

# Cropping Intensity and Agricultural Productivity in South Dinajpur District: A Geographical Analysis

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## ABSTRACT

Cropping intensity has become a central indicator in agricultural geography because it captures the degree to which cultivated land is used across multiple seasons within a limited land base. Yet high cropping intensity does not necessarily produce uniformly high agricultural productivity. In districts marked by uneven irrigation, variable soil fertility, selective crop concentration, and unequal market access, intensification often generates differentiated rather than evenly distributed agrarian outcomes. South Dinajpur district in West Bengal offers a particularly important case for examining this contradiction. Official district records identify a net sown area of 188.6 thousand hectares, a gross cropped area of 331.9 thousand hectares, and a cropping intensity of 176 percent, which together indicate strong land-use intensification. At the same time, the district remains only partially irrigated, with a net irrigated area of 82.54 thousand hectares and a rainfed area of 93.08 thousand hectares, suggesting that repeated cultivation is not equally secured across space. Recent literature from West Bengal and the wider Eastern Indo-Gangetic Plain shows that irrigation, crop diversification, infrastructure, climate variability, and soil quality strongly shape agricultural performance, while aggregated district statistics may obscure finer spatial inequalities. This article addresses the gap by developing a district-focused review of cropping intensity and agricultural productivity in South Dinajpur. It synthesizes official district statistics, recent peer-reviewed work on agrarian transition, agricultural sustainability, irrigation, remote sensing of cropping intensity, and emerging soil-fertility evidence from the Barind tract of Dakshin Dinajpur. The article argues that South Dinajpur should not be read simply as a high-intensity agricultural district. Rather, it should be understood as an internally differentiated agrarian space in which productivity is mediated by the uneven geography of irrigation access, soil fertility, cropping structure, and infrastructural support. The article contributes a spatial analytical framework for future empirical and GIS-based research on the district and clarifies why cropping intensity and productivity should be treated as related but analytically distinct geographical processes. (Department of Agriculture & Farmers Welfare, 2025; Government of India, 2011; Malo & Saha, 2025; Nandi et al., 2025; Paria et al., 2022)

**Keywords-** cropping intensity, agricultural productivity, South Dinajpur, West Bengal, spatial disparities, irrigation, agricultural geography, Barind tract.

## I. INTRODUCTION

Agricultural geography in India is increasingly shaped by a simple structural reality: the land frontier has narrowed, but the demand placed upon agricultural land continues to rise. Under such conditions, the repeated use of the same land parcel across seasons becomes a major strategy for sustaining food production, rural employment, and household income. This is why cropping intensity has become one of the most frequently used indicators in agrarian analysis. At the national level, India reported a cropping intensity of 155.9 percent in 2022-23, based on a net sown area of 140,705 thousand hectares and a gross cropped area of 219,357 thousand hectares. These figures indicate how central multiple cropping has become in the country's agricultural structure. Yet they also raise a more difficult question: does more frequent use of land reliably

translate into better agricultural productivity across all regions and within all districts? (Department of Agriculture & Farmers Welfare, 2025)

That question is especially important in eastern India, where agriculture remains highly land-dependent, socially dense, and ecologically variable. In such regions, cropping intensity often rises not because all enabling conditions are uniformly favorable, but because farm households are under pressure to derive more output from limited operational holdings. The result is that intensification can coexist with vulnerability. A district may record high gross cropped area and repeated seasonal cultivation, yet still display uneven productivity if access to irrigation, soil nutrients, infrastructure, and markets differs sharply from one locality to another. Recent work from West Bengal has shown that agrarian transition toward more productive and diversified systems depends not only on irrigation but also on fertilizer use, road connectivity, storage, market access, and climate-sensitive conditions. At the same time, comparative work across the Eastern Indo-Gangetic Plain demonstrates that aggregate district or sub-national indicators may conceal profound variation at smaller spatial scales. (Nandi et al., 2025; Paria et al., 2022)

South Dinajpur district in West Bengal provides an excellent geographical case through which to examine this tension between intensification and productivity. According to the district agriculture contingency profile, South Dinajpur has a geographical area of 221.9 thousand hectares, a cultivable area of 204.85 thousand hectares, a net sown area of 188.6 thousand hectares, an area sown more than once of 143.3 thousand hectares, and a gross cropped area of 331.9 thousand hectares, yielding a cropping intensity of 176 percent. This is substantially higher than the recent all-India average. Yet the same official profile reports that the district has a net irrigated area of only 82.54 thousand hectares, a gross irrigated area of 135.23 thousand hectares, and a rainfed area of 93.08 thousand hectares. It also shows that bore wells or shallow tube wells account for the largest share of irrigation, while canal irrigation is absent in the reported source structure. These features suggest a district that is highly intensified overall, but not uniformly secured by irrigation. (Government of India, 2011)

This district profile immediately complicates any easy equation between cropping intensity and agricultural productivity. If large parts of the district remain dependent on rainfall or on localized irrigation systems, then the ability to cultivate land more than once does not imply that all cultivated space is equally productive, equally resilient, or equally sustainable. The same district document also identifies a strong monsoonal rainfall regime, with 1,549.8 mm of rainfall concentrated in the southwest monsoon and a mean annual rainfall of 1,847.8 mm, indicating a hydrologically seasonal agricultural environment. In such a landscape, repeated cultivation is likely to be supported unevenly across lowland, medium land, and upland agricultural settings. Intensification therefore needs to be interpreted spatially rather than only statistically. (Government of India, 2011)

The problem becomes sharper when recent soil evidence is considered. A 2025 study of the Barind tract of Dakshin Dinajpur argues that the soil fertility of rice-based cropping systems in the study area is deficient for sustainable production and explicitly identifies the need for site-specific nutrient management and GIS-based assessment. The same study states that the research investigates spatial variations in soil fertility parameters under rice-based cropping systems in the Barind tract of Dakshin Dinajpur. This is a significant intervention because it shows that the district's agricultural performance cannot be understood only through land-use frequency. Soil quality itself varies spatially, and that variability is likely to shape the relationship between intensification and productivity. (Malo & Saha, 2025)

A second reason South Dinajpur is important lies in the geography of scale. Recent work on crop diversification across the Eastern Indo-Gangetic Plain has shown that sub-national patterns can obscure district, sub-district, and even community-level divergence. That finding has major implications for district-based geographical research. A high district average may be statistically correct and yet substantively misleading if it is produced by the coexistence of highly intensified and weakly intensified localities. South Dinajpur is therefore not merely a case of high cropping intensity. It is a case that raises the question of what district averages hide. (Nandi et al., 2025)

This article addresses that problem by offering a district-focused geographical analysis of cropping intensity and agricultural productivity in South Dinajpur. It does not present a new empirical dataset. Instead, it works as a review article that synthesizes official district records, recent peer-reviewed literature on agrarian transition and agricultural sustainability, remote-sensing work on cropping intensity, and district-relevant soil-fertility evidence. The article is guided by three research questions: First, how should the high reported cropping intensity of South Dinajpur be interpreted geographically? Second, what factors are most likely to mediate the relationship between cropping intensity and agricultural productivity in the district? Third, why is a spatial rather than purely aggregate reading necessary for understanding the district's agrarian structure? These questions allow the article to move beyond descriptive district profiling toward a clearer analytical framework.

The central argument of the article is that South Dinajpur should be understood as an internally differentiated agrarian space in which cropping intensity and agricultural productivity are related but not identical. High cropping intensity indicates strong land-use pressure and repeated cultivation, but productivity is mediated by uneven irrigation access, soil fertility, crop structure, and infrastructural conditions. The article's originality lies in bringing these strands together into one district-focused geographical interpretation. Existing work has explored agrarian transition in West Bengal, agricultural sustainability in India, crop diversification in the Eastern Indo-Gangetic Plain, and soil fertility in the Barind tract, but the accessible literature does not yet provide an integrated analytical article focused specifically on South Dinajpur's cropping

intensity and productivity relation. This review seeks to fill that gap. (Das et al., 2024; Jatav & Naik, 2023; Malo & Saha, 2025; Nandi et al., 2025; Paria et al., 2022)

## II. LITERATURE REVIEW

The distinction between cropping intensity and agricultural productivity is central to any serious geographical analysis of agrarian systems. Cropping intensity measures the extent to which land is cropped more than once during the agricultural year. It is thus a land-use indicator, not a complete productivity indicator. Agricultural productivity, by contrast, concerns output relative to land, labor, or a bundle of inputs and therefore refers to performance rather than merely repeated use. This distinction is sometimes blurred in planning language because intensive cultivation often accompanies rising output, but the two are not conceptually identical. Recent work in Tamil Nadu explicitly describes the analysis of cropping patterns and intensity as essential for policy and food-security assessment, while also recognizing that these patterns are embedded in wider agro-physical and management conditions. Similarly, research on agricultural sustainability in India treats cropping intensity as one important indicator among many, alongside irrigation intensity, foodgrain productivity, crop diversification, transport, credit, and demographic factors. (Jatav & Naik, 2023; Pazhanivelan et al., 2025)

This conceptual distinction matters because it prevents intensification from being treated as self-explanatory. Intensification can produce higher productivity when repeated cultivation is supported by reliable water, adequate nutrients, viable crop combinations, and favorable market conditions. It can also produce stress when the resource base is fragile, the crop structure is narrow, or irrigation is uncertain. In such cases, the same land may be used more frequently without proportionate or stable gains in output. From a geographical perspective, this means that the relation between intensity and productivity has to be mediated through environmental and infrastructural context rather than assumed as automatic. This article adopts that position and treats cropping intensity as a necessary but incomplete indicator of agricultural performance. (Das et al., 2024; Jatav & Naik, 2023)

A major debate in the literature concerns irrigation. In recent district-level work on West Bengal, Paria et al. show that irrigation, fertilizer use, road connectivity, and market and storage facilities are major drivers of agrarian transition in favor of non-foodgrains. This finding is important because it shifts attention away from a single-factor explanation of agricultural change. Irrigation remains central, but it works through a broader enabling environment. Das et al., working on Karnataka, similarly report that agricultural efficiency depends significantly on irrigation intensity, but also note that over time other factors such as high-yield seeds and chemical fertilizers become increasingly important. Together, these studies show that irrigation is a key spatial filter for productivity, but not the only one. (Das et al., 2024; Paria et al., 2022)

A second debate concerns crop diversification. Nandi et al. demonstrate that crop diversification across the Eastern Indo-Gangetic Plain shows clear spatiotemporal variation and that sub-national diversification patterns may obscure district and sub-district realities. Their work is especially useful for the present article because it offers both a substantive and a methodological lesson. Substantively, it suggests that cereal-centric agricultural systems are likely to perform differently from more diversified ones in terms of resilience and sustainability. Methodologically, it shows that aggregate measures can conceal important smaller-scale variation. In a district like South Dinajpur, where official agricultural records point to strong multiple cropping but local conditions are uneven, this literature suggests that one should expect differentiated agricultural outcomes even when the district average appears robust. (Nandi et al., 2025)

A third debate concerns the sustainability of intensive agricultural systems. Jatav and Naik use a Pressure-State-Response framework to assess agricultural sustainability in India and identify higher cropping intensity, irrigation intensity, foodgrain productivity, crop diversification, transport facilities, and institutional support among the indicators associated with stronger agricultural sustainability. The value of this framework lies in its refusal to treat agricultural success as a purely output-based matter. Intensification may contribute to sustainability if supported by institutional, environmental, and infrastructural conditions. But where those supports are weak, high intensity may instead reflect pressure on land and livelihoods. This is particularly relevant to South Dinajpur because the district profile reveals strong land-use pressure but only partial irrigation coverage and significant dependence on groundwater-based sources. (Government of India, 2011; Jatav & Naik, 2023)

Remote-sensing research adds a further methodological dimension. Pazhanivelan et al. argue that spatial and temporal analysis of cropping patterns and intensity is essential for timely policy decisions and climate-responsive strategies. Their study also notes that while spatial resolution may not be a major constraint at larger scales, it can matter more for smaller study areas. This is highly relevant for South Dinajpur because the district is small enough for aggregate statistics to appear coherent, yet internally varied enough that fine-scale mapping is likely to change the interpretation of its agrarian structure. A geographical analysis of the district therefore cannot rely indefinitely on district-level averages alone. It needs to move toward a block-level and GIS-supported approach. (Pazhanivelan et al., 2025)

South Dinajpur's own district-level literature remains limited but revealing. The official agriculture contingency profile provides a useful baseline for land use, soils, rainfall, irrigation, and cropping intensity. It identifies the district as part of the Lower Gangetic Plain and the Old Alluvial Zone, records multiple major soil groups including very deep clay loam, deep clay, deep loamy, sandy, and sandy loam soils, and shows significant variation in irrigation source structure. This

alone suggests that agricultural conditions are spatially differentiated. The district cannot be understood as a single, uniform agricultural surface because its physical setting, water access, and land quality already vary. (Government of India, 2011)

More recent district-relevant work adds a stronger explanatory layer. Malo and Saha's study of the Barind tract of Dakshin Dinajpur explicitly focuses on spatial variation in soil fertility parameters under rice-based cropping systems and argues that location-specific fertility assessment and zonal nutrient management are necessary. The authors also note that the use of GIS-based mapping and geostatistical techniques remains limited in the Barind area and position their work as a gap-filling intervention. This matters because it provides direct support for the article's core argument: agricultural productivity in South Dinajpur is likely to be uneven because the ecological basis of cultivation itself is uneven. (Malo & Saha, 2025)

A supplementary district-level study on agricultural development in Dakshin Dinajpur, though not a high-impact journal source, is still instructive because it uses thirteen variables at block level and reports that four blocks fall in a high agricultural-development category, two in a medium category, and two in a low category. It attributes low agricultural performance to deteriorating irrigation, faulty water management, lack of infrastructural facilities, and weak technical know-how. This finding should be treated cautiously because of the publication outlet, but it is nevertheless consistent with the broader peer-reviewed literature and with the district profile itself. It reinforces the point that block-level divergence exists and that irrigation and infrastructure are major spatial determinants. (Afzal et al., 2017)

The literature gap, then, is not simply the absence of more district statistics. It is the absence of a district-focused geographical article that integrates South Dinajpur's official agricultural profile with current debates on intensification, productivity, irrigation, sustainability, scale, and soil fertility. The available literature discusses West Bengal's agrarian transition, Indian agricultural sustainability, EIGP diversification patterns, and Barind soil conditions, but these strands are rarely brought together into one coherent interpretation of South Dinajpur. This article addresses that gap by constructing an analytical framework through which cropping intensity and agricultural productivity in the district can be read geographically rather than administratively.

### III. METHODOLOGY

This study is designed as a review article with a district-focused analytical framework. An empirical research article would require block-wise crop-area data, yield series, irrigation coverage by season and source, field-level or village-level observations, and ideally GIS layers for land use, soils, and water access. Because such a dataset has not been supplied, the most defensible methodological choice is a review design that remains transparent about its evidentiary limits while still producing an original district-focused interpretation.

The source base consists of three main categories. First, official district and national agricultural documents were used to establish the baseline structure of South Dinajpur and to situate it within the wider Indian agricultural context. These include the Agriculture Contingency Plan for Dakshin Dinajpur and the Annual Report 2024-25 of the Department of Agriculture and Farmers Welfare. Second, recent peer-reviewed studies were selected to represent the main conceptual debates relevant to the topic: agrarian transition and crop-pattern change, irrigation and agricultural efficiency, agricultural sustainability, crop diversification, and spatial analysis of cropping intensity. Third, district-relevant soil-fertility research from the Barind tract of Dakshin Dinajpur was included to connect district-level agricultural statistics with a concrete biophysical mechanism affecting productivity. (Department of Agriculture & Farmers Welfare, 2025; Government of India, 2011; Malo & Saha, 2025)

The analytical framework used in the article proceeds through four steps. The first step establishes South Dinajpur's aggregate agricultural profile by examining cropping intensity, net sown area, gross cropped area, irrigation extent, irrigation sources, rainfall, and soil distribution. The second step identifies the key explanatory variables emphasized in current literature, namely irrigation intensity, crop diversification, infrastructure, sustainability indicators, and spatial scale. The third step brings the district baseline into dialogue with the peer-reviewed literature in order to identify the likely mechanisms producing divergence between cropping intensity and agricultural productivity. The fourth step formulates a district-specific geographical interpretation that can guide future empirical work. This approach does not claim to measure block-wise differences directly. Instead, it identifies the structures through which such differences are likely to emerge.

The article's conceptual model can be described in sequence. Land pressure and agrarian dependence encourage multiple cropping. Irrigation access determines whether repeated cultivation is stable across seasons. Soil fertility conditions shape how far intensified cultivation can actually sustain output. Crop structure and diversification affect resilience, risk, and value realization. Infrastructural conditions such as roads, storage, and market connectivity influence whether production gains can be consolidated. These variables together produce the observable relation between cropping intensity and productivity. In South Dinajpur, the argument developed here is that they are spatially uneven, which is why district averages alone are insufficient.

The source selection strategy emphasized recent peer-reviewed literature from 2022 onward wherever possible, while retaining older official district records because they remain the clearest accessible district baseline. The official district contingency plan is dated, and this is a limitation, but its core facts on land use, irrigation structure, soils, and rainfall still provide a foundational district profile. Recent peer-reviewed sources were then used to update the analytical interpretation

rather than to replace the district baseline. No human subjects were involved and no primary data were collected, so formal ethical clearance was not required for this review design.

## IV. RESULTS AND THEMATIC ANALYSIS

### 4.1 South Dinajpur as a high-intensity agricultural district

The first major result of the review is that South Dinajpur is unmistakably a high-intensity agricultural district when assessed through district-wide land-use indicators. The official district profile records 188.6 thousand hectares as net sown area, 143.3 thousand hectares as area sown more than once, and 331.9 thousand hectares as gross cropped area, producing a cropping intensity of 176 percent. Compared with the all-India figure of 155.9 percent for 2022-23, the district appears strongly intensified. This confirms that repeated cultivation is not marginal in South Dinajpur but central to its agrarian structure. (Department of Agriculture & Farmers Welfare, 2025; Government of India, 2011)

Yet this first result immediately leads to a second and more significant one: the district's high intensity does not rest on uniformly secure production conditions. The same official profile shows that only 82.54 thousand hectares are net irrigated, while 93.08 thousand hectares are classified as rainfed. Bore wells or shallow tube wells account for the largest share of irrigated area, followed by lift irrigation and tanks, while canal irrigation is absent from the profile. This means that the district's multiple cropping regime is sustained under uneven water conditions. Some localities are likely to enjoy more stable irrigation access than others, and this difference is likely to affect both seasonal continuity and yield performance. (Government of India, 2011)

This relation between intensity and irrigation is consistent with broader Indian evidence. Das et al. show that agricultural efficiency in Karnataka remains significantly connected to irrigation intensity, even though the relationship is not exclusively determined by water. Their findings suggest that irrigation is a major enabling condition for agricultural efficiency, but that its effects are mediated by other inputs and institutional factors. Applied to South Dinajpur, this supports the view that high cropping intensity is likely to conceal a differentiated geography of agricultural performance depending on how reliably local irrigation supports repeated cultivation. (Das et al., 2024)

### 4.2 Land-use intensity is not equivalent to productivity

The second thematic result is conceptual but substantive: cropping intensity in South Dinajpur cannot be treated as a direct proxy for agricultural productivity. The official statistics demonstrate repeated land use, but they do not establish how evenly yields are distributed or how securely repeated cropping is maintained over time. This is why the distinction between land-use frequency and production performance matters. A district may crop land two or three times a year and still display uneven productivity if one part of the district is supported by stronger irrigation and better soils while another is more exposed to rainfall variability and declining nutrient status.

Recent sustainability research reinforces this distinction. Jatav and Naik identify cropping intensity as one indicator among several that influence agricultural sustainability, including irrigation intensity, foodgrain productivity, crop diversification, transport, credit, and social factors. Their framework implies that a high-intensity agrarian system cannot be judged adequately by land-use ratios alone. Productivity and sustainability emerge through a combination of environmental and institutional supports. This is a particularly useful lens for South Dinajpur because the district profile suggests that intensification is structurally significant, but the conditions needed to translate it into uniformly strong productivity are uneven. (Jatav & Naik, 2023)

### 4.3 The spatial filter of irrigation

A third result concerns the geography of irrigation sources. In South Dinajpur, the irrigation profile is not only incomplete but also selective. The district depends primarily on bore wells or shallow tube wells, which account for 53.3 thousand hectares or 57.8 percent of total irrigated area in the district plan, followed by lift irrigation at 22.4 thousand hectares and tanks at 10.36 thousand hectares. Open wells are negligible and canal irrigation is absent in the reported table. Such a structure is important because groundwater-based and lift-based irrigation systems are rarely distributed evenly. Their reach depends on hydrogeology, local investment capacity, access to pumping technology, electricity, and institutional arrangements. Thus, even before block-wise data are assembled, the irrigation-source profile itself suggests that repeated cultivation opportunities must be spatially differentiated. (Government of India, 2011)

This interpretation aligns with broader West Bengal findings. Paria et al. show that irrigation, fertilizer use, road connectivity, and market and storage facilities are major drivers of agrarian transition in favor of non-foodgrains in the state. That result matters because it suggests that irrigation is best seen not as an isolated variable but as part of an enabling geography. Where water access is stronger and infrastructure more supportive, farmers are more able to shift cropping patterns and potentially improve productivity. Where such supports are weak, repeated cultivation may remain narrow, input-stressed, or seasonally insecure. In South Dinajpur, this implies that irrigation likely acts as a spatial filter through which intensification is stabilized in some localities and constrained in others. (Paria et al., 2022)

### 4.4 Crop structure and selective diversification

A fourth result is that South Dinajpur's agricultural intensification appears to be structurally narrow rather than broadly diversified. The district contingency plan does not provide a full crop-area table in the searchable lines used here,

but the cropping contingencies repeatedly foreground rice-based systems such as rice-mustard, rice-wheat or mustard, rice-potato, rice-vegetable, and jute-rice under different soil and irrigation situations. This indicates that the district's intensification is organized largely around rice-led and rice-linked cropping systems rather than around a highly diversified agricultural mosaic. Such a pattern is not inherently unproductive, but it raises concerns about risk concentration, water use, and nutrient withdrawal when repeated cultivation depends heavily on similar rotations. (Government of India, 2011)

The importance of diversification is clear in the regional literature. Nandi et al. show that the Eastern Indo-Gangetic Plain remains highly cereal-centric and argue that increasing crop diversification can improve agricultural sustainability. They also demonstrate that aggregate patterns may make diversification appear moderate even when some districts remain closer to monocropping or weak rotations. This is directly relevant to South Dinajpur. A high district-level cropping intensity may coexist with limited diversity in crop combinations, and such selectivity can shape productivity outcomes. Areas capable of moving into more varied and higher-value crop mixes may perform differently from areas that remain tied to narrower cereal-based sequences. (Nandi et al., 2025)

#### **4.5 Soil fertility and the Barind tract effect**

A fifth and especially important result concerns the soil base of intensified agriculture. Malo and Saha's recent study of the Barind tract of Dakshin Dinajpur explicitly investigates spatial variation in soil fertility parameters under rice-based cropping systems and concludes that the overall soil fertility status is deficient for sustainable rice production. Their article further positions GIS-based mapping and zonal nutrient management as necessary because existing fertility assessment in the Barind area remains insufficiently location-specific. This finding is crucial because it introduces a district-relevant biophysical explanation for why high cropping intensity may not yield evenly strong productivity. (Malo & Saha, 2025)

The significance of this result lies in the way it changes the meaning of intensification. If repeated cultivation occurs on soils that are nutrient-deficient or unevenly managed, then high cropping intensity can become a sign of pressure as much as performance. The Barind tract study points toward precisely this possibility. It suggests that productivity in parts of South Dinajpur may depend not simply on how often land is cultivated, but on whether soil conditions can sustain repeated rice-based production without deeper fertility decline. In geographical terms, this means that agricultural productivity in the district is partly a soil-mediated outcome. Areas with more favorable fertility conditions, or with better capacity for nutrient management, are likely to convert intensity into productivity more effectively than areas where repeated cultivation accelerates nutrient depletion. (Malo & Saha, 2025)

#### **4.6 Why district averages are insufficient**

A sixth result is methodological: district averages are analytically too coarse to explain the relation between cropping intensity and agricultural productivity in South Dinajpur. Nandi et al. show that sub-national crop diversification patterns can obscure district, sub-district, and community-level differences. Pazhanivelan et al. similarly stress the importance of spatial and temporal analysis of cropping patterns and note that resolution becomes more consequential as the study area becomes smaller. Together, these findings strongly suggest that a single cropping-intensity figure for South Dinajpur is useful for comparison but insufficient for explanation. It tells us that intensification exists, but not how it is distributed, how it interacts with water and soils, or where it fails to generate corresponding productivity gains. (Nandi et al., 2025; Pazhanivelan et al., 2025)

The district-focused evidence available outside major journals also points in the same direction. The block-level study by Afzal et al. reports high, medium, and low agricultural-development blocks within Dakshin Dinajpur and attributes weaker performance to deteriorating irrigation, poor water management, infrastructural deficits, and limited technical know-how. Although this source should not be weighted as heavily as the peer-reviewed literature, it nonetheless illustrates the plausibility of intra-district divergence. The district is not functioning as a homogeneous agrarian field. It is better understood as a set of differentiated agricultural spaces linked within one administrative unit. (Afzal et al., 2017)

#### **4.7 A district-specific geographical interpretation**

Taken together, these findings support a district-specific explanatory model. In South Dinajpur, cropping intensity is generated by pressure to maximize the use of a substantial but limited cultivated land base. However, the conversion of repeated cultivation into agricultural productivity is mediated by four unevenly distributed factors: irrigation access, soil fertility, crop diversification potential, and infrastructural support. Irrigation determines whether multiple crops can be reliably sustained. Soil fertility determines whether repeated cultivation can maintain yields without resource exhaustion. Crop diversification influences resilience, value realization, and seasonal flexibility. Infrastructure shapes the practical viability of shifts in crop patterns and the consolidation of production gains. Because these factors are not evenly distributed, agricultural productivity is unlikely to be uniform even where cropping intensity is high.

This district-specific interpretation is the main analytical outcome of the article. It suggests that South Dinajpur should not be read merely as a district of successful intensification, nor merely as a district constrained by irrigation and soils. It is both. Its agricultural geography is defined by the coexistence of strong land-use intensity and uneven enabling conditions. That coexistence is what makes the district a compelling case for geographical analysis.

## V. DISCUSSION

The findings of this review clarify why the relation between cropping intensity and agricultural productivity in South Dinajpur has to be approached geographically rather than administratively. District statistics show a strong intensification profile, but the district's irrigation structure, soil heterogeneity, and likely variation in crop combinations make it improbable that the benefits of this intensification are evenly distributed. In that sense, South Dinajpur exemplifies a broader agrarian pattern visible in parts of eastern India: land is used intensively because it must be, but the capacity to convert intensity into stable productivity depends on local ecological and infrastructural supports. (Das et al., 2024; Government of India, 2011; Paria et al., 2022)

This discussion also highlights the analytical importance of distinguishing productivity from performance averages. A district may appear agriculturally strong because its aggregate cropping intensity is high, yet that same average may be produced by the coexistence of well-performing irrigated localities and weaker rain-dependent or soil-constrained localities. Once the unit of analysis shifts from the district to smaller spatial units, the apparent coherence of the average begins to dissolve. Nandi et al.'s work on diversification across the Eastern Indo-Gangetic Plain is especially valuable here because it shows how easy it is for larger-scale patterns to hide sharp small-scale contrasts. The same insight applies to South Dinajpur's cropping intensity. (Nandi et al., 2025)

The article also contributes to the literature by showing why district-focused agricultural geography should be careful about celebratory interpretations of intensification. High cropping intensity is often presented as evidence of progress, efficiency, or successful agricultural development. In South Dinajpur, that interpretation is only partially correct. High intensity undoubtedly indicates repeated and extensive use of agricultural land, but the district's limited irrigation coverage and emerging soil-fertility concerns suggest that intensity may also reflect pressure on land and resource systems. This is where the sustainability literature becomes important. Jatav and Naik's framework reminds us that agricultural strength is multidimensional. A high-intensity district is not necessarily a fully sustainable or evenly productive district. (Jatav & Naik, 2023; Malo & Saha, 2025)

Another implication concerns the geography of crop choice. The evidence reviewed here suggests that South Dinajpur remains strongly shaped by rice-based and rice-linked cropping systems. Such systems can be productive, but they also make the district sensitive to water availability, nutrient depletion, and climate fluctuations. Paria et al. show that transition toward non-foodgrains in West Bengal depends on a combination of irrigation, fertilizer, roads, markets, storage, and climate conditions. This implies that selective diversification in South Dinajpur is unlikely to be random. It will emerge where supportive conditions allow it. The geography of productivity is therefore also a geography of opportunity: not all localities have the same capacity to intensify, diversify, and realize gains. (Paria et al., 2022)

The role of soil fertility further deepens the geographical reading. The Barind tract evidence is especially important because it grounds the discussion in a district-relevant environmental process rather than an abstract claim. If parts of Dakshin Dinajpur are characterized by deficient soil fertility under rice-based systems, then intensification can become self-limiting unless nutrient management is improved. This means that the relation between cropping intensity and productivity is not just about water or infrastructure. It is also about the metabolic capacity of the soil to sustain repeated cultivation. In practical terms, this implies that two localities with similar cropping frequency may produce different outcomes because one has a more favorable fertility base or better nutrient management. (Malo & Saha, 2025)

The article's broader disciplinary contribution lies in showing how agricultural geography can bridge planning statistics and spatial explanation. Official district data are indispensable, but they rarely explain the internal logic of disparity. Peer-reviewed literature provides the conceptual tools to interpret the same district differently. Once irrigation, scale, diversification, sustainability, and soil fertility are brought together, South Dinajpur appears not as a simple district average but as a layered agrarian space. That interpretive move is what geographical analysis adds. It converts an administrative profile into an explanation of why agricultural performance is likely to vary across space.

## VI. CONCLUSION

This article has argued that the most defensible way to write under the title "Cropping Intensity and Agricultural Productivity in South Dinajpur District: A Geographical Analysis" without an original dataset is as a review article grounded in official district records and current peer-reviewed literature. The review shows that South Dinajpur is a high-intensity agricultural district by aggregate measures, with a cropping intensity of 176 percent, a net sown area of 188.6 thousand hectares, and a gross cropped area of 331.9 thousand hectares. At the same time, the district is only partially irrigated, relies heavily on groundwater-based and lift-based irrigation, and contains soil-fertility constraints that are now being documented in the Barind tract. These conditions make it unlikely that intensification translates uniformly into productivity across the district. (Department of Agriculture & Farmers Welfare, 2025; Government of India, 2011; Malo & Saha, 2025)

The article's central contribution is therefore interpretive. It shows that cropping intensity and agricultural productivity in South Dinajpur should be treated as related but analytically distinct processes. Cropping intensity captures the repeated use of land. Productivity depends on how repeated cultivation is mediated by irrigation, soil fertility, crop

structure, and infrastructure. Because those enabling conditions are unevenly distributed, the district's agricultural geography is best understood as internally differentiated rather than homogeneous. (Das et al., 2024; Jatav & Naik, 2023; Nandi et al., 2025; Paria et al., 2022)

The policy implication is clear. District agricultural planning should not rely only on headline indicators such as cropping intensity. It should identify where intensity is securely supported by irrigation and soils, where it depends on fragile resource conditions, and where limited diversification constrains productivity and resilience. South Dinajpur is a strong example of why spatially differentiated policy is necessary within a single district. Uniform recommendations are unlikely to address the district's actual agrarian diversity. (Government of India, 2011; Malo & Saha, 2025; Paria et al., 2022)

The main limitation of this article is methodological. It does not present block-wise or village-level empirical data, nor does it map actual yield variation through GIS. It therefore cannot quantify the district's internal disparities directly. Its contribution lies instead in showing why those disparities are likely to exist and what structures are most plausibly producing them. That is a useful but incomplete achievement. The article should therefore be read as a framework for empirical work rather than as the final word on South Dinajpur's agrarian geography.

### FUTURE RESEARCH DIRECTIONS

Future research on South Dinajpur should proceed in four directions. First, block-wise empirical analysis is needed to relate cropping intensity directly to crop yield and value data. Second, GIS-based mapping of irrigation sources, cropped area, and seasonal land use should be developed in order to identify the district's actual geography of repeated cultivation. Third, soil-fertility mapping should be extended and linked to crop performance so that the ecological basis of productivity variation can be measured rather than inferred. Fourth, research should examine whether localities with greater crop diversification display more stable or more remunerative productivity trajectories than localities that remain narrowly rice-based. These steps would allow the present review framework to be tested empirically and would move the study of South Dinajpur from district description to robust spatial explanation. (Afzal et al., 2017; Malo & Saha, 2025; Nandi et al., 2025; Pazhanivelan et al., 2025)

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