the changes of food consumption pattern and inflation in both in adopted and non-adopted areas. The off-season crop has significantly higher cost than the seasonal crops. The demand-supply relation and food consumption pattern are two faces of coin. The demand increased, the price or family expenditure increased and vice-versa.

A similar kind of studies conducted by Hasan & Singh (2017) and revealed that the share of food in total consumption expenditure was about 52.82 per cent in rural and 42.65 per cent urban sectors, respectively. The share of cereals and pulses was higher in rural sector, while the share of milk and fruits was higher in the urban sector.

In a nutshell, there is significant changes were observed in cropping pattern, farming system, cropping system, cropping intensity, crop diversification, food consumption pattern, expenditure pattern and net income during these 5 years.

References

- Annamalai, S.J.K. (2018). Study relating to formulating long-term mechanization strategy for each agro climatic zone/state in India. Government of India.
- Athare, P.G., Verma A., Malhotra R. and Ramadas S. (2019). Economics of milk production in Pune district of Maharashtra: A comparative analysis. *Indian Journal of Dairy Science*, **72(6)**, 652-658.
- Choudhary, R. and Marandi R.K. (2019). Assessment of the status of dairying in the eastern states and potential to improve socio-economic status of the milk producers and convergence of all central & state schemes at district level in Jharkhand. Government of India, New Delhi.
- Das, A.B. and Sahoo D. (2012). Farmers' educational level and agriculture productivity: A study of tribals of KBK districts of Odisha. *International Journal of Educational Economics and Development*, **3(4)**, 363-374.
- Gupta, A. and Mishra D.K. (2014). Food consumption pattern in rural India: A regional perspective. *Journal of Economic & Social Development*, **10(1)**, July 2014.
- Government of India. (2011). Population Census 2011.
- Hasan, R. and Singh H.P. (2017). Changing consumption pattern of agricultural commodities in Uttar Pradesh: An inter-regional analysis. *Indian Journal of Agricultural Economics*, **72(3)**, July-Sept 2017.
- Kumbhkar, K. (2010). *The tribal states of India*. Walk Through India.
- Lal, R. and Miller F.P. (1990). Sustainable farming system for tropics. In R. P. Singh (Ed.), *Sustainable agriculture: Issues and prospective* (Vol. I, 68-89). Indian Society of Agronomy, IARI, New Delhi.
- Ministry of Agriculture and Farmers Welfare (2021). Annual Report 2021. New Delhi.
- Pratap, T. (2020). GB Pant Memorial Lecture. GB Pant University of Agricultural Science and Technology, Uttarakhand.
- Samuel, J. (2021). Technology adoption and farmers' income: Evidences from rain-fed agriculture. *Indian Farming*, **71(02)**, 06-07; February 2021.
- Swaminathan, M.S. (2006). National Commission on farmers, fifth and final report, October 4, Vol I, Government of India.
- Yaswanth, T., Vamsi K., Acharya S.K., Biswas A. and Haque M. (2022). Assessment of constraints and opportunities of technology adoption in agriculture during pandemic by participatory exercise. *The Pharma Innovation Journal*, **SP-11(2)**, 1212-1215.