Chapter 6

Enhancing Adaptive Capacity of Farmers Through Climate Smart Interventions: A Case Study of Corporate Social Responsibility by ITC in Sehore District, Madhya Pradesh

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Abstract*:* Agriculture in India contributes nearly 20% of the total GDP and supports the livelihood of 70% of the country's population. Significant changes in the climate, such as delayed monsoons and increased temperature, have made this sector vulnerable. This warrants climate smart interventions as an adaptation measure to climate change. Some of the notable programs of the government, such as the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Pradhan Mantri Fasal Bima Yojana (PMFBS), and Rashtriya Krishi Vikas Yojana help in improving the adaptive capacity of the rural poor. However, many corporates have also played a significant role in enhancing the livelihoods of the rural population. ITC has been implementing various activities to enhance agricultural productivity in Madhya Pradesh. The study was undertaken to assess the impact of ITC interventions in reducing farmers' vulnerability to climate change in the Sehore district. The case-control study design was used to draw comparatives between the case (two villages with ITC interventions) and control (two villages without ITC interventions) based on 20 different indicators through a structured questionnaire. The study concluded that the case villages recorded higher yields, better access to the latest farming technologies, improved access to water for irrigation, and higher awareness about different government schemes than the control villages. The overall agricultural vulnerability was computed using different indicators for the case and control villages. The agricultural vulnerability of the case villages was significantly lower (0.18) compared to the control villages (0.88). This implies that ITC's

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interventions have helped enhance the farmers' adaptive capacities in the case villages.

Keywords: Climate change, Adaptive capacity, Climate-smart intervention, Corporate Social Responsibility, vulnerability

1. Introduction

India is a country with high diversity in seasons, crops, and farming systems, and most of the cultivated areas are rain-fed. The agriculture sector forms the backbone of the Indian economy and contributes ~ 20 % to the country's GDP (Zaveri et al., 2016). The Intergovernmental Panel on Climate Change (IPCC) predicts that if the present rate of GHG emissions continues without mitigation measures, the global mean surface temperature shall increase from 3.7 to 4.8°C compared to pre-industrial levels (IPCC, 2015), which will entail a threat to the food security due to adverse impacts of climate change on the agricultural sector (IPCC, 2014). The livelihood of the significant population in the country depends upon agriculture (Census of India, 2011), which is highly vulnerable to climate change (Sathaye et al., 2006). Further, the impact of climate change will be more severe in developing countries due to their geographical locations and lesser adaptive capacity to climate change (IPCC, 2007). This implies that the rural poor of developing countries will be more vulnerable to climate change will experience profound food security implications (Wheeler and von Braun, 2013). In response to this, various strategies have been developed to address the water and agriculture sector at the individual/community/country levels all over the globe to combat the adverse effects of climate change (IPCC, 2014, Macchi et al., 2015).

The Government of India has been highly concerned about the livelihood vulnerability and the natural resource degradation in the country and has introduced various schemes and policies for the same. Mahatma

Gandhi National Rural Employment Guarantee Act (MGNREGA) is one such successful scheme at the country level launched by the government to employ during lean periods through the creation of assets at the individual or community level, which addresses livelihood vulnerability of the rural poor. Launched in 2006 to enhance the livelihood security of people in rural areas, the scheme has served the dual purpose of reducing the livelihood vulnerability of the people and enhancing environmental sustainability (Esteves et al., 2013, Sinha et al., 2017).

The majority of the works done under the MGNREGA are related to water conservation and rejuvenation, soil conservation, improving rural connectivity, and plantations, which have proven to be beneficial to society and have also resulted in adaptation measures to climate change (Esteves et al., 2013, Sinha et al., 2010, 2013). The Pradhan Mantri Fasal Bima Yojana (PMUY) and the Pradhan Mantri Ujjwala Yojana (PMUY) are some of the notable schemes launched by the Government exclusively for the development of rural population that further enhance their adaptive capacity to climate change. However, these government efforts have not been able to achieve the desired results. Similarly, different corporate bodies under their corporate social responsibility (CSR) have implemented different activities to strengthen the social, economic, and environmental conditions in rural India to achieve sustainable development (Gupta and Sharma, 2009).

ITC is one of the top investors in the sector, with an investment of 214.1 crores for the financial year 2014-15 and 247.5 crores for the financial year 2015-16 under their CSR (ITC, 2016). The company formally introduced the "Mission Sunehra Kal" in 2003-04 under its social investment program and initiated various interventions for soil and moisture conservation, livelihood improvement, enhancing energy efficiency, knowledge, and capacity building (ITC, 2016). Looking at the amount of money invested and the number of interventions initiated for the benefit of farmers, we decided to capture the potential of these interventions to have a clearer vision and knowledge about the existing system in the rural landscape of Sehore district in the state of Madhya Pradesh. The study essentially aimed to capture the adaptation and mitigation potential of the interventions made by the ITC and to find their impact on agricultural sustainability in the region.

2. Method

2.1 Study Sites

The study was conducted in four villages in the Sehore district of Madhya Pradesh. It is primarily an agricultural district withwith almost 80 percent population residing in rural areas, primarily dependent on agriculture for their livelihood (Census of India, 2011). The major crops include Wheat, Rice, Jowar (Sorghum) Maize, and Soyabean; gram is also grown by many farmers to meet their domestic needs. The study was conducted in collaboration with ITC and a local NGO (Vibhavari) in the year 2017 in four villages of the Sehore district with a critical focus on understanding the potential of the various climate-smart interventions and capturing their effectiveness in the region. The study site has been highlighted in Figure 1.

2.2. Data Collection and Analysis

The four villages viz. Deh Khedi, Ratanpur, Rampur, and Umarkhal were chosen using a purposive sampling technique in consultation with the ITC officials and studied for the assessment. Deh Khedi and Ratanpur were case villages. Rampura and Umarkhal control villages had a similar demographic profile, bio-geographic conditions, and socio-economic status. Sixty randomly selected households were surveyed for the study, i.e., thirty households each in the case and control villages with a sampling intensity of ten percent. The survey of these sixty households included the collection of information on households’ socio-economic characteristics, crops and cropping practices, climate change adaptation, and mitigation strategies adopted by farmers.

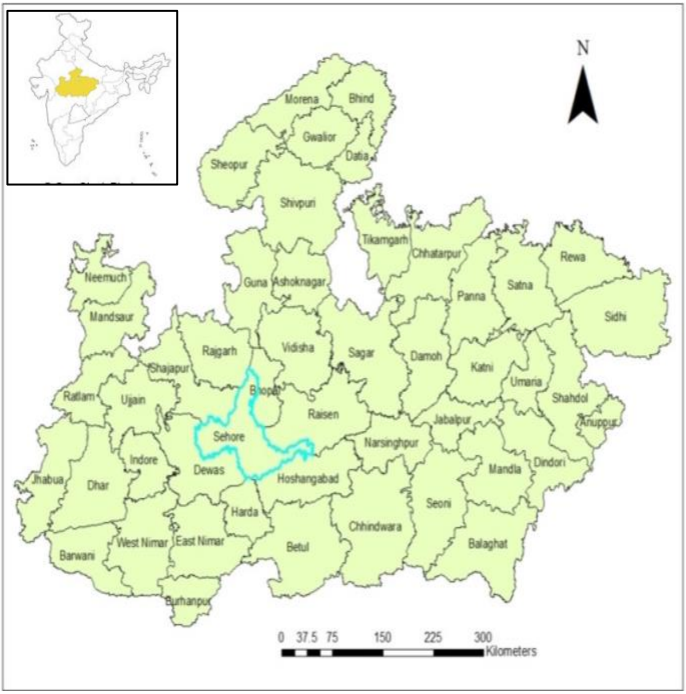

Figure 1. Map of the study site

During the survey, a master list of interventions was prepared, and suitable indicators were identified to conduct the survey, taking insights from the available list of indicators for the assessment of climate-smart interventions specified in Singh et al. (2024), IFAD (2012) and CCAFS (2011,2014) *(as shown in Table 1*).

Table 1. List of indicators used for the assessment of the interventions

S. No.	Indicator
1.	Farmers using drip and sprinkler irrigation methods.
2.	Farmers totally dependent on rainfall for irrigation.
3.	Farmers having farm ponds for water conservation.
4.	Farmers having more than two sources of irrigation.
5.	Number of check dams/ stop dams in the village.
6.	Percentage of farmers having a soil health card.
7.	Percentage change in the amount of fertilizers used.
8.	Percentage change in the amount of compost used.
9.	Farmers checking the germination percentage of seeds before sowing.
10.	Farmers using organic manure made from vermicompost
11.	Farmers knowing the latest farming techniques (%)
12.	Farmers having access to weather information (%)
13.	Number of functional SHG's in the village
14.	Farmers knowing the latest government schemes (%)
15.	Number of WUG (Water user group) committees in the village
16.	Percentage of farmers dependent on fuelwood and dung cakes
17.	Percentage of farmers having alternative sources for cooking
18.	Percentage of farmers practising crop residue burning
19.	The difference in mean yield per hectare of the crops in kharif and rabi Season
20.	Percentage of farmers practising farm bunding

Farmers were asked to provide data for the years 2003-04 and the year 2016-17 to study the impact of the interventions that have been implemented. For the same purpose, a paired t-test was conducted at a 95% confidence interval to study the before-after scenario, while for the quantification of the mean differences between the case and control villages, the independent sample T-test was used. The overall climate smartness of the village was computed using the normalized values of indicators mentioned in *Table 1*. Based on the indicators, village wise agricultural vulnerability index was computed as per the work done by Jha et al. (2017). The normalization was computed using the formula

$$Index_{sv} = \frac{S_V - S_{min}}{S_{max} - S_{min}} \dots\dots\dots\dots\dots\dots\dots\dots.. (i)$$

Where S_V is the average value of the indicator at the village level.
S_{min} and S_{max} are the minimum and maximum values of the indicator at the village level.
After the normalization of each indicator, they were averaged using equation – *(ii)* to calculate the climate-smart quotient.

$$M_v = \frac{\sum_{i=1}^{n} Index}{n} \dots\dots\dots\dots\dots\dots\dots\dots\dots (ii)$$

M_v is the index of one of the components,
The index is the indicator value of i^{th} indicator.
n is the number of indicators in the index.

Further, agricultural vulnerability index = 1- Climate Smart Quotient of the village.

3. RESULTS

ITC has implemented various on-farm and off-farm interventions in the region (Table 2), particularly for soil and moisture conservation, knowledge and capacity building, and enhancing the energy efficiency of the farmers. Based on the indicators (Table 1), all these interventions were assessed and analyzed, and the following results were obtained:

3.1. Water Smart

Water is a major cause of concern for the farmers as, during the last couple of years, rains have continuously failed or erratic. Therefore, there is an urgent need for water conservation and natural resource management (Paavola 2008). As per the annual rainfall data reports by the India Meteorological Department (IMD), Sehore district received 1308.8 mm of rainfall in the monsoon season of 2012, 1404.1 mm in 2013, 824.3 mm in 2014, and 1080.8

mm in 2015 (Kaur and Purohit, 2012, 2013, 2014, 2015) which indicated that the rainfall in the area varied significantly over the years. The study revealed that there had been a significant difference in the irrigation facilities in the villages owing to the moisture conservation interventions by the ITC. For irrigation during the Kharif season, the major chunk of the population in case villages was dependent on either rainfall (41%) or wells (38%) in 2003-04, whereas the farmers had different sources for irrigation in the year 2016-17. Although the dependence on rainfall has not reduced drastically, 60 % of farmers had two or more irrigation sources in 2016-17 compared to 20% of farmers in 2003-04. However, 70% of the farmers of control villages still depend on rainfall during the kharif season.

Table 2. Major interventions done by ITC in the sehore district

Category	Major Interventions
Soil Conservation & Fertility Management	Soil Health Card
	Farm-bunding
	Bund Plantation
	Germination Percentage Kit
	Vermi–Compost
	Modern Agriculture Tools
Water Conservation	Drip and Sprinkler Irrigation
	Stop Dam
	Farm Pond
	Wells
	Gabions
Knowledge and Capacity Building	Farmers Field School (FFS)
	Provision of Weather Information
	Self Help Groups (SHG's)
Enhancing Energy Efficiency	Biogas

Rabi season, in particular, had improved regarding water availability in the case villages since 2003-04. The farmers reported enhanced water availability for irrigation in 2016-17 while 17% met their needs from farm ponds; 30% of farmers resorted to stop dams and wells, particularly for the *rabi* crop. The farmers of the control villages were highly dependent on the natural pond that was located in a close vicinity and met their irrigation needs for the *Rabi* season. The dependency on the pond has reduced, but only a marginal shift from (97%) to (67%) was observed. In addition to the alternative water sources, the case villages have a quite low dependency on rainfall for their irrigation needs, particularly in the *rabi* season, and have also started using the latest water-conserving irrigation techniques such as drip and sprinkler irrigation. In contrast, the farmers of the control villages still rely on conventional techniques for irrigation.

3.1. Nutrient Smart

The villages have been made “nutrient smart” through site-specific nutrient management techniques. These include the utilization of soil health cards to check the nutrient contents of the soil, the optimum utilization of fertilizers, low dependency on fertilizers, and the utilization of organic manures. Effective nutrient management techniques have proven beneficial to help build a nutrient-enriched soil (Khatri-Chhetri et al., 2016). Interventions, such as soil health cards, checking the germination percentage of the seeds, vermicomposting, and optimum fertilizer inputs, have been implemented by ITC. A comparative assessment of the case and control villages gave a clear distinction that the nutrient management in the case villages was better and more sustainable than in the control villages, where there were no interventions for nutrient management.

During the kharif season of 2003-04, the control villages applied 58.08 kg/ha DAP and 55.86 kg/ha Urea, while the case villages applied 38.08 kg/ha DAP and 28.47 kg/ha Urea (Table 3). This was attributed to water-intensive crop varieties in control villages. While case villages witnessed a usage shift of DAP in 2016-17, the DAP usage in the control villages remained unchanged. The increase in DAP usage could be due to effective water harvesting and management practices in the case of villages. The urea usage increased marginally, which could be attributed to enhanced water availability. However, compost usage increased for both case and control villages in 2016-17.

Table 3. Mean use of fertilizers and compost in Kharif season

	Mean ± SD Case Villages	Mean± SD Control Villages	Mean Difference Case-Control	Significance
DAP (Kg/ha) 2003-04	38.08 ±31.06	53.08 ±34.90	-14.29	>0.05
DAP (Kg/ha) 2016-17	93.74 ±76.85	58.14 ±33.14	35.62	<0.05*
Urea (Kg/ha) 2003-04	28.47 ±29.34	55.86 ±53.47	-27.39	<0.05*
Urea (Kg/ha) 2016-17	35.50 ±36.26	57.83 ±57.17	-22.32	>0.05
Compost (Kg/ha) 2003-04	1621.42 ±1273.77	2095.05 ±1589.23	-473.62	>0.05
Compost (Kg/ha) 2016-17	2215.89 ±1568.68	2351.18 ±2523.58	-135.29	>0.05

**significant at a 5% level of significance between 2003-04 and 2016-17*

In the rabi season, a significant difference was observed between case and control villages for the baseline year (2003-04) regarding DAP usage (Table 4). However, the difference was meager and insignificant for the year (2016-17). Urea usage was significantly lower in case villages than in control villages. This could be attributed to the adequate soil and fertility management interventions. It was observed that the case villages practiced soil conservation techniques such as farm-bunding (Observed in 100% of the farms in the case villages), which was not found in the control villages. The farmers in the case villages even cpracticed bund plantation used soil health cards, and applied modern agriculture tools such as BBF (Broad bed and furrow) attachment, seeder, etc., for optimum nutrient management and soil conservation. The data analysis revealed that 40% of farmers (40%) in the case villages produced organic manures using the vermicomposting technology and applied it in their farmlands, whereas the farmers of the control villages applied simple compost in their farms. A significant majority of the farmers in the case villages (97%) used soil health cards to check the nutrient content of their soils, while only 7% of farmers in the control villages practiced this technique. The use of soil health cards significantly changes the amount of fertilizers that the farmers put in their farmlands, resulting in higher usage of fertilizer in the control villages (Tables 3 and 4).

Table 4. Mean Use of Fertilizers and Compost In Rabi Season

	Mean ± SD Case Villages	Mean± SD Control Villages	Mean Difference Case-Control	Significance
DAP (Kg/ha) 2003-04	25.41 ±37.56	65.20±42.83	-39.78	<0.05*
DAP(Kg/ha) 2016-17	62.71 ±93.46	66.77 ±48.02	-5.05	>0.05
Urea (Kg/ha) 2003-04	31.94 ±34.62	143.08 ±108.81	-111.14	<0.05*
Urea (Kg/ha) 2016-17	36.07 ±41.23	189.64 ±194.55	-153.56	<0.05*
Compost (Kg/h) 2003-04	Nil	Nil	NA	NA
Compost (Kg/h) 2016-17	Nil	Nil	NA	NA

**Significant at a 5% level of significance between 2003-04 and 2016-17*

3.3. Knowledge Smart

Knowledge dissemination and capacity building are criticalaspects for doing holistic development of a village, especially when we wish to enhance the adaptive capacity of a region (Braun et al., 2000). As per the observations recorded during the field survey, it was found that 83% of the farmers in the case villages knew the latest farming techniques as compared to only 10% in the control villages. The farmers in the case villages were highly informed about the latest government schemes and had access to weather information. This gave them an upper hand over the farmers in the control villages who were found to be struggling with access to the latest government schemes and access to weather information. The case villages had four functional self-help groups (SHGs), while the control villages had none. As per the study, 37 % of the farmers in the control villages lacked knowledge about the government schemes and initiatives as compared to only 3 % of the farmers of the case villages, which proved that the farmers in the case villages were well equipped with knowledge and were better informed than the farmers of control villages.

3.4. Energy Consumption and Utilization

The comparative assessment on the source of fuelwood for 2003-04 and 2016-17 for the case and control villages indicated that in 2003-04, the situation was similar in all the villages, i.e., the majority of the population was dependent on fuelwood and dung cakes for cooking (Table 5). However, it has completely changed in Case villages with the ITC interventions. The study found that 30% of the farmers had totally shifted to biogas while another 10% had shifted to LPG, causing a significant decline in the fuelwood and dung cake consumption in the case villages, whereas the comparatives from the control villages suggested that 70% of the population was still dependent on fuelwood and dung cakes for their cooking needs.

3.5. Agriculture Smart

The overall impacts of the interventions were significant not only on the socio-economic conditions of the farmers but also on the environmental sustainability. The interventions have particularly led to the development of durable assets for the farmers and have led to benefits such as enhanced water availability, reduced soil erosion, and nutrient-enriched soil, thereby leading to enhanced productivity of various crops.

Table 5. Fuelwood and dung cake utilization for cooking in case and control villages

Indicator	Years	Fuel wood consumption (Kg/hh/yr)	Dung-cakes (Number/hh/yr)
Case	2003-04	1813.7	617.2
	2016-17	758.6	358.6
Control	2003-04	1506.4	1009.6
	2016-17	1567*	874.1*
Mean Diff between Case and Control	2003-04	307.3	-392.4
	2016-17	-809.1	-515.5
Significance	2003-04	>0.05	<0.05**
	2016-17	<0.05**	<0.05**

**Paired t-test significant at a 5% level of significance between 2003-4 and 2016-17*
*** Independent sample t-test at a 5% level of significance*

Significant impacts were observed, particularly on crop production, and as per the data analyzed from the sample studies, it can be concluded that there has been an increase in the overall yields for both kharif and rabi seasons crops in the case villages (Table 6). Due to the non-implementation of soil and moisture conservation activities and continuously failing monsoons, crop production has remained stagnant over the years in the control villages and witnessed a decline in Kharif crops.

Table 6. Mean yield per hectare of case and control villages

Crops	Case Villages		Control Villages	
	2003-04	2016-17	2003-04	2016-17
	Mean Yield (Q/ha)	Mean Yield (Q/ha)	Mean Yield (Q/ha)	Mean Yield (Q/ha)
Kharif	8.11 ± 2.59	9.16*±3.41	8.91±4.19	6.18±2.83
Rabi	9.18±5.08	15.01*±5.02	15.12±5.68	15.52±6.19

**significant at a 5% level of significance between 2003-04 and 2016-17*
**Paired t-test significant at 5% level of significance*

The final analysis showed a significant increase in the yield of soyabean for case villages in 2016-17 compared to the baseline year (2003-04), which could be attributed to a variety of soil and water conservation techniques adopted by the farmers. Apart from this, the provision of modern agriculture tools, dissemination of scientific knowledge related to modern agriculture practices, and different training and exposure visits conducted by ITC have also led to enhanced agricultural production and income.

The overall climate smartness quotient of the villages was computed as the average of normalized indicators of the matrix listed in Table 1. The climate smartness quotient of the case villages Deh Khedi and Ratanpur was 0.82 as compared to 0.12 for the control villages, Rampura and Umarkhal. The significant difference between the case and control villages for the present climate-smart quotient is essentially due to the climate-smart interventions implemented by ITC in the case villages. Furthermore, these interventions have resulted in the overall reduction in agricultural vulnerability in the case villages.

4. Conclusion

Climate change is a global crisis that severely impacts human and ecological systems worldwide, with the agriculture sector being highly vulnerable. Despite implementing various schemes for the farmers, the government has been able to address the overall issue related to the farmers. Over the years, corporates are also trying to impact rural communities by implementing different CSR activities. ITC, in this regard, has implemented a variety of activities to enable farmers to improve their agricultural productivity. This, in turn, has enhanced the adaptive capacity of the farmers and made them less vulnerable to the adverse effects of climate change. The study concludes that the different climate-smart interventions implemented by ITC have brought significant improvement in agricultural productivity in addition to the reduction in agricultural vulnerability. Other implementing agencies can use the experience of ITC to promote overall sustainability in the region.

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