Impact of MGNREGA in Building Climate Change Resilience in Western Dry Region, Rajasthan

Dr. Babasaheb Kazi[1] Satish Macwan[2]

Abstract

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) works towards providing guaranteed employment to rural communities for creating critical rural assets. It is aimed at improving socio-economic and ecological conditions in rural areas, which can potentially help build resilience to climate change. This study assesses the impact of MGNREGA on building resilience to climatic change in the Western Dry Region of Rajasthan, a climate-vulnerable area. Eight blocks were studied, with two from each of the four districts, based on the highest and lowest MGNREGA expenditures. The study found that MGNREGA implementation has helped in improving soil, water, irrigation, and cultivation areas in the study region. It has significantly reduced migration by improving agriculture, livestock, and local employment opportunities. The study showed a significant difference in the income increase from agriculture in high-performing MGNREGA blocks compared to those with minimum expenditure. Overall, the results indicate that MGNREGA has helped rural communities in Western Rajasthan adapt and absorb the impacts of climate change and build resilience by improving local natural resources and sustaining household income.

Keywords: *MGNREGA, Climate Change, Resilience*

[1] **Dr. Babasaheb Kazi,** Associate Professor, School of Rural Development, TATA Institute of Social Sciences, Tuljapur
[*] Corresponding Author Email: btkazi@tiss.edu
[2] **Satish Macwan,** Doctoral scholar, School of Rural Development, TATA Institute of Social Sciences, Tuljapur
[*] Corresponding Author Email: snmacwan@gmail.com

1. Introduction

Enacted in 2005, the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is a significant legislation that aims to provide 100 days of guaranteed wage employment to every rural household in a financial year. The program has a multifaceted approach to addressing poverty in rural India. It seeks to ensure livelihood security for the poor by creating durable assets and improving water security, soil conservation, and land productivity. Since its inception in 2005, the program has expanded its objectives to include improving the durability and sustainability of assets created under the program, enhancing local governance, and promoting skills development at the local level (MoRD 2021).

Almost during the same period of the last two decades, climate change and its implications on vulnerable communities have raised up the global development agenda. Climate change poses a significant challenge to development and there is evidence that the rural poor in developing countries will be most adversely affected by climate change (Sen 1999; IPCC 2014). For the poorest households and communities, it can reverse development gains made in recent decades and reinforce the underlying drivers of poverty and inequality that keep millions of people below the poverty line (IPCC 2014).

MGNREGA provides a safety net to help the poor and marginalized communities during difficult times. The programme can play a central role in helping households and the local economy absorb the effects of climate risk, adapt to climate impacts and transform their ability to address escalating and future climate stresses (Agrawal et al., 2017). However, the role of MGNREGA has not been sufficiently researched for its climate role. But the fact that it provides wages and assets to millions of rural people, most of whose livelihoods depend on climate-sensitive sectors such as natural resources, means that the programme has inherent characteristics that respond to climate change vulnerability. Few studies have attempted to explore how MGNREGA can help communities build resilience to climate change by developing durable infrastructure, increasing household wages during climate shocks, and strengthening communal assets (Tiwari et al. 2011; Adam 2015; Steinbach et al. 2016). It is also observed that conceptually, the MGNREGA meets basic normative requirements for mainstreamed

adaptation action but that functional methodological limitation prevents it from taking on a more purposeful role. (Adam 2015)

A large number of studies have looked into the impact of MGNREGA on socio-economic conditions, finances, and administration and implementation (for instance, Shah 2007; Ambasta et al. 2008; Kareemulla et al. 2009). Studies to assess the impact of MGNRGA on the environment have shown positive impacts and have also shown that environmental benefits generated by programme have increased the adaptive capacities of beneficiary households reducing their vulnerability to climate risks. Previous studies have also suggested to view the programme in light of its role in enhancing resilience to long-term climate change. (IIS 2013). However, previous studies have kept a limited understanding of climate resilience not taking the systems view or the socio-ecological systems perspective on how MGNREGA can improve climate resilience.

In light of the above, a study was undertaken with the objective of exploring the role of MGNREGA in building climate resilience, measured in three resilience capacities of absorptive, adaptive, and transformative changes, in one of the highly vulnerable agro-climatic regions of India i.e. Western Dry Region in the state of Rajasthan.

1.1 Research Setting

The selection of the study region was guided by two primary factors. Firstly, since the study aims to assess the impact of MGNREGA, Rajasthan was chosen due to its outstanding performance in providing the highest number of employment days under the program (MGNREGA MIS, 2022). Secondly, the study targeted the Western Dry Region in Rajasthan, which is highly vulnerable to the impacts of climate change. (Pathak 2014) This selection was made deliberately to align with the study's objective of evaluating the effectiveness of MGNREGA in enhancing climate change resilience.

The study used the Analytical Framework (Figure 1) to explore the response of the community towards climate change in three categories of climate resilience. (International Institute for Environment and Development, 2017).

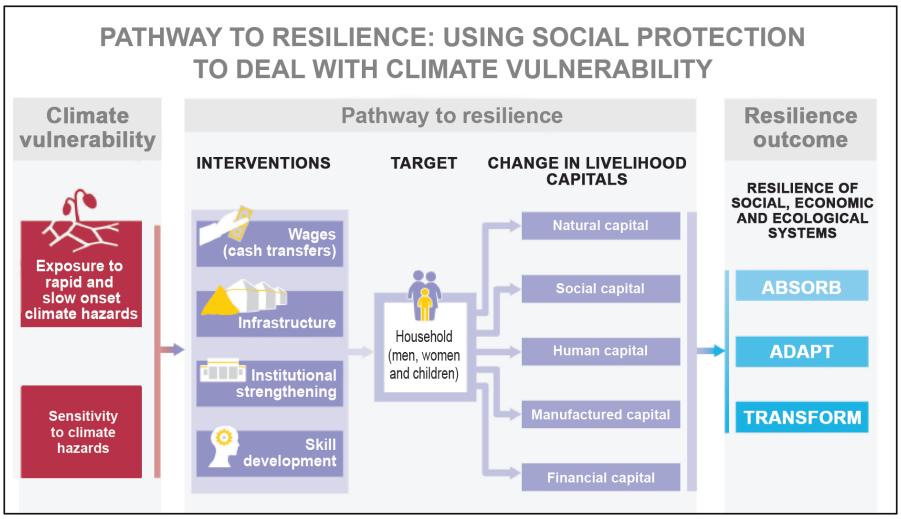

Figure 1 : Analytical Framework on how MGNREGA Contributes to Resilience

Source: Working paper on Climate change resilience, Institute for Environment and Development, 2017

Absorptive resilience: the ability of social, economic, and ecological systems to maintain their original structure by preparing for, mitigating or recovering from the impacts in order to preserve and restore essential basic structures and functions. (Béné et al. 2012; Cutter et al. 2008).

Adaptive resilience: the ability of social, economic, and ecological systems to improve their original structure by adjusting, modifying or changing its characteristics and actions in order to better respond to existing and anticipated future climatic shocks and stresses and to take advantage of opportunities (Béné et al. 2012; Brooks, 2003; IPCC 2012).

Transformative resilience: the ability of social, economic and ecological systems to fundamentally change their structure, characteristics and actions when the existing conditions become untenable in the face of climatic shocks and stresses to move beyond vulnerability thresholds (Béné et al., 2012, Walker et al., 2004).

2. Climate Change Variability in Western Dry Region, Rajasthan

In India, Climate change has affected a number of states and regions through climate change induced risks such as drought, flood, rising temperature etc. Rajasthan is one

of the most vulnerable states owing to the frequent occurrence of droughts, extremely low and erratic rainfall and limited surface water sources. Apart from the water scarcity issues in the state, the resource base for productive agriculture is also not adequate in most places. (ICAR 2014)

The soil organic content stands at 70.08 tonnes per hectare, which is one of the lowest amongst all Indian states (Singh et al., 2010). It also ranks among the states where proportion of land undergoing degradation is highest (Ajai et al., 2009). Studies show Rajasthan as part of the group that are major food grain-producing states according to the level of groundwater development and suggest that groundwater is overexploited to the tune of 109%–145% (Sharma, 2009). In spite of having the highest share of land area among all other Indian states, the state is not as agriculturally productive as most of the state falls under the semi-arid agro-climatic zones while the Western Dry Region is totally arid region. Moreover, more than 5.02 million hectare of land is cultivable wasteland. The yield of food grains in the State is only 803 kg per hectare and is the lowest for any state in India (Kakade et al., 2003). Droughts are ubiquitous to Rajasthan, with erratic rainfall and extreme temperatures being common features in many areas (Kakade et al., 2003).

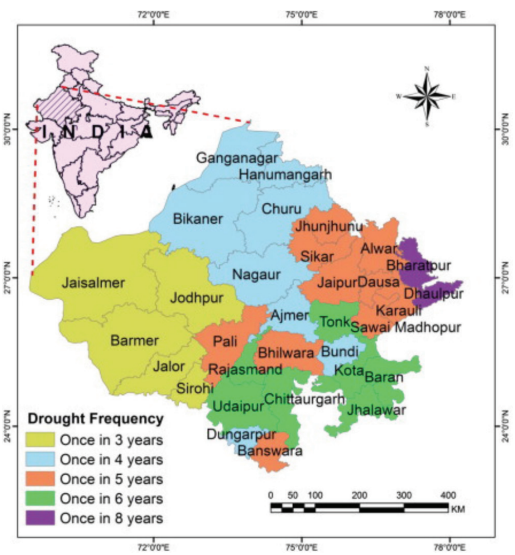

Figure 2 : Drought Frequency Map of Rajasthan

Source: Disaster management and Relief Department, Rajasthan 2015

The 11 districts which fall on the western and north-western side of the ranges constitute a part of the great Thar Desert. These are Barmer, Bikaner, Churu, Ganganagar, Hanumangarh, Jaisalmer, Jalor, Jhunjhunun, Jodhpur, Nagaur and Sikar. Two of the 11 districts have overcome the problem of aridity through extensive irrigation (Pathak, 2014). The remaining nine districts, viz. Barmer, Bikaner, Churu, Jaisalmer, Jalor, Jhunjhunun, Jodhpur, Nagaur and Sikar constitute the western dry region of Rajasthan.

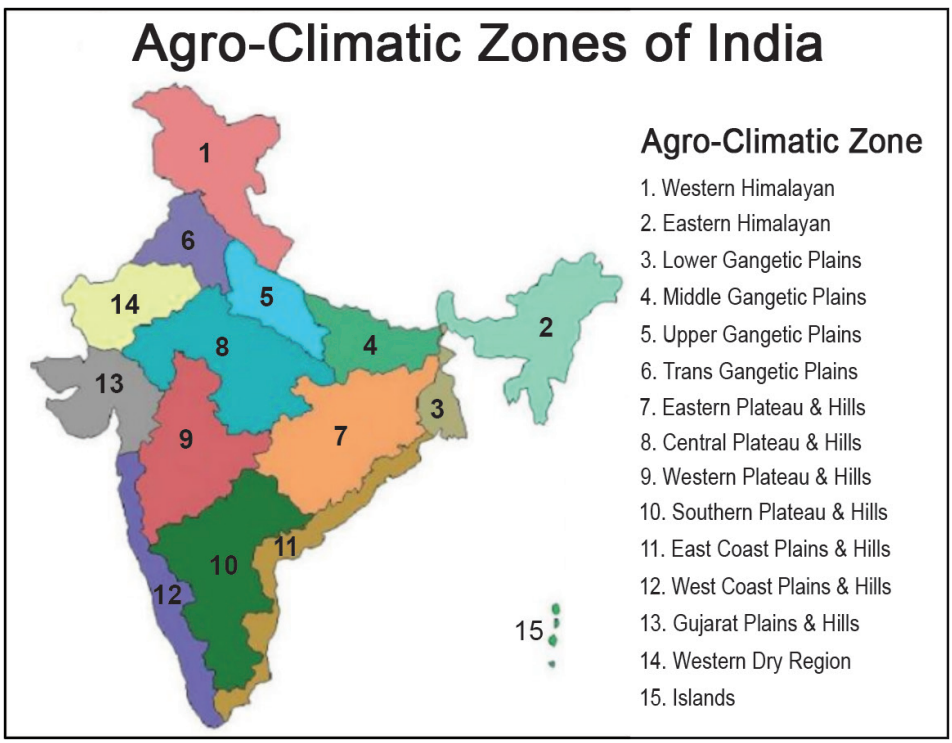

Figure 3 : Agro-Climatic Zones of India

Source: ICAR (Indian Council of Agriculture Research) and Planning commission of India, 1974

Climate: The climate of the region ranges from semi-arid to arid. The region has harsh climate with great extremes of temperatures, long periods of severe drought, high wind velocities and low humidity. The normal annual rainfall in the Western most district of Jaisalmer is 185.5 mm and it increases to 400 or more as one move towards

east. About 85% of the rainfall is received during the period June to September. Jaisalmer and Jodhpur have the highest average wind velocity. Evaporation in the region greatly exceeds the total annual precipitation. The variation in the annual rainfall is very high and in drought years, it is not sufficient to grow even crops like Bajra without some irrigation (ICAR, 2000).

The zone has all the characteristics of a hot desert. Rains are scanty and erratic, rate of evaporation is high, there are no perennial rivers, and ground water table is very deep and is often brackish. Vegetation is sparse. The average rainfall is about 400 mm but with very high year to year variations. The average temperature varies from about 45°C in May–June to less than 2°C in December–January. High wind velocity, scorching heat and sand storms are common features during summer months. The soil is mostly sandy, loamy sand and sandy loam. About 28% of the land is tilled; 11% of the cultivated area is irrigated. Productivity is among the lowest in the country. (ICAR, 2000).

Recurring drought is a common phenomenon in the Western Dry Region owing to the factors mentioned above. The droughts cause devastating effects on the lives of people and adversely impact the environment for the long term.

Several studies expound on the seriousness of recurring droughts in the region. They also examine the long term impacts of droughts on people's assets, livestock in particular and recognize that despite being a single occurrence, the effects are far reaching and deep. A study of the impacts of droughts in Shergarh tehsil in western dry region from 1899–1976 revealed that out of the 78 years studied, 43 were mild drought years where 50% of the crops reached maturity, 19 were drought years where 25% of the crops reached maturity and 8 were severe drought years where no crops matured. Analysis of land use changes revealed a positive correlation between the intensity of drought and the extent of the area damaged. Mean annual yield of kharif crops decreased from 90%–100% in a drought year and 30%- 66% in a moderately deficit year. Livestock losses ranged from 17% for goats to 50% for cattle during drought years (Bharara, 1980).

Villages in Western Dry Region have also experienced decline in area and deterioration in quality of common property resources over three decades. Disruption in traditional management of resources caused farmers to adjust to shrinking common property resources by reducing herd size, by changing its composition, and by relying more on private resources to rear animals (Kazi et al., 2022)

The impact of climate change would be the most severe for the poor communities, with limited options for livelihood and high level of dependence on the natural resources as the case in Western Dry Region. The impacts increase the food insecurity, water stress and extreme weather events which would affect the livelihood security of these communities and increase their vulnerability. MGNREGA addresses these issues by undertaking diverse activities aimed towards water harvesting, drought proofing, flood protection and plantations (Kazi et al., 2022).

3. Methodology

A total of 310 households in 8 Panchayats of 8 blocks of Western Dry Region in Rajasthan are taken as sample for the study, in each district, one block with maximum expenditure and another block with lowest expenditure in MGNREGA were selected. From each block, few villages were selected where there is a significant work under MGNREGA to be able to study the impact of the program. The maximum expenditure block is classified as Group A block while the lowest expenditure block is categorized as Group B block. The expenditure of the last 7 years (2014-2021) from these blocks was considered to identify the blocks as well as the Panchayats in these blocks.

A structured interview schedule was used to collect the major part of the data. The schedule was prepared based on the data required on main categories of demographic, climate change impact, livelihoods and income, MGNREGA contribution, etc. Interviews were conducted with the head of the households of the sample households. Majority of the head of households were male out of the total sample of 310 (282 males, 28 females).

The study also used Focused Group Discussion (FGD) with a homogenous group of wage seekers of MGNREGA and community leaders of village institutions/Panchayats. The FGD Guide included discussion points on how MGNREGA was used to avail employment and work on the natural resources in the villages, how these works helped in agriculture and livestock and meeting the livelihoods needs of the community.

Secondary data on climate variables were collected from the India Meteorological Department, land use and land cover data from Bhuvan, NRSC, and demographic data from Census 2011. Data on MGNREGA's performance was collected from the official

website of MGNREGA, data from various reports on MGNREGA such the impact of Mission Jalshakti works under MGNREGA, and the Ministry of Rural Development (MoRD).

4. Results and Discussions

4.1 Climate Change Risks

Climate change poses a great risk to agriculture and livestock, major livelihood sources in the western dry region.

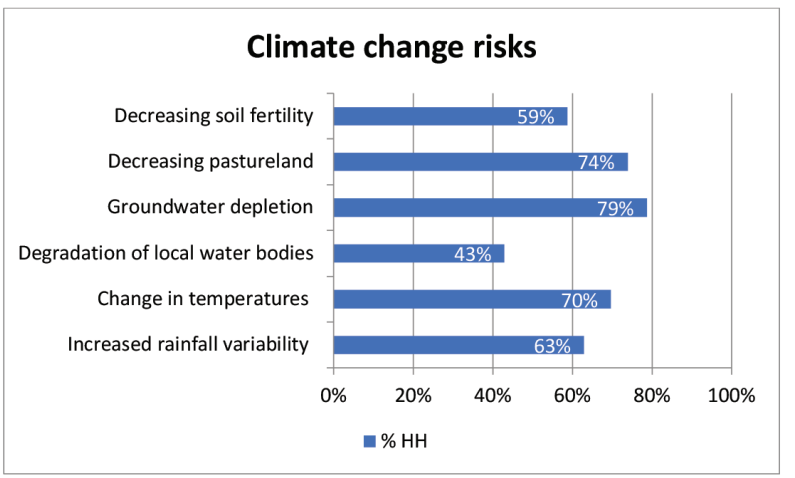

Figure 4 : Climate Change Risks Perceived by the Community

Source: Kazi et al., 2022, Households Survey The perceived climate change risks among communities are largely linked to extreme weather conditions, such as rising temperatures and increased summer days, as well as changing monsoon patterns with variable rainfall. According to a survey, a significant majority of respondents (70%) reported changes in temperature, specifically an upward trend in the number of summer days, which is highly pertinent to the climatic conditions of the arid western region. The survey also indicated that groundwater depletion was viewed as a major climate change risk by 79% of respondents, while 43% recognized water body degradation, including ponds and check dams, as a concern. The rise in temperature not only reduces water volume in resources but also curtails the number of water-staying days, resulting in direct impacts on crop patterns and drinking water availability for cattle, a crucial source of livelihoods for local communities.

Table 1 : Yearly Average Rainfall

District	Block	Yearly average rainfall in mm					CV (Coefficient of variation)
		2016	2017	2018	2019	2020	
Bikaner	Bikaner	348	308	355	388	353	8.14
	Dungarpur	328	285	254	292	302	9.20
Barmer	Dhorimana	204	709	107	314	290	70.78
	Samdadhi	296	550	152	380	348	41.67
Churu	Rajgadh	562	375	332	369	421	21.80
	Birasar	445	354	332	484	359	16.70
Jalore	Raniwada	536	1287	176	729	755	57.86
	Dayalpura	753	729	230	645	548	36.46

Source: India Meteorological Department, 2021 (www.imdpune.gov.in) The findings of community perception on climate change risks is validated by the rainfall data. It clearly shows high rainfall variability across the blocks except two blocks of Bikaner. Though Bikaner rainfall is consistent, the precipitation is consistently lower throughout the last five years compared to other blocks with mean rainfall data around 350 mm.

In the rest of the blocks except Bikaner, the year 2018 is low rainfall year and marked with drought like condition. While in the year 2017, most blocks show highest rainfall variability as much as from the lowest 107 mm to 1287 mm indicating greater erratic nature of rain. Other risks perceived by the community like ground water depletion, change in temperature, soil fertility etc. are indirectly related to this kind of rainfall pattern.

4.2 Impact of Climate Change

The biggest climate change impact experienced by the community is about the adverse impact on livestock and agriculture. More than 80 % of the households responded the impact of climate change in crop loss and livestock disease. The crop loss is due to pest attack and crop disease as well as severe climatic conditions such as extreme temperature.

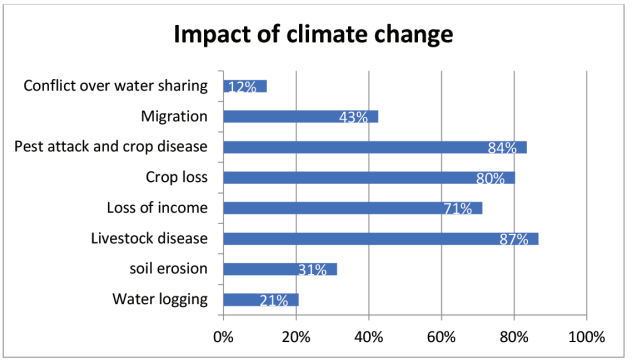

Figure 5 : Impact of Climate Change

Source: Kazi et al., 2022, Households Survey The survey results indicated that over 70% of the respondents reported the loss of income as another significant impact of climate change.Furthermore, agriculture and livestock have been adversely affected, leading to migration as an associated impact of climate change. With no alternative livelihood options, people are compelled to migrate in search of work. About 43% of households viewed migration as a direct result of changing climate conditions. In this context, the role of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) becomes crucial in preventing migration as it aims to provide 100 days of guaranteed employment within the village Panchayat.

4.3 Impact of MGNREGA

The impact of MGNREGA was evaluated to understand the effectiveness of the programme in addressing the climate change risks as mentioned above.

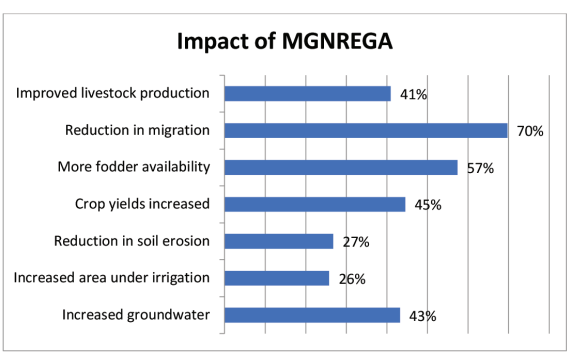

Figure 6 : Impact of MGNREGA

Source: Kazi et al., 2022, Households Survey The most significant impact of MGNREGA was its role in reducing migration, indicating that the program has effectively met its objective. Approximately 70% of respondents recognized the positive impact of MGNREGA on increasing employment opportunities and reducing migration. The impact was slightly higher in the group A blocks, with respondents clearly attributing the impact to the program. Improvement in fodder availability and water are also key factors contributing to preventing migration especially for the livestock keepers.

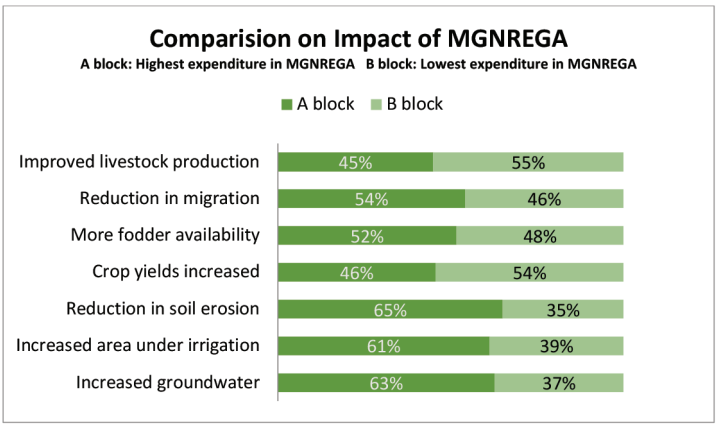

Figure 7 : Impact of Climate Change

Source: Kazi et al., 2022, Households Survey

MGNREGA has had a significant impact in terms of increasing groundwater levels, ground and surface water availability, and reducing soil erosion. This impact is reflected in the increased area under irrigation, number of irrigations, and overall improvement in soil health. The difference made by MGNREGA is particularly significant, with a higher impact ranging from 23 to 32% in these parameters observed in group A Panchayats.

However, this impact has not necessarily translated into a significant increase in livestock production and agriculture yields, as there is not much difference in these parameters between both groups of blocks. Nevertheless, the income from agriculture and livestock is higher in group A blocks, indicating a higher productivity of the livestock and agriculture systems in these areas. Overall, the positive impact of MGNREGA on the environment and livelihoods in rural areas is evident, but more research is needed to understand the complex relationships between various parameters and the sustainability of these improvements over time.

Table 2 : Change in Income

	Agriculture			Livestock		
Change Category	**Total %**	**Group A blocks**	**Group B blocks**	**Total %**	**Group A blocks**	**Group B blocks**
Decreased	3%	50%	50%	8%	76%	24%
Increased	24%	84%	16%	20%	70%	30%
No change	72%	51%	49%	68%	53%	47%
No income	0	0 %	0%	4%	38%	63%

Source: Kazi et al., 2022, Households Survey The impact of MGNREGA on household income from agriculture and livestock is significant, with high performing Group A blocks showing a clear increase compared to the minimum expenditure Group B blocks. In Group A blocks, 84% of households reported an increase in income from agriculture compared to only 16% in Group B blocks. Similarly, for income from livestock, 70% of households in Group A blocks reported an increase compared to only 30% in Group B blocks.

However, it is noteworthy that despite the clear increase in income for some households, around 72% of households in both groups did not experience any change in income from agriculture and 68 % from livestock. These results, when coupled with the climate change conditions in the region, suggest that MGNREGA has helped the community in absorbing the shocks of climate change and adapting to the situation. The program has thus played a crucial role in improving the resilience of rural households to climate change-induced challenges.

4.4 Change in Drinking Water Availability

MGNREGA works are specifically designed to enhance water conservation and water harvesting structures, such as check dams, ani-cuts, ponds, drains, and nadis. These works are expected to increase the availability of water for multiple purposes, including agriculture, livestock, and drinking water. The expenditure data of MGNREGA suggests that the category of "water conservation and water harvesting" had the highest expenditure, which highlights the importance of water conservation in the region.

Table 3 : Change in Drinking Water Availability

Change Category	Total %	Group A	Group B
Decreased	5%	55%	45%
Increased	32%	74%	26%
No change	62%	49%	51%

Source: Kazi et al., 2022, Households Survey The household survey data shows that 32% of the respondents reported an increase in drinking water availability. Interestingly, 74% of these respondents were from group A blocks, which indicates the positive impact of MGNREGA in increasing water availability. However, 62% of the respondents reported no change in water availability, and there was no significant difference in responses from both groups.

4.5 Change in he Availability of Minor Forest Produce

Table 4 : Change in Availability of Minor Forest Produce

Change Category	Total %	Group A	Group B
Decreased	8%	50%	50%
Increased	20%	74%	26%
No change	66%	46%	54%
Don't know	5%	94%	6%

Source: Kazi et al., 2022, Households Survey Common land such as pastures, forests, water bodies are crucial for sustaining the eco systems and meeting firewood, fodder, food, medicine and other needs of the poor households of the villages. Minor forest produce from common land acts as safety nets for the poor in times of crisis. The results on change in Minor Forest Produce (MFP) from common land show similar results as other parameters of availability of drinking water for cattle. In the Group A blocks, the availability of MFP is significantly higher than the group B blocks suggesting impact of MGNREGA. However, for more than 65% there is no change in the availability of MFP and it remained same. This also indicates that there is no degradation or deterioration of natural resources as a result of climate condition and anthropogenic pressure.

4.6 MGNREGA Expenditure (2014-2021)

In order to understand the MGNREGA expenditure pattern in terms of work wise category-wise utilization and implications on the impact as discussed earlier, details on two sample Panchayats of Jalore district is given to understand the difference in works under MGNREGA in high-performing MGNREGA blocks (Group A) and low performing MGNREGA Panchayats (Group B).

Table 5 : MGNREGA Expenditure of Two Sample Panchayats of Jalore District (2014-2021)

(Amount in INR lakhs)

	Group A		Group B	
Work category	**Expenditure**	**%**	**Expenditure**	**%**
Anganwadi/ Other Rural Infrastructure	2.40	0%	8.80	3%
Bharat Nirman Sewa Kendra	0	0%	12.26	4%
Drought Proofing	27.53	3%	1.73	1%
Flood Control and Protection	45.05	5%	16.61	6%
Land Development	0	0%	14.33	5%
Other Works	0	0%	48.54	17%
Renovation of Traditional Water Bodies	10.72	1%	6.66	2%
Rural Connectivity	119.44	14%	35.06	12%
Water Conservation and Water Harvesting	568.69	67%	120.30	41%
Works on Individuals Land (Category IV)	712	0	26.38	9%
Grand Total	**290.68**	**100%**	**845.03**	**100%**

Source: MGNREGA MIS, 2022

In Group A - Raniwara gram panchayat, total expenditure during the year 2014 to 2021 is almost three times higher than in Group B-Dayalpura Panchayat which represents the low MGNREGA expenditure block. Expenditure in NRM works altogether in group A Panchayat is significantly higher at 86% while its 64% in Group B Panchayat.

In both the groups, expenditure on water conservation and water harvesting is the highest with 41% and 67% respectively. Raniwara which is group A Gram Panchayat also has much higher expenditure in the works on water conservation and harvesting (67%). It can be inferred that the Panchayats which have taken up these works are likely to fair better in MGNREGA performance. It can be also attributed to the introduction of the Jal Shakti Mission programme where the focus was mostly on these kind of works.

4.7 Landuse /Land Cover

The analysis of land use land cover (LULC) data provides evidence of the positive impact of MGNREGA on building climate resilience. The available LULC data from 2013 and 2018 of both group A and group B Panchayats for one of the blocks shows a significant increase in the area under Rabi crop. In Group A, the area under Rabi crop increased by 27%, while in group B it increased by 12%, from almost nil area under Rabi cropping in the year 2014 in both locations.

The increase in the area under Rabi crop indicates improved water and moisture availability after the monsoon season, which is crucial for agriculture and helps to mitigate the impacts of climate change. This increase in Rabi crop area can be attributed to the water conservation and water harvesting structures developed under MGNREGA, which have helped in improving the water availability and soil moisture, thereby enhancing the agricultural productivity and resilience of the region.

Table 6 : Land use Land Cover (2013-18)

	Group A		Group B	
	2013	2018	2013	2018
LULC category	Area in %	Area in %	Area in %	Area in %
Kharif only	41%	4%	82%	3%
Rabi only	1%	27%	0%	12%

	Group A		Group B	
	2013	2018	2013	2018
LULC category	Area in %	Area in %	Area in %	Area in %
Double/Tripple	38%	17%	9%	2%
Current fallow	11%	40%	5%	76%
Other wasteland	5%	4%	3%	1%
Scrubland	4%	0%	1%	1%

Data Source: Bhuvan, NRSC, 2021

However, there was a decrease in Kharif cropping area in both locations due to significantly low rainfall in the monsoon of 2018, which was almost drought-like. This led to an increase in the current fallow area in both locations. Nevertheless, the increase in current fallow area was significantly lower in Group A Panchayats compared to Group B Panchayats, which can be attributed to the higher number of works and investments for improving soil and water conservation under MGNREGA. Similarly, there was a reduction in double/triple crop area in both locations, but the impact was much lower in Group A Panchayats due to the works carried out for improving natural resources.

Therefore, it can be inferred that MGNREGA's performance is directly correlated with an increase in second cropping area, higher double/triple crop area, and a reduction in fallow land.

5. Conclusion

The Western Dry Region in Rajasthan is facing significant climate change risks, such as increasing temperature, rainfall variability, and depleting water resources, as reported by the respondents as well as evidenced by scientific data on temperature and rainfall patterns. In this context, the implementation of the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) has played a crucial role in mitigating the impact of climate change and sustaining the livelihoods of the local community.

The study results show that the implementation of MGNREGA has a positive impact on the soil, water, irrigation, and cultivation areas, leading to an increase in income from both agriculture and livestock production systems. The study highlights that rural households have been able to sustain their income levels and that, in cases of

higher MGNREGA investment Panchayats, reported an increase in income, despite the challenges posed by climate variability. Moreover, it has significantly reduced migration from rural to urban areas as a result of improved agriculture, livestock, pastures, and local employment opportunities.

In conclusion, the study provides substantial evidence to support the positive impact of MGNREGA in enhancing the absorbing and adaptive capacities of communities to combat the impacts of climate change in the Western Dry Region.

References:

1. Adam, H. 2015. Mainstreaming adaptation in India – the Mahatma Gandhi National Rural Employment Guarantee Act and climate change. Climate & Development. 2015, Vol. 7 Issue 2, p142-152.
2. Ali, J. 2007. Commentary: Livestock, Common Property Resources and Rural Smallholders in India. International Journal of Agricultural Sustainability 5 (4): 265–268. https://doi.org/10.1080/14735903.2007.9684826.
3. Agarwal, A. 2000. Conceptualizing Environmental Collective Action: Why Gender Matters. Cambridge Journal of Economics 24 (3): 283–310. https://doi.org/10.1093/cje/24.3.283.
4. Aguilar, B. and T. D. Sisk. 2009. A Framework to Evaluate Ecological and Social Outcomes of Collaborative Management: Lessons from Implementation with a Northern Arizona Collaborative Group. Environmental Management 45: 132–44. https://doi.org/10.1007/s00267-009-9400-y.
5. Aryal, J. P., T. B. Sapkota, R. Khurana, et al. 2020. Climate Change and Agriculture in South Asia: Adaptation Options in Smallholder Production Systems. Environment, Development and Sustainability 22: 5045–5075. https://doi.org/10.1007/s10668-019-00414-4.
6. Bassi, N., D. M. Kumar, V. Niranjan, and M. Sivamohan, 'Employment Guarantee and Its Environmental Impact: Are the Claims Valid?' Economic and Political Weekly, vol. 46, no. 34, 20 August 2011.
7. Béné, Christophe, et al. "Resilience: new utopia or new tyranny? Reflection about the potentials and limits of the concept of resilience in relation to vulnerability reduction programmes." IDS Working Papers 2012.405 (2012): 1-61.
8. Centre for Science and Environment (CSE), An Ecological Act: A Backgrounder to the National Rural Employment Guarantee Act, New Delhi: CSE, 2009.
9. Indian Institute of Forest Management (IIFM), 'Impact Assessment of MGNREGA's Activities for Ecological and Economic Security', Report submitted to the Ministry of Rural Development/UNDP, Bhopal: IIFM, 2010.
10. Janssen, M. and J. Anderies. 2013. Sustaining the Commons. Arizona, US: Centre for the Study of Institutional Diversity.
11. Jodha, N. S. 1985. Common Property Resources and Dynamics of Rural Poverty (Field Evidences from Dry Regions of India). Nepal: International Center for Integrated Mountain Development (ICIMOD).
12. Kaushik, G. and K. C. Sharma. 2015. Climate Change and Rural Livelihoods: Adaptation and Vulnerability in Rajasthan. Global NEST Journal 17: 41–47. https://doi.org/10.30955/gnj.001376.
13. Kumar, V. 2014. Changing Agricultural Scenario and Food Prospects in India: A Study with Special Reference to Rajasthan. Rohtak: M. D. University. http://shodhganga.inflibnet.ac.in/handle/10603/107021.
14. ICAR, 2000. Long-term Strategies and Programmes for Mechanization of Agriculture in Agro Climatic Zone, ICAR, 2000
15. MGNREGA: Rajasthan tops in persondays generation for 4th year in a row, Times of India, April 8, 2023.
    http://timesofindia.indiatimes.com/articleshow/99330457.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst
16. Meinzen-Dick, R., H. Markelova and K. Moore. The Role of Collective Action and Property Rights in Climate Change Strategies. CGIAR CAPRi Policy Brief 7, Washington D.C.: International Food Policy Research Institute.

17. Ostrom, E. 1988. Workshop in Political Theory & Policy Analysis. In Rethinking Institutional Analysis and Development: Issues, Alternatives, and Choices edited by V. Ostrom, D. Feeny, and H. Picht. San Francisco: ICS Press, 103–139.
18. Shah, V. D., and M. Makwana, Impact of NREGA on Wage Rates, Food Security and Rural Urban Migration in Gujarat, Vallabh Vidyanagar: Agro-economic Research Centre, Sardar Patel University, 2011.
19. Steinbach et al., 2016. Aligning social protection and climate resilience, International Institute of Environment and Development, 2016. https://www.iied.org/sites/default/files/pdfs/migrate/10157IIED.pdf
20. Tiwari, R, et al. "MGNREGA for environmental service enhancement and vulnerability reduction: rapid appraisal in Chitradurga district, Karnataka." Economic and political weekly (2011): 39-47.