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"Examining Sustainable Livelihood Security Of The Farmers In Uttar Dinajpur District, West Bengal"

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Abstract
The concept of sustainable livelihood security (SLS) holds particular importance for developing economies. The objective of this study is to assess the relative status of SLS in Uttar Dinajpur district, which is known as a backward district in West Bengal and India. This study has used a total of 35 relevant indicators related to the aforementioned four components of the SLS i.e. Ecological Security Index (ESI), Economic Efficiency Index (EEI), Social Equity Index (SEI) and Infrastructural Sufficiency Index (ISI). The indicators have been determined using the Principal Component Analysis (PCA) method, and the Composite Sustainable Livelihood Security Index (CSLSI) used for each CD block of Uttar Dinajpur district. Based on the ESI score, Chopra Block ranked first (0.088), while Raiganj Block ranked last (0.047). According to the EEI score, Hemtabad Block secured the first position (0.080), whereas Chopra Block ranked last (0.013). The SEI score shows Kaliyaganj Block in the top rank (0.110), with Goalpokhar-1 Block occupying the lowest rank (0.010). In terms of the ISI score, Hemtabad Block again ranked first (0.853), while Goalpokhar-1 Block ranked last (0.387). Furthermore, the CSLSI score places Hemtabad Block at the first position with a score of 0.275, whereas Goalpokhar-1 Block ranked ninth with a score of 0.125 and the Uttar Dinajpur district CSLSI value is 0.193 indicates that the district has a low level of sustainable livelihood security. The CSLSI synthesis highlights the need for block-specific and dimension-focused development strategies to reduce inter-block inequality and enhance sustainable livelihood outcomes across the district.

Keywords: *Sustainable Livelihood Security (SLS), Ecological Security Index (ESI), Economic Efficiency Index (EEI), Social Equity Index (SEI), Infrastructural Sufficiency Index (ISI), Sustainable Livelihood Security Index (SLSI), Principal Component Analysis (PCA), Uttar Dinajpur district.*

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I. Introduction

Nearly two-thirds of the world's population living in poverty lives in rural villages in low-income countries, who rely primarily on agriculture and other natural resources for their livelihoods (Satpati & Sharma, 2021). Low productivity in agriculture and limited access to off-farm income sources are increasing the vulnerability of rural populations, who are often deprived of a minimum standard of living (Khatiwada et al., 2017). Sustainable livelihoods as 'the level of resources and stocks and food and cash flows that provide physical and social well-being and protection against being poor' (Chambers, 1986) and sustainable livelihoods is a way of thinking about development goals, opportunities, and priorities to enhance progress in poverty alleviation (Ashley & Carney, 1999). SLS as livelihood alternatives that are environmentally safe, economically efficient and socially equitable underscoring: ecology, economics and equity levels (Swaminathan, 1991a,b) and also sufficiency in infrastructure in the society (Garai et al; 2022) Unbalanced development has contributed to the insecurity of livelihoods and is sustainable for balanced development Livelihood security-includes environmental, economic and equity levels must be ensured (Singh & Hiremath, 2009). The assessment of sustainability on a large spatial scale is complex due to the heterogeneity of ecology, climate and socioeconomic conditions, and for this reason the sustainability of regions dependent on agriculture should be better evaluated at the regional level (Krishna et al., 2020).

Lack of electricity, poor banking facilities, lack of toilets, lack of drinking water, and poor LPG and PNG facilities are the main reasons for regional imbalance (Das et al. 2020). Farmers' coping strategies can lead to greater efficiency in farming, which can lead to better adaptation within the household environment, as well as increased income-generating opportunities, especially in adverse household circumstances and improving social networks and financial capital is a major factor in sustaining households in terms of manpower and finances, providing greater accessibility and availability of resources, making households more resilient to stress (Pandey et al; 2017). The basis for creating sustainable livelihood was employment creation, poverty reduction, health and capacity, livelihood adaptation, vulnerability and natural resource base sustainability (Scoones 1998). So, the

Sustainable Livelihood Security Index is an effective tool for assessing sustainability because it is simple, informative, and understandable (Saleth 1993).

Sustainability status of the three districts namely Maldah, Uttar Dinajpur and Purulia was very low. The level of inter-district variation, Uttar Dinajpur district is the second lowest in West Bengal with an SLSI value of 0.12 (Garai et al; 2022).

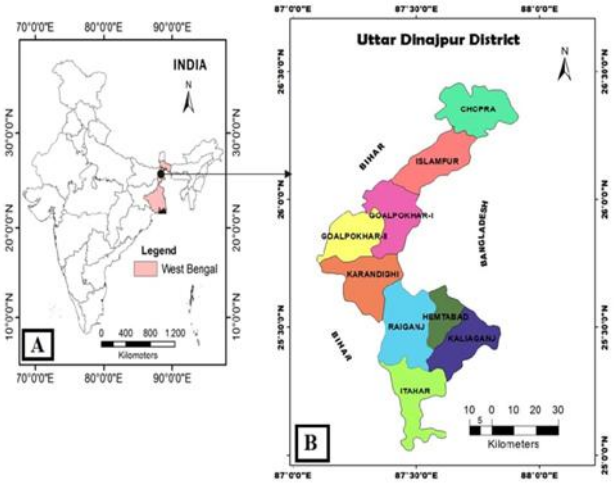
Uttar Dinajpur is one of the least developed districts in West Bengal as well as India, with high illiteracy rates, lack of healthcare and livelihood opportunities, and widespread rural poverty. Although it is a predominantly agricultural district, rapid population growth limits the attraction of new rural workers to agricultural employment, while the low level of urbanization hinders the development of the non-agricultural sector (Roy 2011). According to NFHS 2015-16, Uttar Dinajpur is the second poorest district (42.84%) in West Bengal after Purulia (49.69%) and also according to Multidimensional Poverty Index, Uttar Dinajpur has taken second position (0.209) in West Bengal after Purulia (0.262) (Bhattacharya & Bhuimali 2025). Recent studies (state-level SALSI work) suggest composite indicators for sustainable agricultural livelihood security, but district-level indicators that reflect local indicators are missing for Uttar Dinajpur. Therefore, since the agricultural sector in Uttar Dinajpur is diverse, has many small and marginal farms, and faces climate and market pressures, district-level and block-level evidence is needed for the design of policies and programs to ensure sustainable livelihood security. The objectives of the study are as follows...

1. To analyze the economic efficiency of farmers in Uttar Dinajpur district.
2. To assess the social equity of farmers in Uttar Dinajpur district.
3. To examine the ecological security of farmers Uttar Dinajpur district.
4. To examine infrastructural sufficiency of the farmers in Uttar Dinajpur district.
5. To investigate the relative SLS performance of Uttar Dinajpur district.
6. To identify the major constraints affecting the sustainable livelihood security of farmers in Uttar Dinajpur district.
7. To exploring livelihood options among farmers in Uttar Dinajpur district.

II. Methodology

Study area and Data collection

Uttar Dinajpur is the study area which is one of the districts of West Bengal, India. Uttar Dinajpur district is located between $25^{0}11'$ north latitude and $26^{0}49'$ north latitude and 87049' east longitude and $90^{0}00'$ east longitude. The area of the district is 3,140 square kilometres. It is bordered by Bangladesh to the east, Bihar state to the west, Darjeeling district and Jalpaiguri district to the north, and Malda district and Dakshin Dinajpur district to the south



Data Sources

The data of the study were from Census of India 2011(Office of the Registrar General and Census Commissioner, 2011), District Census Handbook (Uttar Dinajpur, West Bengal) and various literatures.

Table 1: Selected indicators and their relationship with SLS of farmers.

Sl. No	Variables	Description of variables	Relations -hip	Reference	Data Sources
I.	Ecological Security Index (ESI)				

1.	Cropping intensity	Ratio of gross cropped area to net sown area (NSA; %).	Positive	Sajjad et al. (2014); Chandna and Mondal (2020)	Siddiqui et al (2018) Authors calculation.
2.	Forest cover	Percentage of forest area to total geographical area (%)	Positive	Singh and Hiremath (2010); Kundu et al. (2021); Mishra et al. (2022); Das et al. (2025)	District Census Handbook, 2011.
3.	Population density	Number of people in unit area (people/km2)	Negative	Guha et al. (2018); Kumar et al. (2014); Garai et al. (2022);	District Census Handbook.
4.	Wasteland area cover	Percentage of wasteland area to total geographical area (%)	Negative	Sahoo and Swain (2013); Tripathi et al. (2019)	District Census Handbook.
5.	Annual rainfall	Average annual rainfall (mm)	Positive	Mishra et al. (2016); Singh and Nayak (2020); Swain et al. (2020)	NASA Data
6.	Annual Temperature	Average annual temperature ^{0}C	Negative	Mishra et al. (2016);	NASA Data
7.	Population growth rate	Decadal growth rate of population (%)	Negative	Das et al. (2025)	Blocks Wikipedia 2011
8.	Crop Diversification	Using Simpson Index of Diversification.	Positive	Das et al. (2025)	Siddiqui et al (2018) Authors calculation.
II.	**Economic Efficiency Index (EEI)**				
1.	Net irrigated area	Percentage of total irrigated area to total gross area	Positive	Krishna et al. (2020);	District Census Handbook.
2.	Net sown area	Percentage of total sown area to total gross area	Positive	Krishna et al. (2020);	District Census Handbook.
3.	Food grain productivity	Food grain yield (tonne/ha)	Positive	Krishna et al. (2020); Guha et al. (2018); Das et al, (2025)	Siddiqui et al (2018) Authors calculation.
4.	Cereal productivity	Cereal yield (tonne/ha)	Positive	Singh & Hiremath (2010)	Siddiqui et al (2018) Authors calculation.
5.	Pulses productivity	Pulses yield (tonne/ha)	Positive	Singh & Hiremath (2010)	Siddiqui et al (2018) Authors calculation.
6.	Per capita foodgrain production	Per capita foodgrain production per year (kg/h)	Positive	Singh and Hiremath (2010); Sajjad et al. (2014); Krishna et al. (2020)	Siddiqui et al (2018) Authors calculation.
7.	Land holdings	Percentage of operated area to total area of land holdings (%)	Positive	Swaminathan (1991); Saleth and Swaminathan (1993); Krishna et al. (2020)	District Census Handbook, Authors Calculation.
8.	Proportion of main workers	Percentage of main workers to total workers (%)	Positive	De and Das (2021); Satpati & Sharma (2021)	District Census Handbook, 2011.
9.	Access to agricultural Credit	The percentage of farmer village served by agriculture credit facilities (%)	Positive	Satpati & Sharma (2021); Das et al. (2025)	District Census Handbook, Authors Calculation.
10.	Workforce participation rate	Percentage of workforce to total population (%)	Positive	Das et al. (2025)	District Census Handbook, Authors Calculation.
III.	**Social Equity Index (SEI)**				
1.	Literacy rate	Percentage of literacy of total population (%)	Positive	Guha et al. (2018); Das et al, (2023)	District Census Handbook, 2011.
2.	Land availability	Percentage of sown area to households (%)	Positive	Das et al. (2025)	District Census Handbook, Authors Calculation.
3.	Female literacy rate	Percentage of literacy of Female population (%)	Positive	Das et al. (2025)	District Census Handbook, 2011.
4.	Sex ratio	Number of females per thousand males (n)	Positive	Nayak (2016); Singh and Nayak (2020)	District Census Handbook, 2011.
5.	Sanitation Facility	Percentage of households with improved sanitation facility (%)	Positive	Cronin et al. (2014); Tripathi 2015; Mutahara et al. (2016); Das et al. (2020a);	District Census Handbook, 2011.
6.	ST literacy rate	Percentage literacy of ST people (%)	Positive	Satpati & Sharma (2021);	District Census Handbook, 2011.
7..	Poverty ratio	Percentage of households below poverty line to total number of households (%)	Negative	Gregoire (2012)	CD Block Wikipedia, District Census Handbook, 2011.
8.	Dropout rate in primary education	Rate of dropout pupils relative to total primary school enrolment (%)	Negative	Iwasaki (2016)	Human Develop-ment Report Uttar Dinajpur
IV.	**Infrastructure Sufficiency Index**				
1.	Rural road connectivity	Percentage of Rural Road to number of village (%)	Positive	Das et al, (2025); Jain et al. (2022)	District Census Handbook, 2011.

2.	Population served per bank	Average number of people served per bank (n)	Negative	Satpati & Sharma (2021); Singh & Nayak (2020); De & Das (2021); Das et al. (2020a);	District Census Handbook, 2011.
3.	Digital connectivity	Percentage of Digital Connection to villages (%)	Positive	Guha et al. (2018); Das et al. (2020a);	District Census Handbook, 2011.
4.	Primary Health care Centre	Percentage of rural people served/Primary Healthcare Centre facility (%)	Positive	Das et al. (2025);	District Census Handbook, 2011.
5.	Primary School	Percentage of rural people served by the Primary School facility (%)	Positive	Satpati & Sharma (2021); Das et al. (2025)	District Census Handbook, 2011.
6.	Drinking water facility	Percentage of households with improved drinking water (%)	Positive	Mutahara et al. (2016); Singh & Nayak (2020); Das et al. (2021a); Das et al. (2020a);	District Census Handbook, 2011.
7.	Tractors Facility	Percentage of villages with tractor facilities (%)	Positive	Das et al. (2025);	District Census Handbook, 2011.
8.	Availability of electricity	Percentage of households with electricity (%)	Positive	Das et al. (2021a); Das et al. (2021b)	District Census Handbook, 2011.
9.	Market availability	Percentage of villages with market facilities (%)	Positive	Guha et al. (2018);	District Census Handbook, 2011.

Empirical Analysis

Sustainable Livelihood Security Index (SLSI)

According to DFID's (1999), Singh and Hermath (2010), Satpati & Sharma (2021), SLSI, as a relativistic method for assessing the relative sustainability state of a given set of entities, can be expressed as follows:

$$SLSI_{ijk} = \frac{X_{ijk} - Min_k X_{ijk}}{Max_k X_{ijk} - Min_k X_{ijk}} \qquad (1)$$

where i = variables (1, 2, 3, …, I); j = components (1, 2, 3, …, J); k = households (1, 2, 3, …, K); $SLSI_{ijk}$ = index for the i^{th} component of SLSI related to the j^{th} entity (farmers' households) and X_{ij} = value of the variable representing the ith component of I related to the j^{th} entity.

For negative indicators the equation is expressed as:

$$SLSI_{ijk} = \frac{Max_k X_{ijk} - X_{ijk}}{Max_k X_{ijk} - Min_k X_{ijk}} \qquad (2)$$

Where i = variables (1, 2, 3, …, I); j = components (1, 2, 3, …, J); k = households (1, 2, 3, …, K) and Here, Max_k and Min_k are the respective Maximum and Minimum values of ith indicator.

The composite index for each category of farmers was calculated as the weighted mean of the component indices derived from Equation (1 & 2):

$$CSLSI_{jk} = \frac{\sum_{i=1}^{I} W_{ij}\, SLSI_{ijk}}{J} \qquad (3)$$

Where, j = 1, 2, 3, ., J and k = 1, 2, 3,., K.

The indices of four dimensions of D-SLSI were calculated by using calculated index values of indicators ($SLSI_{ijk}$). It is to be calculated by calculating the simple mean of the indices of their respective indicators, that is:

$$ESI_k = \frac{\sum_{i=1}^{M} SLSI_{ik}}{M}, EEI_k = \frac{\sum_{i=1}^{P} SLSI_{ik}}{P}, SEI_k = \frac{\sum_{i=1}^{S} SLSI_{ik}}{S}, ISI_k = \frac{\sum_{i=1}^{T} SLSI_{ik}}{T}$$

Where, ESI = Ecological Security Index (M = Number of ecological indicators) EEI = Economic Efficiency Index (P = Number of economic indicators), SEI = Social Equity Index (S = Number of Social indicators), and ISI = Infrastructural Sufficiency Index (T = Number of infrastructural indicators) (Garai et al., 2019).

Principal Component Analysis (PCA)

After obtaining the normalized values for all the indicators of the CD block, the next step is to determine the factor loadings and weights. The Principal Component Analysis (PCA) method is used to calculate the factor loadings and weights of these indicators (Das et al, 2023). This is one of the oldest multivariate techniques, first developed by Pearson (1901) and later refined by Hotelling (1933). This method is used to understand spatial variations at the CD block level through multiple interrelated multidimensional variables (Pani and Mishra, 2022; Satpati and Sharma, 2021). PCA serves two main purposes: firstly, it helps to reduce the dimensionality of the data set, and secondly, it visually represents the variability of the data through the associated principal components (Pani and Mishra, 2022).

Before performing Principal Component Analysis (PCA), the Kaiser-Meyer-Olkin (KMO) test was conducted to assess the sampling adequacy of the various indicators. The KMO statistic indicates the strength of the relationships among the variables (Pani and Mishra, 2022; Satpati and Sharma, 2021). Its value ranges from 0 to 1. If the calculated KMO value is equal to or greater than 0.600, the data are considered acceptable for PCA; otherwise, they are considered unsuitable for PCA (De and Das, 2021).

All calculations in this study were performed using the IBM SPSS Statistics 16 analytical software and MS Excel. The Maps are created by QGIS software.

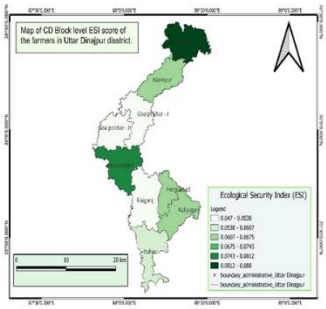
III. Result And Discussion

Ecological Security Index (ESI)

Ecological security refers to the dimension that assesses the fair and sustainable status of environmental resources and environmental conditions that support human livelihoods (Krishna et al; 2020). In Table 1, according to the Cropping Intensity indicator, Chopra block performs better than the other blocks, while Goalpokhar-II block is in a very poor position. Crop diversification is highest in Kaliyaganj block and lowest in Islampur block compared to the other blocks. Based on the Forest Cover Index, Goalpokhar-I block performs better than the other blocks, whereas Goalpokhar-II block is in poor condition.

According to the Population Density Index, Hemtabad block is in a better position, while Karandighi block is in the worst position among the blocks. In terms of the Wasteland Index, Karandighi block performs better, whereas Goalpokhar-I block performs the worst. According to the Population Growth Rate Index, Karandighi block performs better, while Goalpokhar-I block performs the worst among the blocks. Based on the Annual Rainfall Index, Islampur block receives higher rainfall, while Raiganj block has sufficient rainfall compared to the other blocks. According to the Annual Temperature Index, Chopra block performs better, whereas Raiganj block performs the worst among the blocks.

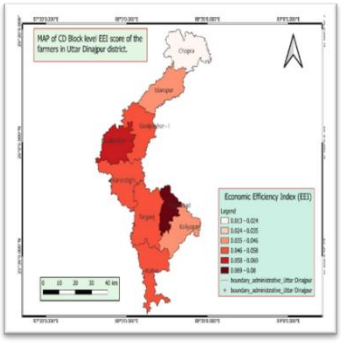
In Table 6, according to the ESI score, Chopra block ranks first with a value of 0.088, followed by Karandighi block in second position with a value of 0.077. Raiganj block ranks lowest with a value of 0.047, while Goalpokhar-I block ranks eighth with a value of 0.048. The comparison of all the blocks based on ESI values is shown in the following map.



Economic Efficiency Index (EEI)

The Economic Efficiency Index reflects the ability of an economy or region to provide adequate income and employment opportunities through the efficient use of available resources, ensuring that livelihoods are economically sustainable and resilient over time (Singh et al; 2012). In Table 2, based on the Net Irrigated Area Index, Itahar block performs better (Siddiqui, 2017 also found that Hemtabad block (56.1%) ranks first for net irrigated area), while based on the Net Sown Area Index, Hemtabad block performs better than the other blocks. As per the Foodgrain Productivity Index, Karandighi block ranks highest, whereas according to the Pulses Productivity Index, Raiganj block performs better than the other blocks. Chopra block ranks the lowest in all the above indices as well as in the Per Capita Foodgrain Index.

In terms of the Cereal Productivity Index, Karandighi block performs better, while Islampur block performs the worst among the blocks. According to the Per Capita Foodgrain Index, Kaliyaganj block holds a good position. Based on the Land Holding Index, Hemtabad block is in a good position, whereas Kaliyaganj block is in a poorer position compared to the other blocks.



According to the Main Worker Index, Chopra block performs better, while Hemtabad block performs the worst among the blocks. In terms of the Credit Access Index, Itahar block performs well, whereas Islampur block is in the worst position. Finally, according to the Workforce Participation Index, Hemtabad block performs better, while Goalpokhar-I block performs the worst among the blocks.

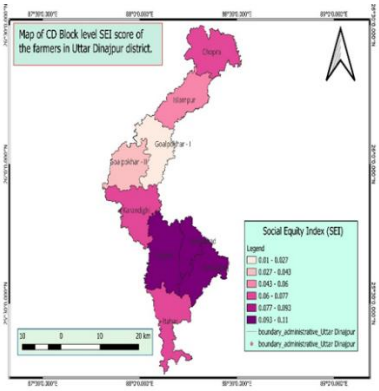
In Table 6**,** according to the EEI score, Hemtabad block ranks first with a value of 0.080, followed by Goalpokhar-II block in second position with a value of 0.068. Chopra block ranks lowest with a value of 0.013, while Kaliyaganj block occupies the eighth position with a value of 0.039. The comparative EEI values of all the blocks are illustrated in the map above.

Social Equity Index (SEI)

The Social Equity Index captures aspects such as education, health, demographic characteristics, gender equality, and access to basic amenities, reflecting how fairly the benefits of development are distributed. A higher SEI indicates greater social justice, inclusion, and equality, which are essential for achieving sustainable and secure livelihoods (Singh & Hiremath 2010). In Table 3, according to the Literacy Rate Index, Hemtabad block performs better, while Goalpokhar-I block performs the worst among the other blocks. Based on the Land Availability Index, Chopra block is in a good position, whereas Raiganj block is in a poorer position compared to the other blocks. According to the Female Literacy Rate and Sex Ratio indices, Hemtabad block performs better, while Goalpokhar-I block performs the worst among the blocks.

In terms of the Sanitation Facility Index, Raiganj block performs better, whereas Islampur block performs the worst compared to the other blocks. According to the ST Literacy Index, Kaliyaganj block is in a good position, while Goalpokhar-I block is in a poorer position than the other blocks. Based on the Poverty Ratio Index, Raiganj block performs better, while Goalpokhar-II block performs the worst among the blocks. Finally, according to the Primary Dropout Index, Hemtabad block performs well, whereas Chopra block is in a poorer position compared to the other blocks.

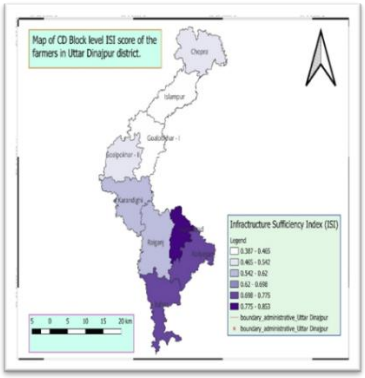
In Table 6, according to the SEI score, Kaliyaganj block ranks first with a value of 0.110, followed by Hemtabad block in second place with a value of 0.108. Goalpokhar-I block ranks lowest with a value of 0.010, while Goalpokhar-II block ranks eighth with a value of 0.032. The comparative SEI values of all the blocks are illustrated in the map above.



Infrastructure Sufficiency Index (ISI)

The Infrastructure Sufficiency Index (ISI) measures the availability, adequacy, and accessibility of basic physical and institutional infrastructure needed to support and sustain livelihoods in a region (Garai et al; 2022). In Table 4, based on the Rural Road Connectivity Index, Raiganj block is in a better position, while Hemtabad block occupies the lowest position among the blocks. According to the Bank Index, Islampur block performs better, whereas Kaliyaganj block performs the worst. In terms of the Digital Connectivity Index, Raiganj block is in a better position, while Goalpokhar-I block ranks the lowest. The Primary Healthcare Index shows that Itahar block performs better, whereas Goalpokhar-I block is in the worst position compared to the other blocks.

According to the Primary School Index, Hemtabad block is in a better position, while Islampur block performs the worst. With respect to the Drinking Water Facility Index and the Availability of Electricity Index, almost all the blocks show uniform performance, achieving a 100 percent level.



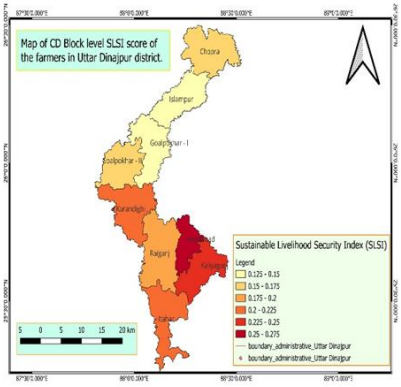
Based on the Tractors Facility Index, Itahar block performs better, whereas Chopra block occupies the lowest position. Finally, according to the Market Availability Index, Chopra block performs better, while Goalpokhar-II block performs the worst among the blocks.

In Table 6, according to the ISI score, Hemtabad block ranks first with a value of 0.853, followed by Kaliyaganj block in second position with a value of 0.760. Goalpokhar-I block ranks lowest with a value of 0.387, while Islampur block ranks eighth with a value of 0.403. The comparative ISI values of all the blocks are depicted in the map above.

Composite Sustainable Livelihood Security Index (CSLSI)

The Composite Sustainable Livelihood Security Index (CSLSI) is an integrated metric that assesses the overall sustainability and security of livelihoods in a region by integrating dimensions of ecological security, economic efficiency,social equity and Infrastructure Sufficiency into a composite score (Jain et al; 2022).

In Table 6, according to the Composite Sustainable Livelihood Security Index (CSLSI) score, Hemtabad block ranks first with a value of 0.275, followed by Kaliyaganj block in second position with a value of 0.243. Goalpokhar-I block ranks lowest with a value of 0.141, while Islampur block occupies the eighth position with the same value of 0.141. The comparative CSLSI values of all the blocks are illustrated in the map above. For Uttar Dinajpur district, the Ecological Security Index (ESI) is 0.062, the Economic Efficiency Index (EEI) is 0.051, the Social Equity Index (SEI) is 0.070, and the Infrastructure Sufficiency Index (ISI) is 0.587. Based on these component indices, the overall Composite Sustainable Livelihood Security Index (CSLSI) of the district is calculated as 0.193, but according to Garai et al. (2022) in the level of inter-district variation, Uttar Dinajpur district is the second lowest in West Bengal with an SLSI value of 0.12 which is very closed and also According to Das et al. (2023), Uttar Dinajpur district ranked lowest in the Sustainable Agricultural Livelihood Security Index and the level of sustainability in agricultural livelihoods was significantly limited. The CSLSI value of 0.193 indicates that Uttar Dinajpur district has a low level of sustainable livelihood security, with comparatively stronger infrastructure security but weaker environmental, social and economic dimensions.



IV. Conclusion

Integrated assessment of Ecological Security Index (ESI), Economic Efficiency Index (EEI), Social Equity Index (SEI), Infrastructure Sufficiency Index (ISI), and Composite Sustainable Livelihood Security Index (CSLSI) reveals significant spatial disparities in livelihood security across blocks of Uttar Dinajpur district. Overall, no single block exhibits equally high performance across all indicators, highlighting the nature of livelihood security in the district.

From an ecological perspective, Chopra block exhibits strong performance in terms of cropping intensity, annual temperature suitability, and land availability, yet it exhibits poor results in several productivity including food grains, pulses productivity, and per capita food grain availability. Karandighi block emerges as a comparatively strong performer in foodgrain and cereal productivity, wasteland utilization, and population growth control. In contrast, Goalpokhar-II block consistently records weak

performance in key indicators such as cropping intensity, forest cover, poverty ratio, and market availability, placing it among the most vulnerable blocks. Goalpokhar-I block shows better forest cover but performs poorly in wasteland status, population growth rate, workforce participation, literacy, and digital connectivity, highlighting a mismatch between ecological endowment and socio-economic outcomes. Islampur block benefits from relatively higher rainfall but lags in crop diversification,

cereal productivity, sanitation facilities, credit access, and primary education, which constrains its overall livelihood sustainability. With respect to food security and land-based indicators, Hemtabad block performs well across several dimensions, including population density, net sown area, landholding size, literacy (including female literacy), sex ratio, workforce participation, and primary dropout rates, indicating comparatively stronger human capital and social conditions. These findings are partly consistent with earlier observations (e.g., Siddiqui, 2017), which identified Hemtabad as a leading block in terms of net irrigated area. Kaliyaganj block stands out in crop diversification, per capita foodgrain availability, and ST literacy, but performs relatively poorly in landholding size and banking infrastructure. Raiganj block demonstrates comparatively better performance in pulses productivity, sanitation facilities, poverty reduction, rural road connectivity, digital connectivity, and overall rainfall adequacy, reflecting stronger urban-linked infrastructure and service access. Itahar block shows notable strengths in net irrigated area, credit access, primary healthcare, tractor availability, and irrigation-related indicators, suggesting better institutional and mechanization support for agriculture.

Table 1: CD Block wise indices and index value for calculation of ESI in Uttar Dinajpur district.

SL No.	CD Block Name	Cropping intensity		Crop Diversification		Forest Cover		Population Density		Wasteland Cover		Population growth rate		Annual Rainfall		Annual Temperature	
		%	Index	SID	Index	%	Index	P/km	Index	%	Index	%	Index	mm	Index	^{0}C	Index
1.	Chopra	169.99	1.000	0.69	0.385	0.79	0.629	799.47	0.768	4.21	0.393	24.93	0.425	5.73	0.948	23.65	1.000
2.	Islampur	138.5	0.468	0.64	0.000	0.91	0.729	912.2	0.327	5.75	0.132	27.51	0.267	5.85	1.000	23.80	0.915
3.	Goalpokhar-1	121.49	0.181	0.75	0.846	1.24	1.000	927.3	0.267	6.52	0.000	31.88	0.000	5.17	0.707	24.70	0.407
4.	Goalpokhar-2	110.77	0.000	0.72	0.615	0.02	0.000	945.6	0.196	2.11	0.751	28.60	0.200	5.23	0.733	24.17	0.706
5.	Karandighi	132.77	0.371	0.75	0.846	0.48	0.375	995.5	0.000	0.65	1.000	15.51	1.000	5.17	0.707	24.57	0.480
6.	Raiganj	134.72	0.404	0.72	0.615	0.34	0.258	911.23	0.330	2.65	0.658	18.83	0.797	3.53	0.000	25.42	0.000
7.	Hemtabad	115.05	0.072	0.75	0.846	0.43	0.338	740.4	1.000	3.20	0.565	19.55	0.753	4.14	0.263	25.02	0.226
8.	Kaliyaganj	133.39	0.382	0.77	1.000	0.18	0.131	742.44	0.992	3.38	0.535	17.96	0.850	4.06	0.228	25.15	0.153
9.	Itahar	115.49	0.080	0.74	0.769	0.29	0.219	837.96	0.618	1.51	0.853	19.28	0.770	4.10	0.246	25.12	0.169

Table 2: CD Block wise indices and index value for calculation of EEI in Uttar Dinajpur district.

SL No.	CD Block Name	Net Irrigated Area		Net Sown Area		Foodgrain Productivity		Cereal Productivity		Pulses Productivity		Per capita Foodgrain		Land Holdings		Main Worker		Agri. Credit access		Workforce Participation	
		%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index
1.	Chopra	6.56	0.000	35.31	0.000	2.24	0.000	2.24	0.100	0.01	0.000	176	0.000	78.04	0.086	81.38	1.000	3.45	0.497	31.14	0.064
2.	Islampur	30.82	0.458	82.74	0.864	2.30	0.017	1.91	0.000	0.39	0.331	194	0.051	82.74	0.453	78.98	0.843	0.99	0.000	30.87	0.040
3.	Goalpokhar-1	50.34	0.826	83.59	0.879	3.19	0.272	2.73	0.248	0.46	0.397	289	0.319	82.56	0.439	79.91	0.904	2.78	0.362	30.39	0.000
4.	Goalpokhar-2	36.32	0.562	87.12	0.943	2.37	0.037	2.36	0.136	0.02	0.004	237	0.172	86.98	0.784	72.45	0.417	5.92	0.996	31.39	0.085

5.	Karandighi	36.99	0.574	83.80	0.883	5.73	1.000	5.22	1.000	0.50	0.433	452	0.780	83.43	0.507	72.01	0.388	1.50	0.103	40.54	0.858
6.	Raiganj	34.91	0.535	80.10	0.816	4.80	0.734	3.65	0.526	1.15	1.000	393	0.613	79.97	0.237	71.98	0.386	3.62	0.531	38.08	0.650
7.	Hemtabad	49.34	0.807	90.23	1.000	3.97	0.496	3.53	0.489	0.44	0.380	466	0.819	89.75	1.000	66.07	0.000	3.51	0.509	42.22	1.000
8.	Kaliyaganj	26.24	0.371	77.10	0.761	5.08	0.814	4.22	0.698	0.86	0.747	530	1.000	76.94	0.000	77.44	0.743	3.14	0.434	42.18	0.996
9.	Itahar	59.55	1.000	77.91	0.776	4.42	0.625	3.55	0.495	0.87	0.756	439	0.743	77.70	0.059	75.14	0.593	5.94	1.000	37.49	0.600

Table 3: CD Block wise indices and index value for calculation of SEI in Uttar Dinajpur district.

SL No.	CD Block Name	Literacy rate		Land availability		Female literacy rate		Sex ratio		Sanitation facility		ST literacy rate		Poverty ratio		Primary Dropout rate	
		%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index
1.	Chopra	59.71	0.686	69.06	1.000	51.62	0.623	934	0.405	70.95	0.712	45.03	0.596	50.6	0.384	63.43	0.000
2.	Islampur	53.53	0.449	56.24	0.306	45.41	0.396	941	0.595	37.34	0.000	41.67	0.471	40.7	0.642	37.40	0.543
3.	Goalpokhar-1	41.82	0.000	56.51	0.321	34.62	0.000	919	0.000	51.33	0.296	28.94	0.000	59.2	0.159	44.13	0.403
4.	Goalpokhar-2	46.07	0.163	53.70	0.169	39.24	0.169	940	0.568	69.79	0.687	33.70	0.176	65.3	0.000	53.22	0.213
5.	Karandighi	53.42	0.445	53.39	0.152	46.08	0.420	953	0.919	68.93	0.669	42.15	0.489	37.2	0.734	20.60	0.894
6.	Raiganj	62.78	0.804	50.58	0.000	55.54	0.767	940	0.568	84.57	1.000	49.90	0.776	27.0	1.000	16.41	0.981
7.	Hemtabad	67.88	1.000	59.35	0.475	61.89	1.000	956	1.000	69.76	0.686	48.62	0.729	57.0	0.217	15.50	1.000
8.	Kaliyaganj	66.50	0.947	60.54	0.539	57.95	0.856	947	0.757	76.77	0.835	55.94	1.000	35.4	0.781	22.37	0.857
9.	Itahar	58.55	0.642	55.87	0.286	52.45	0.654	949	0.811	68.07	0.651	41.63	0.470	64.9	0.010	28.97	0.719

Table 4: CD Block wise indices and index value for calculation of ISI in Uttar Dinajpur district.

SL No.	CD Block Name	Rural Road Connectivity		Population served by Bank		Digital Connectivity		Primary Healthcare		Primary School		Drinking Water Facil..		Tractors Facility		Availability of Electricity		Market Availability	
		%	Index	P/B	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index	%	Index
1.	Chopra	36.21	0.168	31600.33	0.777	94.83	0.721	0.0113	0.820	0.037	0.133	98.28	0.000	13.79	0.000	100	1.000	65.52	1.000
2.	Islampur	41.58	0.366	44074.00	0.000	89.11	0.383	0.009	0.344	0.031	0.000	100.0	1.000	39.60	0.422	100	1.000	21.78	0.106

3.	Goalpokhar-1	40.97	0.343	36235.56	0.488	82.64	0.000	0.0006	0.000	0.040	0.193	100.0	1.000	38.199	0.399	100	1.000	19.444	0.059
4.	Goalpokhar-2	45.56	0.513	36406.50	0.478	94.67	0.711	0.010	0.452	0.051	0.440	100.0	1.000	65.688	0.849	98.2	0.000	16.577	0.000
5.	Karandighi	51.50	0.732	36833.20	0.451	88.00	0.317	0.010	0.506	0.051	0.451	100.0	1.000	70.500	0.928	100	1.000	22.500	0.121
6.	Raiganj	31.67	0.000	28681.40	0.959	99.55	1.000	0.013	0.850	0.051	0.443	99.10	0.477	29.411	0.256	100	1.000	19.911	0.068
7.	Hemtabad	58.777	1.000	28411.20	0.975	98.25	0.923	0.011	0.658	0.076	1.000	100.0	1.000	74.556	0.995	100	1.000	22.811	0.127
8.	Kaliyaganj	39.27	0.280	28017.75	1.000	97.91	0.903	0.013	0.923	0.071	0.897	100.0	1.000	59.669	0.751	100	1.000	20.944	0.089
9.	Itahar	48.40	0.617	37959.75	0.381	97.26	0.865	0.014	1.000	0.063	0.722	99.54	0.722	74.489	1.000	100	1.000	16.889	0.007

Table-6: Score and ranking of ecological security index (ESI), economic efficiency index (EEI) social equity index (SEI), infrastructural sufficiency index (ISI) and sustainable livelihood security index of 9 Blocks in Uttar Dinajpur district.

SL.	CD Block	ESI	Rank	EEI	Rank	SEI	Rank	ISI	Rank	SLSI	Rank
1.	Chopra	0.088	1th	0.013	9st	0.065	6th	0.513	6nd	0.170	6nd
2.	Islampur	0.062	4th	0.042	7rd	0.056	7rd	0.403	8rd	0.141	8rd
3.	Goalpokhar-1	0.048	8th	0.54	5th	0.010	9st	0.387	9th	0.125	9st
4.	Goalpokhar-2	0.053	7th	0.068	2th	0.032	8nd	0.494	7th	0.162	7th
5.	Karandighi	0.077	2th	0.056	3th	0.075	4th	0.612	4th	0.205	4th
6.	Raiganj	0.047	9st	0.051	6th	0.101	3th	0.561	5st	0.190	5th
7.	Hemtabad	0.061	5rd	0.080	1th	0.108	2th	0.853	1th	0.275	1th
8.	Kaliyaganj	0.063	3th	0.039	8nd	0.110	1th	0.760	2th	0.243	2th
9.	Itahar	0.056	6nd	0.055	4th	0.075	5th	0.703	3th	0.223	3th
**	Uttar Dinajpur	0.062	***	0.051	***	0.070	***	0.587	***	0.193	***

Hemtabad block consistently emerges as a high-performing block, ranking first in EEI and ISI and achieving the highest CSLSI score, indicating balanced and relatively secure livelihood conditions. Kaliaganj block also exhibits strong performance, particularly in SEI and CSLSI. In contrast, Goalpokhar-I, Goalpokhar-II and Islampur blocks frequently rank low on multiple indicators, reflecting persistent environmental, economic, and social vulnerabilities. While the district exhibits relatively high ISI values, low ESI and EEI scores undermine overall livelihood security. The CSLSI synthesis emphasizes the need for block-specific and dimension-focused development strategies to reduce inter-block disparities and improve sustainable livelihood outcomes in districts. This spatial imbalance indicates the need for block-specific, indicator-driven policy interventions rather than uniform district-level planning.

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