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Socio-economic Impact of MGNREGA on Sustainable Rural Livelihood - A Village Level Case Study of Tripura State

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Abstract

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) is one of the world's largest social protection programs, aimed at enhancing rural livelihoods by creating durable assets that support economic and environmental sustainability. The present research evaluates the contribution of MGNREGA to sustainable rural livelihood in Uttar Nalicharra Gram Panchayat under Ambassa Block in Dhalai District of Tripura state. A total of 610 geotagged assets were used in this study. The Kernel Density Estimation maps of SDG-2 and SDG-13 were prepared to depict the spatial distribution of different asset categories. Normalized Difference Vegetation Index and Normalized Difference Water Index showed improvements in vegetation health and Land Cover/Land Use maps were made to show the changes for the years of 2013-14 and 2023-24 which were generated from LISS-IV sensor. The quantitative and qualitative data from 40 beneficiaries through socio-economic survey have been analyzed using 5 point Likert scale and the One-Way ANOVA test was used. Results revealed a significant correlation between MGNREGA asset and income. The supporting evidence drawn from remote sensing, geospatial analysis and socioeconomic data depicted that MGNREGA have enhanced rural livelihoods in the study area, facilitating to sustainable development goals linked to food security and local climate preparedness.

1. Introduction

The Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) aims to enhance livelihood security in rural areas by providing up to one hundred days of guaranteed wage employment annually to households whose adult members volunteer for unskilled manual work. The scheme has been studied extensively for its socioeconomic and environmental benefits (Bunning & De Pauw, 2017; Sarvade et al., 2019). Ahuja et al. (2011) examined its impact on income and employment security, migration, debt repayment, and participation in different States of India. Esteves et al. (2013) analyzed the environmental and socioeconomic benefits of the scheme using block-level agricultural and livelihood vulnerability indices in Rajasthan, Madhya Pradesh, Andhra Pradesh, and Karnataka.

In the 1990s, Sustainable Rural Livelihood (SRL) was adopted as an approach by Oxfam (1993), Care (1994), the United Nations Development Program (UNDP, 1995), and the UK Department for International Development (DFID, 1996). Based on rural poverty studies, the SRL approach combines participatory, bottom-up methods with recognition of macro-level governance, policies, and institutions. Reports (VNR 2017) indicate the program's indirect connections to SDGs 2 (Zero Hunger) and 13 (Climate Action), both aligning with MGNREGA's aims (Faridi et al., 2017). Studies on geographical clustering of works (Divya et al., 2019) and spatial-temporal visualization (Gupta et al., 2020) show the recent use of GIS analysis to gain spatial knowledge of MGNREGA implementation. Water level, agriculture, livestock, livelihood profiles, and MGNREGA income were used to assess the socioeconomic effects of MGNREGA assets (NRM & Non-NRM) on settled communities. Evaluating these effects can guide sustainable development planning (Tilt B. et al., 2009; Egre D. and Senecal P., 2003).

With an emphasis on increasing agricultural land and income, the current study attempts to evaluate the socioeconomic effects of MGNREGA. The objectives of the study are:

- To study the year-wise spatial distribution of MGNREGA geotagged assets,
- To evaluate the improvements in the annual income of selected beneficiaries after MGNREGA implementation and
- To explore the role of MGNREGA in sustainable rural livelihoods through geotagged assets linked with SDG 2 and 13.

1.1 Research Gap

Most research on MGNREGA has focused on state or district levels, often overlooking Gram Panchayat (GP)-level evaluations that could better capture regional variations and challenges. A study by Sahu et al. (2022) examined changes in income, expenditure, savings, migration, and asset creation but lacked micro-level analysis. Similarly, while remote sensing has been used to assess MGNREGA's environmental impacts (Sinha et al., 2017), few studies integrate geospatial data with socioeconomic indicators such as income stability, employment diversification, and agricultural expansion. Mishra and Selvi (2024) explored MGNREGA's role in employment generation and asset accumulation but did not address long-term resilience.

Bridging these gaps is essential for understanding MGNREGA's contribution to SDG 2 (Zero Hunger) and SDG 13 (Climate Action) and fostering inclusive rural development.

2. Study area

The study area Uttar Nalicharra Gram Panchayat (GP) which is a part of Ambassa block, under the Dhalai district, in the North East state of Tripura, India. The study area's geographical location extends from $23^0$06'00" N to $23^0$06'43"N latitude and $92^0$00'0" E to $93^0$00'00"E longitude. The GP is consisted of five villages, namely Uttar Nalicharra Para, Sudharam Para, Sarkar Para, Sambhiram Para, Nimainath Para, and Lalmati Para (Fig. 1).

The implementation of MGNREGA has had a significant impact on the study area's economic situation over the past ten years. Improvements in rural life and options for income creation are seen in comparative yearly income data from 2013–14 and 2023–24.

Figure 2 displayed the impact of MGNREGA assets on rural livelihoods by comparing the average income across different livelihood categories such as Drought Proofing (DP), Fisheries, Land Development (LD), Renovation of Traditional Water Bodies (RTWB), Water Conservation and Water Harvesting (WCWH) and works on Individual Land (WIL) for the years 2013-14 and 2023-24. It showed a significant increase in income across all categories except DP over the decade, highlighting the positive economic impact of MGNREGA interventions. Notably, categories such as RTWB and WCWH showed the highest income growth, suggesting that assets created under MGNREGA have been crucial in enhancing rural earnings and livelihood sustainability.

2.1 Geo-MGNREGA Activities in the study area

This section highlights important work categories using a spatial map (Fig. 3) and field photos (Fig. 4) that depict implementation on the ground. Figure 3 illustrates these works over different years, and Fig. 4 represents the photos taken during field visits in the study area.

3. Data Used

The data used in this study encompasses both geospatial (Table 1) and field survey components to ensure a comprehensive analysis. It includes remote sensing datasets, socioeconomic survey findings, and geotagged records of MGNREGA works within the Gram Panchayat.

Table 1
Satellite Data/products used in the study

Sl No	Satellite data/ Product	Year	Generated Outcomes
1	Cartosat I PAN and Resourcesat 2-LISS IV (SIS-DP Update)	2018-23	Land-cover / Land-use (base layer)
2	Resourcesat 2A LISS 4	2013 & 2014	Land- cover /Land- use Change and NDVI & NDWI
	Resourcesat 2 LISS 4	2023 & 2024	

Over the span of 17 years, a total of 641 geotagged works have been successfully completed under the MGNREGA program. The peak years for work completion were 2013-14 with 95 works (Fig. 5), with the smaller peaks in 2018-19 (49) and 2021-22 (44). Quality checks have been performed on the data for correctness, completeness, and consistency as they constitute essential parameters of large data.

4. Methodology

In order to evaluate how MGNREGA operations affect rural livelihoods and sustainability, the methodology combines statistical tools, field-based socioeconomic surveys and GIS spatial analysis and the details are depicted in Fig. 6. LC/LU analysis and spectral index computation were conducted using satellite remote sensing data, while income-related information for 40 individual MGNREGA beneficiaries for 2013–14 and 2023–24 was obtained through field surveys. GIS was used to analyze the spatial distribution of MGNREGA activities, and Kernel Density Estimation (KDE) was used to depict the concentration and distribution of these activities/assets. To determine whether income growth differed significantly among the various MGNREGA work categories, statistical analysis was performed using One-way ANOVA. By combining these methods, focused and sustainable development planning was made possible by a thorough comprehension of the socioeconomic and spatial effects of MGNREGA interventions.

4.1 Land-Cover/Land-Use (LC/LU) Analysis

Land cover is defined as the observed physical cover on the earth's surface, including vegetation (natural or planted) and human constructions (FAO, 2024). The land cover classification of 2013-14 and 2023-24 with reference to the Space-based Information Support for Decentralized Planning (SIS-DP) at a 1:10,000 was made, and ground truthing was performed to validate the satellite image interpretations, ensuring accuracy in the classification of various land cover categories (Fig. 7).

4.2 Spectral Indices

Spectral Indices such as the Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) have been used in the present study to analyze vegetation health and water availability dynamics.

4.3 Relating MGNREGA activities to relevant SDGs

MGNREGA activities contribute significantly to achieving SDG targets by creating durable assets and enhancing rural livelihoods. The Table below illustrates the alignment of specific MGNREGA asset categories with relevant SDG targets and indicators of the study area (Table 2).

Table 2
SDG Targets/Indicators Vis-à-vis MGNREGA Assets Categories, Uttar Nalicharra GP

SDG No.	Sustainable Development Targets and Indicators	MGNREGA Indicator Work Category/Subcategory	Asset Count
2	**Zero Hunger**		
Target	Target 2.4: By 2030, make sure that food production systems are sustainable and put in place resilient agricultural practices that boost output and productivity, support ecosystem maintenance, strengthen capacity to adapt to climate change, extreme weather, drought, flooding, and other disasters, and gradually improve the quality of land and soil.	*Land development*: construction, repair and maintenance of bunds, land leveling, reclamation of land and plantation;	190
		Micro-irrigation works: construction, lining, renovation, repair and maintenance of canals;	54
Indicators	2.4.1: Proportion of agricultural area under productive and sustainable agriculture.		
13	**Climate Action**		
Target	Target 13.2: improve national preparedness and ability to adjust to risks associated with climate change and natural disasters.	*Drought proofing*: Plantation, afforestation and nursery raising;	100
		Renovation of traditional water bodies: repair and maintenance of traditional water bodies	24
		Water conservation and water harvesting: construction of various types of check dams, bunds, tanks etc.	113
Indicators	13.1.3: Proportion of local governments that adopt and implement local disaster risk-reduction strategies in line with national disaster risk-reduction strategies.		
Source: https://sdgs.un.org/goals			

5 Results

The result presents an integrated analysis of geospatial and socioeconomic dimensions to evaluate the impacts of MGNREGA interventions. It highlights changes in land use, vegetation health, and socioeconomic conditions in the study area.

5.1 LC/LU

The Land Cover Land Use map illustrates the spatial and temporal changes in land use patterns between 2013 and 2014 and 2023–24 using LISS-4 satellite images.

Table 3
Land-Cover Change Matrix of 2017 & 2024

2013-14 Area (ha)	2023-24 Area (ha)									
	Closed Forest	Crop Land	Farm Pond	Open Forest	Reservoirs / Tank	River	Sparse scrub land	Transport Network	Village Settlements	Grand Total
Closed Forest	37.96	24.51	0.51	46.12	0.79				0.28	110.16
Crop Land		172.44	2.92		0.69			0.02	3.27	179.35
Farm Pond		0.65	6.84						0.04	7.53
Open Forest	15.57	9.25	0.20	35.85	0.40			1.39	4.71	67.38
Reservoirs / Tank					1.64					1.64
River		1.36				8.35				9.71
Sparse scrub land		9.50		0.40			3.33		0.48	13.72
Sparse srub land	0.36	10.03		1.11						11.50
Transport Network								9.74		9.74
Village Settlements			0.08						35.86	35.93
Grand Total	**53.89**	**227.75**	**10.55**	**83.48**	**3.53**	**8.35**	**3.33**	**11.14**	**44.65**	**446.66**

Farm ponds increased from 7.53 ha to 10.55 ha between 2013–14 and 2023–24, demonstrating better water-saving practices. Another indication of increased water storage capacity—essential for irrigation and climate resilience—is the growth of reservoirs and tanks from 1.64 ha to 3.53 ha. The transportation network expanded from 9.74 hectares to 11.14 hectares, enhancing accessibility and connection. From 35.93 ha to 44.65 ha, the area covered by village settlements increased, indicating infrastructure expansion and potentially improved living circumstances. Furthermore, afforestation or forest regeneration efforts are highlighted by expanding open forests from 67.38 ha to 83.48 ha, promoting ecological stability (Fig. 7 and Table 3).

5.2 Crop Area changes

Significant changes in crop area have been seen in the mapped region over the last 10 years (2013–14 and 2023–24), which reflects shifting land use dynamics and agricultural methods. These changes are depicted on this map to help visualize patterns of agricultural area extension (Fig. 8).

Figure 10 shows changes in crop area between 2013-14 and 2023-24, with an increase from 179.35 hectares to 227.75 hectares. In 2013–14, crops such as paddy, pulses, maize, and vegetables—including potato, pumpkin, tomato, cucumber, and coriander—were cultivated but only on a limited portion of the land. By 2023–24, the cultivation of these crops had expanded significantly, covering a much larger area. The expansion is particularly noticeable in the circled regions of the 2023-24 map, where previously uncultivated land has been converted into agricultural fields. The land development suggests that these interventions may have contributed to agricultural expansion by improving land productivity.

5.3 NDVI Analysis

The NDVI (Table 4 and Fig. 9) values for the Kharif, Rabi, and Zaid seasons indicate an overall increase in vegetation health from T1 (2013-14) to T2 (2023-24) across all three seasons. In the Kharif season, the mean increased from 0.55 to 0.57, with a

slight decrease in the maximum value, suggesting suitable vegetation conditions with minor variations. The Rabi season shows a more significant increase in mean from 0.29 to 0.46, with a higher maximum value, indicating improved vegetation cover due to better water availability and agricultural practices. The most notable change is in the Zaid season, where the mean almost doubled from 0.25 to 0.47, with a significant increase in the minimum value from − 0.23 to 0.15, suggesting reduced barren or water-logged areas. The overall trend across seasons indicates improved vegetation conditions, potentially linked to better water management, agricultural interventions, and MGNREGA activities.

Table 4
NDVI Statistics of 2013-14 and 2023-24

Kharif				
Year	Min	Max	Mean	STD
T1	-0.03	0.75	0.55	0.10
T2	0.08	0.74	0.57	0.09
Rabi				
Year	Min	Max	Mean	STD
T1	-0.05	0.59	0.29	0.09
T2	-0.02	0.71	0.46	0.13
Zaid				
Year	Min	Max	Mean	STD
T1	-0.23	0.50	0.25	0.07
T2	0.15	0.64	0.47	0.07

5.4 NDWI Analysis

All three seasons (rabi, kharif, and zaid) exhibit a notable positive change in the NDWI (Table 5 and Fig. 10) values from 2013 (T1) to 2024 (T2), suggesting increased surface water availability. The minimum value changed from negative to positive throughout the Kharif season, while the mean rose from − 0.42 to 0.44, indicating a significant improvement in water retention. Similar to this, the mean increased from − 0.21 to 0.35 during the Rabi season, indicating improved moisture conditions brought on by increased water availability from MGNREGA operations. The Zaid season shows a discernible improvement in water present throughout the dry season, with the mean rising from − 0.17 to 0.36.

Table 5
NDWI Statistics of 2013-14 and 2023-24

Kharif				
Year	Min	Max	Mean	STD
T1	-0.63	0.09	-0.42	0.08
T2	0.62	0.01	0.44	0.08
Rabi				
Year	Min	Max	Mean	STD
T1	-0.47	0.18	-0.21	0.06
T2	0.57	0.11	0.35	0.09
Zaid				
Year	Min	Max	Mean	STD
T1	-0.47	0.15	-0.17	0.05
T2	0.52	-0.03	0.36	0.06

5.5 Socio-Economic Survey Analysis

A 5-point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) was used in the survey to assess the satisfaction and perceived impacts among job card holders who completed 100 days of work (Rensis Likert, 1932). The responses, presented through charts, provide a clear picture of beneficiary satisfaction and project outcomes. This method allowed both qualitative and quantitative insights to be analyzed together, offering useful perspectives for evaluating the project's effectiveness and guiding future planning (Fig. 11).

With 43% of respondents strongly agreeing and 33% agreeing that MGNREGA has made land more cultivable, which has enhanced crop output and revenue generation, the establishment of suitable agricultural land has also been acknowledged as a key advantage. SDG 2, which seeks to eradicate hunger, improve food security, and advance sustainable agriculture, is in line with MGNREGA's contribution to economic stability and food security (UNSDG, 2015).

According to survey results, 51% of respondents strongly agree and 36% agree that agricultural revenue has risen, while 33% strongly agree and 33% agree that it has improved food security. By supporting land development and water conservation, enables small farmers to cultivate their land more effectively, expanding agricultural land and providing a more suitable food supply.

Moreover, plantation activities have received strong support, with 55% of respondents agreeing that afforestation efforts have enhanced environmental sustainability, further promoting agricultural resilience. The improvement in food production, where 47% strongly agree and 33% agree, reflects the scheme's role in reducing food insecurity and supporting local economies.

5.5. Statistical Analysis of Socio-economic Survey

Statistical analysis, including One-way ANOVA (Analysis of Variance) and the Kruskal-Wallis test, helps assess whether income growth significantly varies across different MGNREGA work categories (Field, 2017). In this study, One-Way ANOVA was chosen because it is suitable for comparing the means of income across more than two independent groups (different work categories), assuming the data meets parametric assumptions such as normality and homogeneity of variance. The test was done using the SPSS software package. The Kruskal-Wallis test a non-parametric alternative was also applied to validate the results where normality assumptions may not hold. These methods provide insights into the effectiveness of rural employment schemes in enhancing livelihoods, aligning with SDG 2 and 13 (UNSDG, 2015). Identifying the most impactful interventions supports data-driven policy decisions for sustainable socioeconomic development (Deininger & Liu, 2019). The annual income

(2013–14 and 2023–24) from MGNREGA assets of 40 individual beneficiaries have been collected from the Gram Panchayat office to show the impact of MGNREGA on sustainable rural livelihood (Tables 6 and 7).

Table 6
One-Way ANOVA

Source	Sum of Squares (sum_sq)	df	F-Statistic (F)	p-value (PR(> F))
C(Category)	3.512472×10^{10}	5	15.0539	0.000
Residual	1.586615×10^{10}	34		

Table 7
Kruskal-Wallis Test Results

Statistic	p-value
23.2434	0.0003

The One-Way ANOVA results (Table 6) indicate that income changes are significantly different across MGNREGA work categories, as shown by a high F-statistic (15.05) and a very low p-value (8.36×10^{-8}, which is 0.0000000836), confirming that at least one category differs from the others. The Kruskal-Wallis test (Table 7), a non-parametric alternative, also supports this conclusion with a test statistic of 23.24 and a p-value of 0.0003, reinforcing the presence of significant variations. These results highlight that water conservation-related interventions such as farm ponds, check dams, earthen bunding, trenches, and land development activities like wasteland development, fallow Land development, land leveling, and land reclamation had the most substantial positive impact on income as well as rural livelihood.

5.6 Kernel Density Analysis of SDG 2 and SDG 13

Kernel density estimation (KDE) is a non-parametric spatial analysis technique used to assess the density of point features over a continuous surface, helping to identify spatial patterns and clustering (Silverman, 1986). Kernel Density Estimation (KDE) (Fig. 12) plays a crucial role in this study as it allows for the spatial visualization of MGNREGA asset concentration (hotspot) and also to analyze & prioritize the areas where new interventions can be taken up (cold spot) and linked to specific Sustainable Development Goals (SDG 2 and SDG 13) (Table 2).

For SDG 2, KDE highlights areas where agricultural development activities—such as land leveling, bund construction, reclamation, and micro-irrigation—are densely located. For SDG 13, KDE enables the spatial assessment of climate-resilient infrastructure—such as afforestation efforts, renovated water bodies and check dams that support community adaptation to climate risks. KDE visualization provides a clear picture of spatial clustering; helping to understand and confirm the implementation of MGNREGA assets supports localized climate adaptation efforts.

6 Discussion

The combined analysis of *LC/LU, NDVI, NDWI*, along with *MGNREGA annual income data* and *socioeconomic survey data*, offers a multidimensional perspective on the progress and challenges in achieving the *SDGs* through the perspective of MGNREGA works.

The observed land use and land cover (Fig. 7) changes between 2013–14 and 2023–24 highlight the expansion of cropland (Fig. 8) and the increase of farm ponds and reservoirs/tanks. The increase in farm ponds and reservoirs/tanks indicates a shift towards improved water conservation strategies, visible in NDWI (Fig. 10), and improved vegetation health improvements in NDVI (Fig. 9), particularly through initiatives under the MGNREGA projects. The expansion of cropland, along with the increase in farm ponds and reservoirs/tanks, aligns with SDG 2 (Zero Hunger) and SDG 13 (Climate Action).Target 2.4, which emphasizes resilient agricultural techniques and sustainable food production, is supported by the LCLU's extension of agricultural land, which is in line with SDG 2 (FAO, 2017; UN, 2023).

As evidenced by changes in land cover and water bodies, MGNREGA's land development and micro-irrigation initiatives promote agricultural improvement and enhance SDG 2 (FAO, 2017).

The intervention mainly linked to SDGs 2 and 13, as shown by the rise in NDVI values (Fig. 9) during the Kharif, Rabi, and Zaid seasons, which reflect better vegetation cover and higher agricultural productivity.

The significant role of MGNREGA scheme to SDG 2 and 13 are reflected in the improvements of NDVI during Kharif, Rabi, and Zaid seasons, indicating better vegetation health and growth performance. The improvement in the NDVI values from 2013–14 and 2023–24 showed sustainable farming practices aligned with SDG 2, Target 2.4. MGNREGA interventions including afforestation, drought-proofing, and water conservation structures have enhanced land fertility and supported ecological restoration in rural areas (Kumar et al., 2023).

KDE mapping of MGNREGA geotagged interventions, along with NDWI analysis (Fig. 10) from 2013–14 to 2023–24, showed significant improvement in surface water availability. Water conservation structures such as check dams, ponds, and recharge systems have supported water preservation and minimized drought risk, reflected in rising NDWI values. Various studies showcased that MGNREGA’s water interventions structure enhanced rural local climate resilience (Nalgire & Chinnasamy, 2022). The spatial distribution between the high cluster intervention areas and higher NDWI values (PIB Delhi, 2019) indicated the major role of MGNREGA in climate adaptation and sustainable water management, promoting SDG 13.

Through drought-proofing, water conservation, and water harvesting interventions, as well as by renovating traditional water bodies and strengthening agricultural durability and climate resilient in the Gram Panchayat. These climate-smart interventions enhance food productivity, encourage rural livelihoods, and reduce vulnerability to climate risks (Vermeulen et al., 2012; Tirado et al., 2013).

The integration of remote sensing data and derived analysis, along with the output of the socioeconomic survey (Fig. 11), provides a comprehensive view of MGNREGA's impact on enhancing rural livelihood, aligning with SD2 and SDG 13. The survey data indicates that land development activities under MGNREGA, including the development of fallow land, wasteland, and land leveling, have significantly contributed to the expansion of the cultivated area, with 65% of respondents strongly agreeing and 25% agreeing that these interventions have made their land more fertile and suitable for improving cropping intensity.

Improved water retention through MGNREGA-supported structures such as check dams, farm ponds, sunken ponds, and earthen bunds has been recognized by 85% of respondents (40% moderate, 45% strong) as a key factor in ensuring consistent water availability for agricultural use, contributing to enhanced cultivation practices and reduced dependence on unpredictable rainfall.

MGNREGA's environmental conservation efforts align with SDG 13 by addressing climate-related vulnerabilities through afforestation, water conservation, and drought mitigation. The survey results indicate that 50% of respondents agree and 35% strongly agree that MGNREGA has helped reduce drought occurrences by improving water availability.

The construction and maintenance of traditional water bodies, check dams, and bunds have played a crucial role in climate adaptation by preventing soil erosion and sustaining groundwater levels. These findings highlight MGNREGA's dual role in improving agricultural sustainability and enhancing climate resilience, making it a key instrument for achieving both SDG 2 and SDG 13 targets.

The KDE maps of SDG 2 and 13 derived from Table 2 showed the spatial distribution (Fig. 12) of MGNREGA geotagged assets clearly indicating the presence of hostspot in the GP.

The KDE maps for SDG 2 and SDG 13 show the spatial clustering of MGNREGA asset interventions across the study area. In the SDG 2 map (left), high-density zones in the southern and central regions indicate concentrated agricultural development works, including land leveling, bund construction, land reclamation (190 assets), and micro-irrigation activities like canal repair and lining (54 assets). These align with SDG Target 2.4 and Indicator 2.4.1, supporting sustainable and resilient farming practices. In the SDG 13 map (right), dense cluster highlight climate-resilience measures such as drought-proofing (100

assets), water conservation structures like check dams and tanks (113 assets), and renovation of traditional water bodies (24 assets), contributing to SDG Target 13.2 and Indicator 13.1.3 on climate adaptation and disaster risk reduction. Overlapping high-density areas indicate a synergistic impact of agricultural and climate interventions under MGNREGA, fostering integrated rural resilience.

Conclusions

The comprehensive analysis of MGNREGA's impact within the study area emphasizes the pivotal role of the scheme in sustainable rural livelihood, which is linked with SD2 and SDG 13, particularly in the study area. The positive land cover changes and improvements in NDVI and NDWI indicators showcase the schemes' success in supporting sustainable agricultural practices and improving vegetation health, directly related to SDG 2 and indirectly to SDG 13.

Declarations

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Author Contribution

Aneesah Rahaman: writing original draft, Validation, Software, resources, methodology, formal analysis, and interpretation. Solomon: prepared figures and tables. Dr. Anjum Mahtab: Supervision,review & editing, visualization and project administration.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request. Geotagged asset data were obtained from the Bhuvan GeoMGNREGA portal (https://bhuvan.nrsc.gov.in/governance/mgnrega/), and remote sensing imagery (LISS-4) was sourced from Bhoonidhi portal-NRSC/ISRO.

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Figures

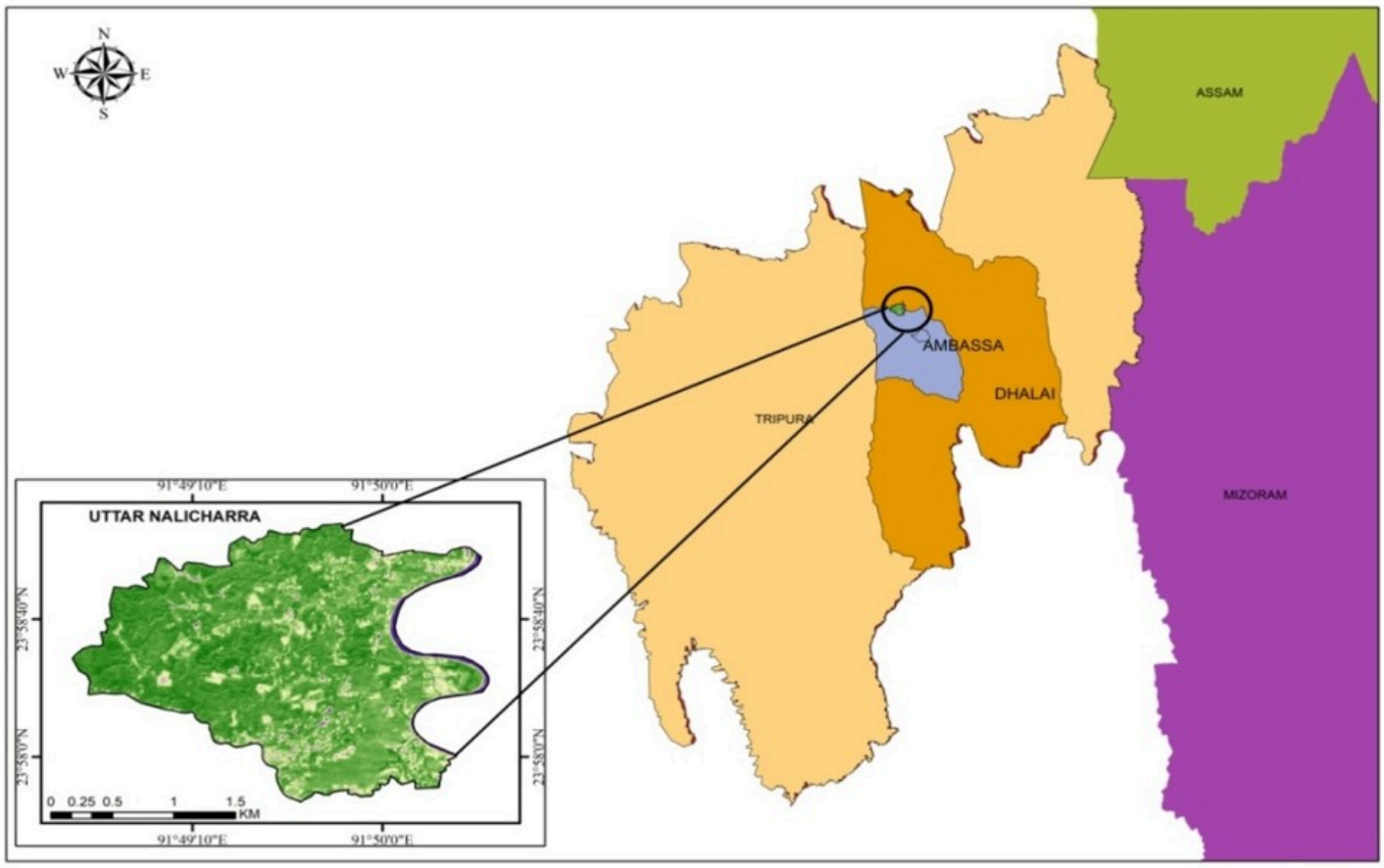


Figure 1

Location Map of Uttar Nalicharra GP, Tripura

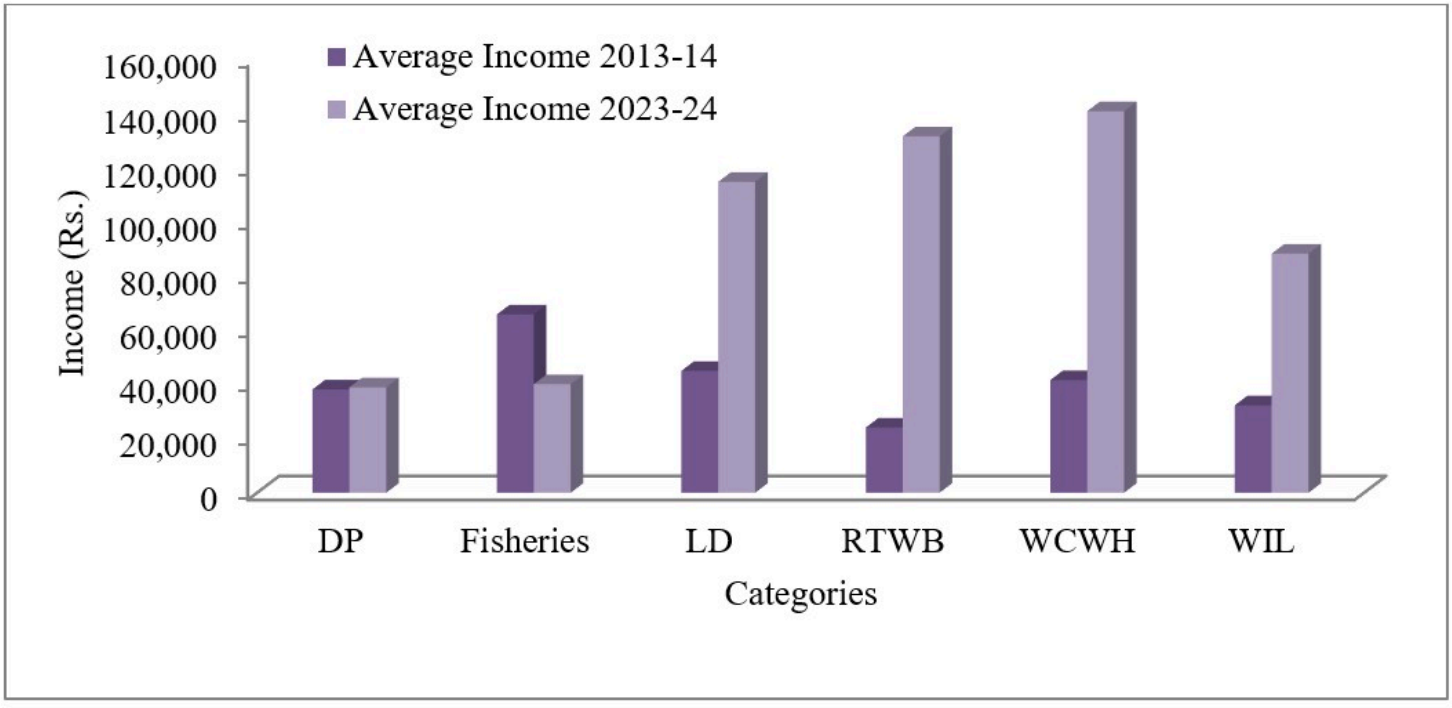


Figure 2

Income Distribution of 2013-14 and 2023-24 from MGNREGA Assets

Source: https://bhuvan-app2.nrsc.gov.in/mgnrega/mgnrega_phase2.php

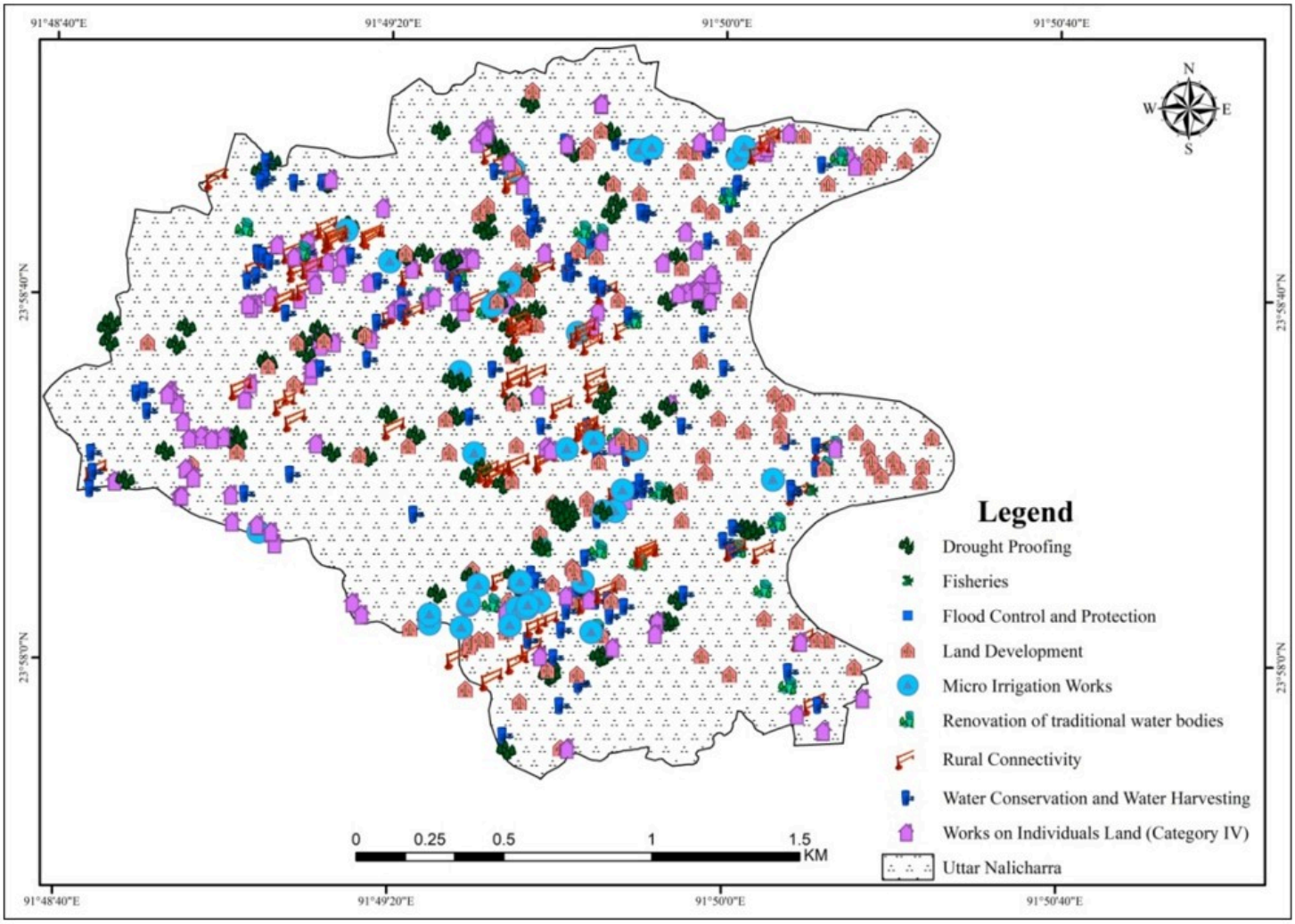


Figure 3

Major Category of MGNREGA works and their Geotags

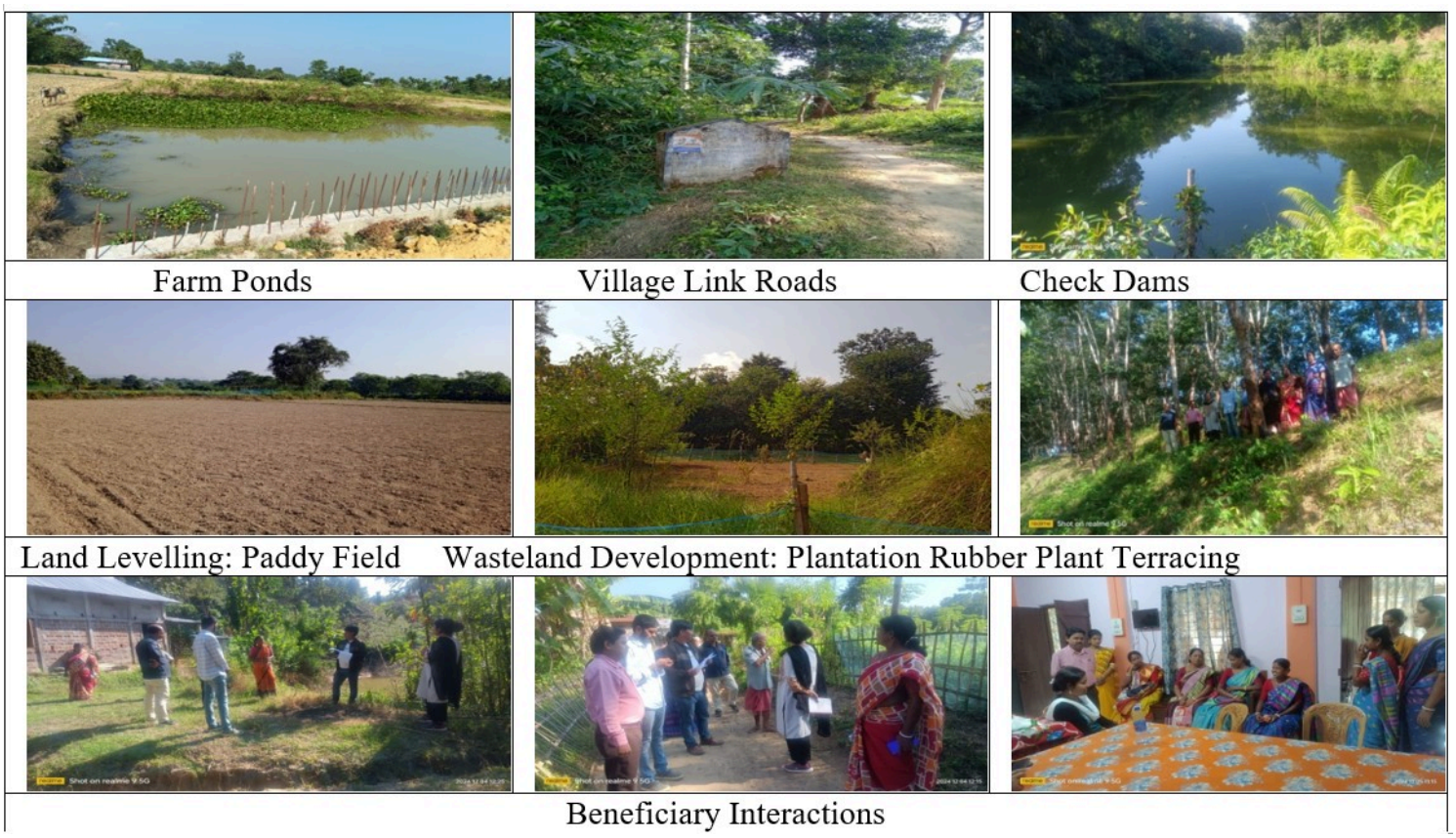


Figure 4

Categories of MGNREGA work in Uttar Nalicharra GP

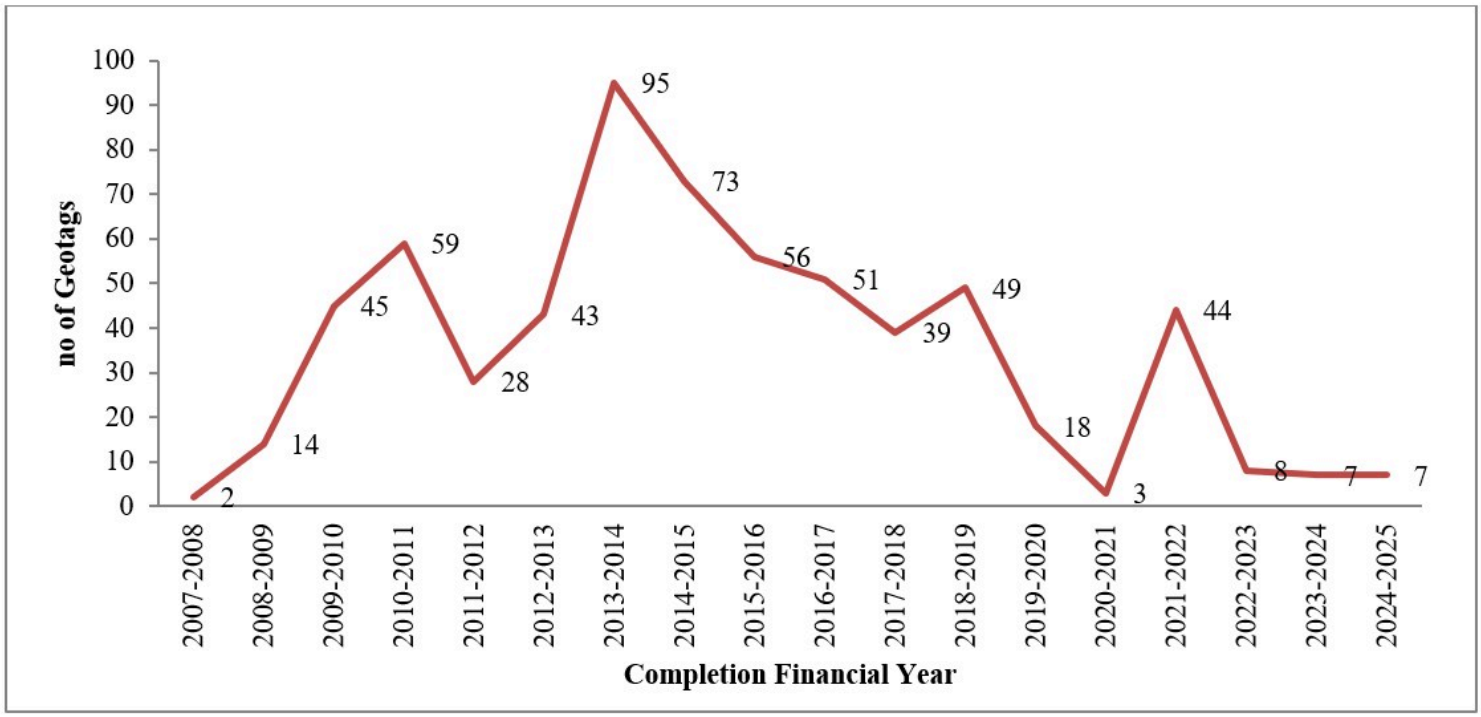


Figure 5

NRM & Non-NRM Assets with Peak Year of MGNREGA Activities

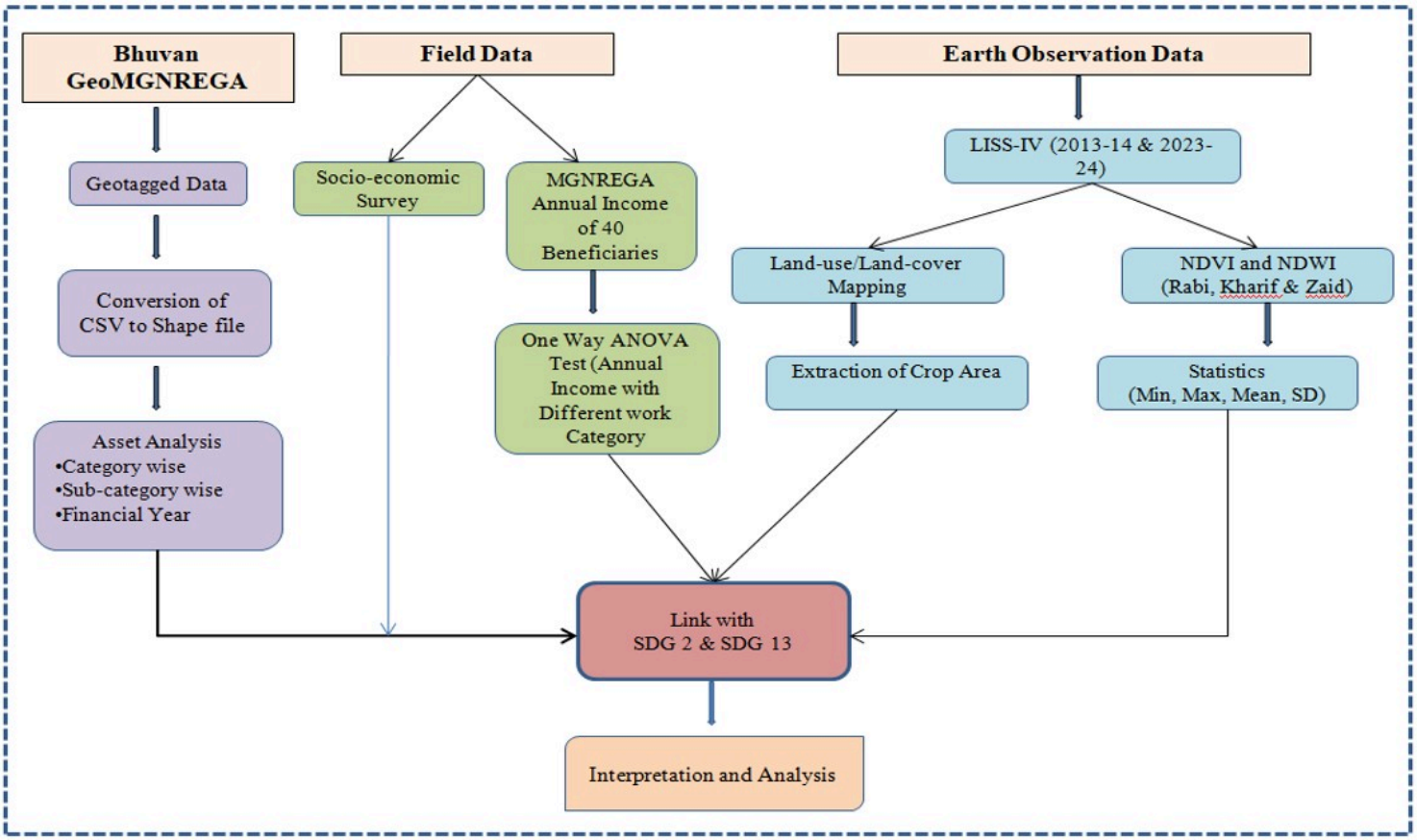


Figure 6

Methodology used in the study

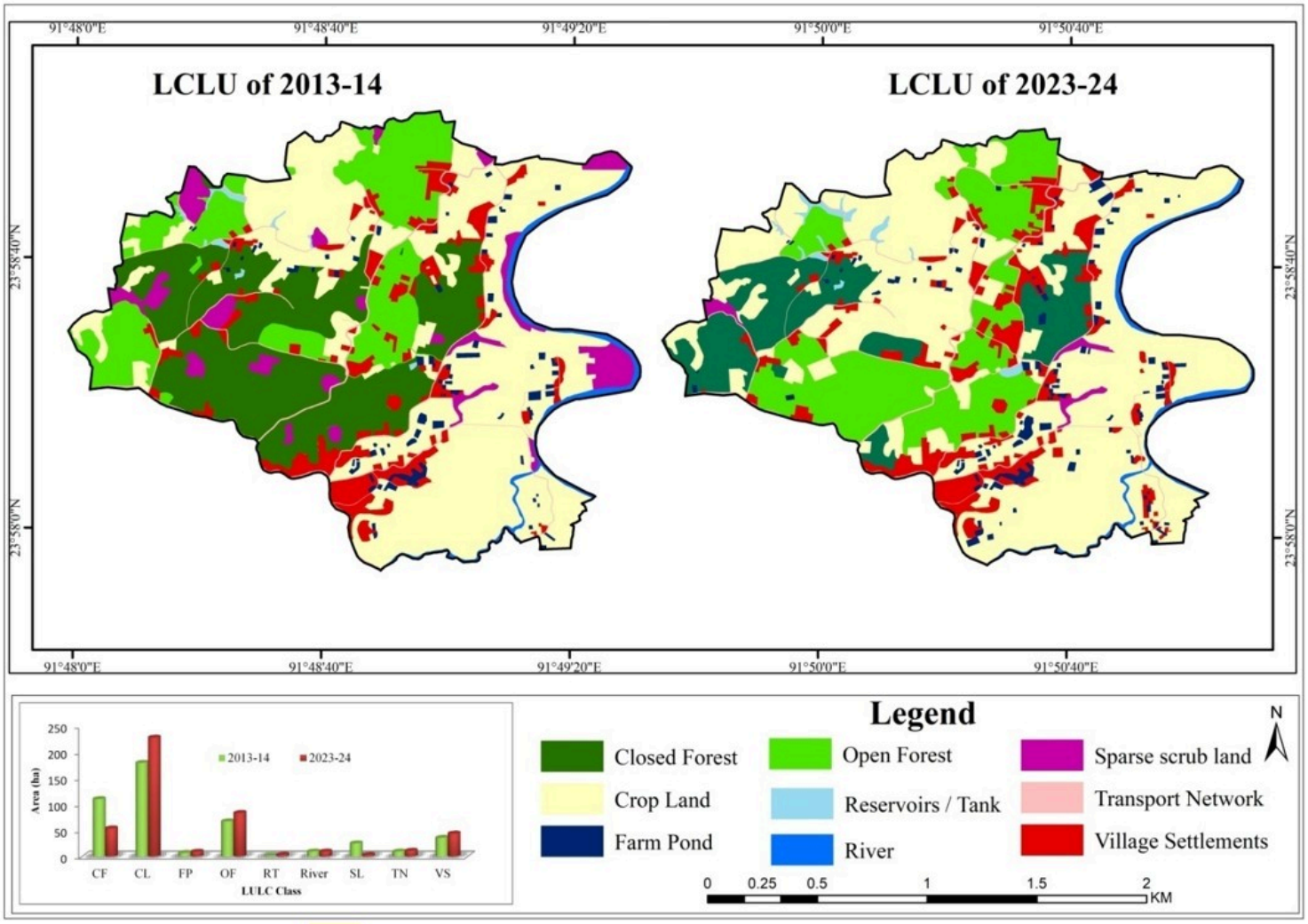


Figure 7

Land-cover Map of 2013-14 & 2023-2

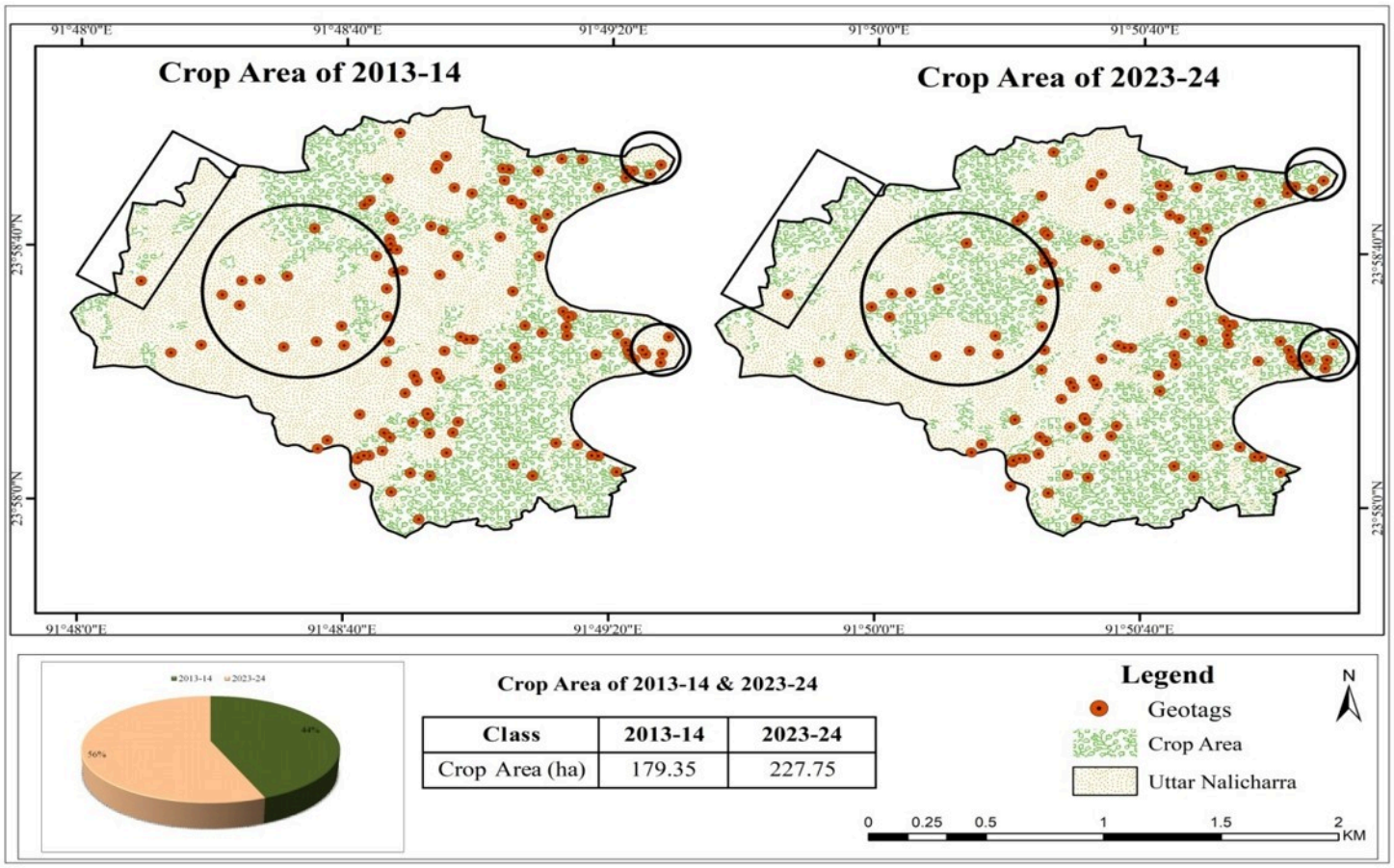


Figure 8

Crop Area Map of 2013-14 & 2023-24

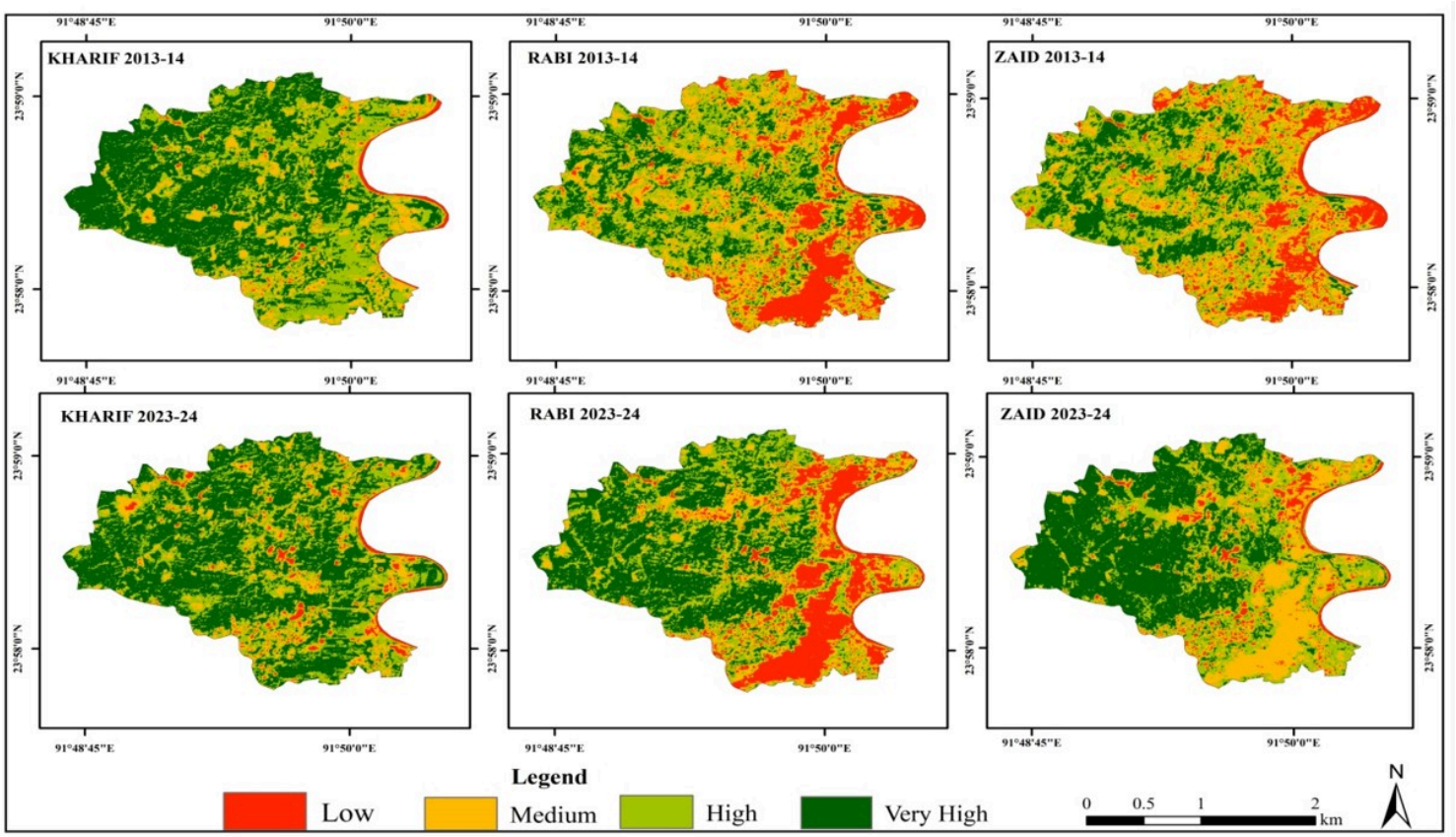


Figure 9

Normalized Difference Vegetation Index of 2013-14 & 2023-24

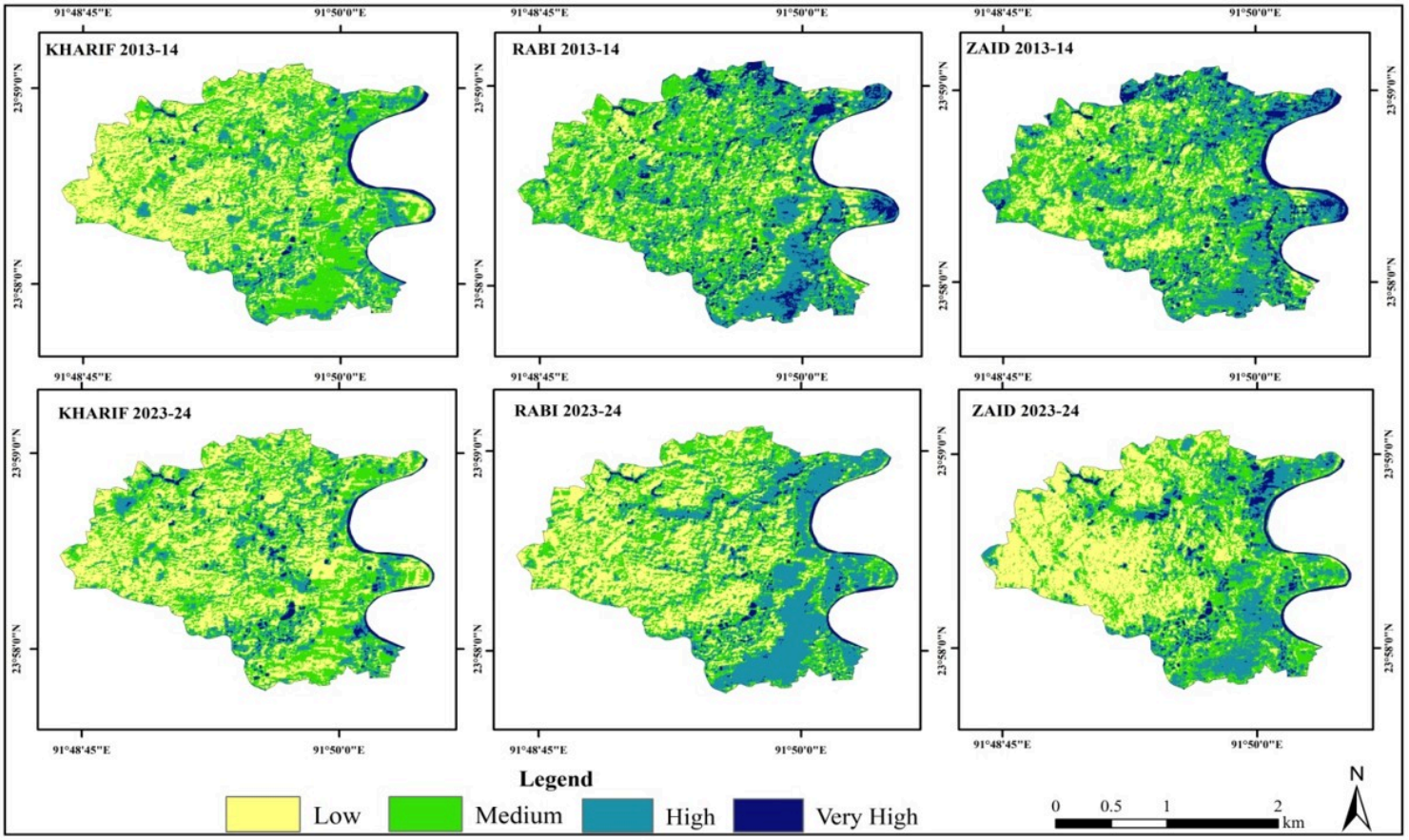


Figure 10

Normalized Difference Water Index of 2013-14 & 2023-24

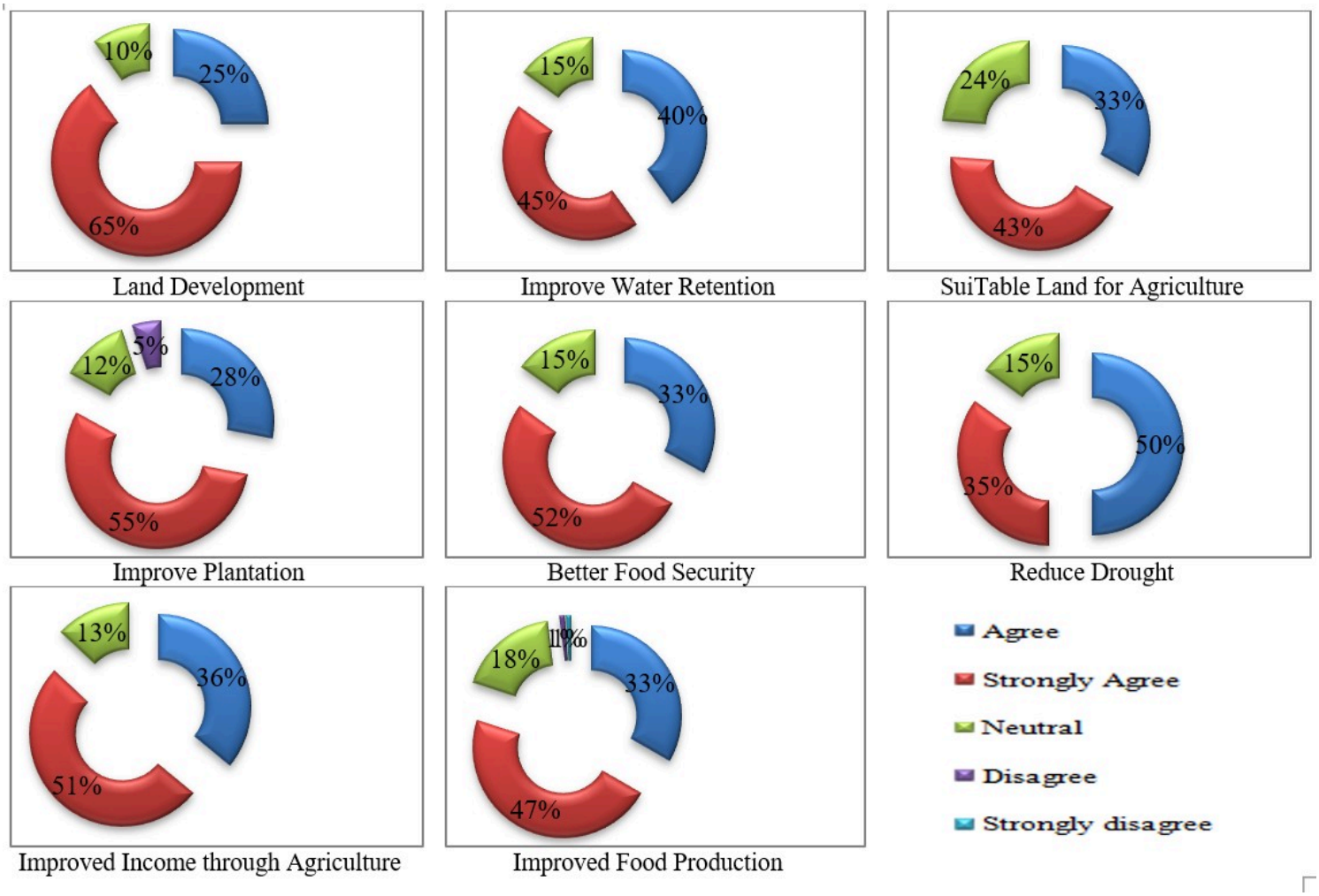


Figure 11

Socio-economic Survey Analysis

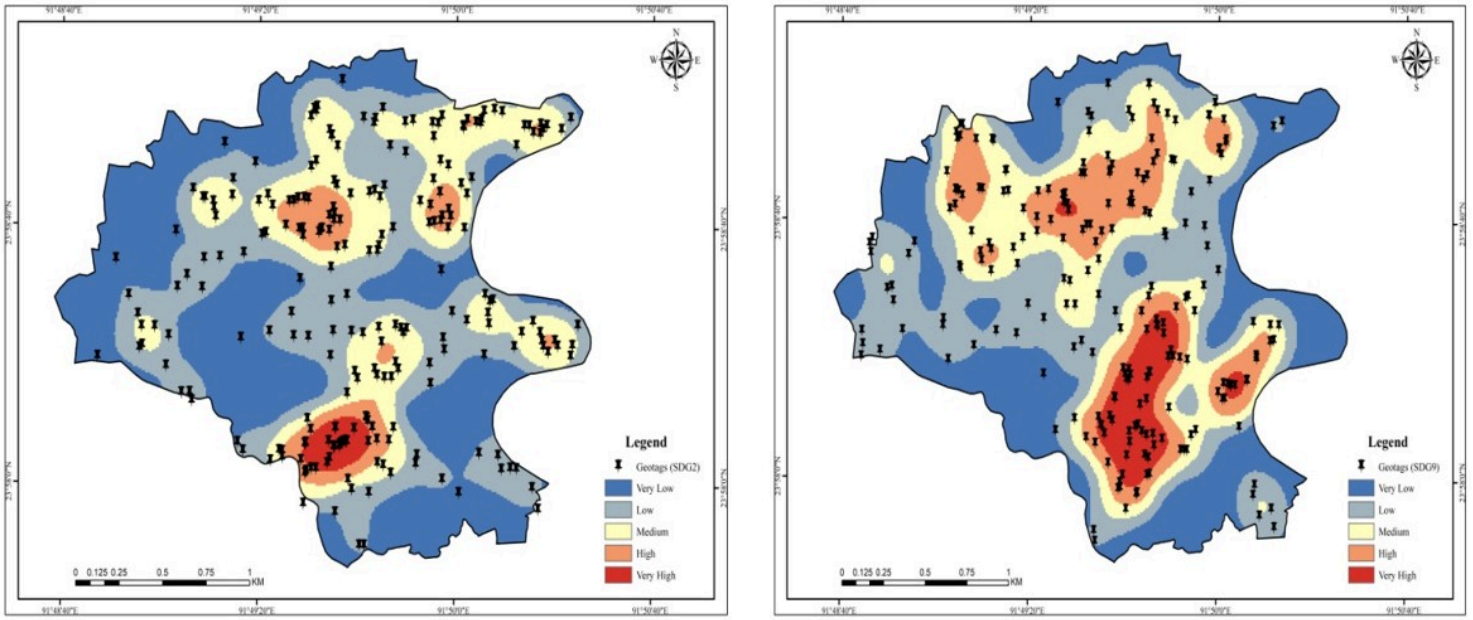


Figure 12

Kernel Density Map of SDG-2 (left) and SDG-13 (right)