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Rice Production, Land Utilization and Agricultural Intensification in Kono District Compared with the Eastern Region of Sierra Leone: Evidence from the 2024 Annual Agricultural Survey

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Abstract: Rice is central to food consumption and smallholder livelihoods in Sierra Leone, making evidence on participation, cultivation timing and production systems important for agricultural planning. This study compares rice-farming participation, cultivation cycles, rice-variety patterns and growing periods in Kono District and the Eastern Region using published results from the 2024 Sierra Leone Annual Agricultural Survey (SLAAS). A descriptive comparative design was applied to published survey tables, with percentages and figures used to clarify patterns. The survey reports 84,164 agricultural holdings cultivating rice in Kono, compared with 233,993 in the Eastern Region. Kono accounts for approximately 36.0% of regional rice-cultivating holdings. Kono, Kailahun and Kenema each recorded an average of 1.2 completed rice-cultivation cycles, while the mean interval between cycles was 8.7 weeks in Kono, 6.8 weeks in Kailahun and 16.9 weeks in Kenema. Regional data show Rok 34 and other varieties are prominent in the Eastern Region, while reported growing periods for several varieties differ from national averages. These results describe participation and timing, not comparative yields or causal effects. The study concludes that Kono has a substantial rice-farming base and that locally targeted improvements in water management, seed quality, agronomic practices and post-harvest systems merit attention. However, the published tables do not provide all key indicators, particularly Kono specific rice area, output, yield, profitability and household food-security outcomes is needed to establish relative productivity. The paper recommends further district-level analysis using survey micro-data and farm-level validation.

Keywords: *Rice Production; Land Utilization; Agricultural Intensification; Kono District.*

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I. INTRODUCTION

Agriculture is a major livelihood activity in Sierra Leone and a foundation for food security, employment and rural development. The 2024 Sierra Leone Annual Agricultural Survey was designed to strengthen evidence for agricultural policy through information on crop production, production methods, land management and environmental conditions (Statistics Sierra Leone [Stats SL] & Ministry of Agriculture and Food Security [MAFS], 2024). Rice is particularly important: SLAAS identifies it as the most widely cultivated crop, with 714,821 agricultural holdings reporting rice cultivation nationally (Stats SL & MAFS, 2024).

Rice production depends not only on the number of farmers involved, but also on cultivated area, variety suitability, water availability, soil conditions, labour, inputs and the timing and management of cultivation. Research across sub-Saharan Africa documents how drought, flooding, soil constraints and inadequate water control can contribute to yield gaps. It also identifies improved water management and integrated good agricultural practices as potential routes to sustainable rice production, although performance depends on local production environments and implementation conditions (Dossou-Yovo et al., 2022; van Oort et al., 2022a).

Kono District forms part of Sierra Leone's Eastern Region alongside Kailahun and Kenema. Comparing Kono with the region can help identify whether rice-farming

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participation and cultivation timing resemble or differ from neighbouring districts. However, the Eastern Region total includes Kono; it is therefore not an independent comparison group. Some SLAAS indicators are also reported only at regional or national level. This paper distinguishes district-level statistics from regional and national results and does not treat regional varietal data as Kono-specific.

The study uses descriptive comparisons. Tables present core indicators, while figures make cross-district differences and regional varietal patterns easier to interpret. The design cannot demonstrate that a shorter interval between rice cycles causes higher yields, nor can participation counts alone establish productivity or household food security.

Sustainable intensification. Sustainable intensification literature stresses that productivity gains should be assessed alongside environmental and social outcomes, rather than through output alone (Pretty et al., 2011; Pretty & Bharucha, 2014). Evidence across farming systems also indicates that diversification can support multiple ecosystem services, although outcomes depend on design and context (Tamburini et al., 2020).

Sustainable agricultural intensification seeks to improve output and resource-use efficiency while avoiding unnecessary environmental damage. In rice systems, higher production may result from improved crop management, suitable varieties, reliable water control, and better soil fertility and reduced post-harvest losses rather than simply expanding cultivated land. A review of African rice research found that integrated good agricultural practices can help close yield gaps, while noting that evidence and interventions vary across irrigated lowland, rainfed lowland and upland systems (van Oort et al., 2022a, 2022b).

Water management and cultivation cycles. Studies of rice systems in sub-Saharan Africa similarly emphasise the need to evaluate yield, profitability, labour productivity and nutrient-use efficiency together when assessing sustainability (Arouna et al., 2021).

The number of completed rice-cultivation cycles and the interval between cycles are useful descriptive indicators of cultivation timing, but they are not direct measures of yield or profitability. Water-related constraints such as drought, flooding, iron toxicity and salinity can affect rice production in different environments. A review by Dossou-Yovo et al. (2022) discusses water-control structures, the Smart-Valleys approach, supplemental irrigation and other context-specific measures, while identifying the need for stronger evidence on costs, adoption and scaling.

Varietal choice and growing periods. The role of varietal and management choices is also consistent with research on rice yield gaps, which finds that integrated good agricultural practices and locally appropriate technologies are important for narrowing gaps (Dossou-Yovo et al., 2020; van Oort et al., 2022a, 2022b).

Rice varieties differ in growing duration and adaptation. A shorter growing period may offer scheduling advantages, but duration alone does not establish superiority: yield potential, grain quality, stress resistance, seed availability, consumer preference and management requirements also matter. Since SLAAS reports variety shares and growing periods at regional level, these statistics frame questions for Kono but cannot identify the varieties or growing periods used by Kono farmers.

Research gap. These limitations matter because earlier research in Sierra Leone shows considerable diversity in smallholder rice strategies, underscoring the need for farm-level data before generalising about performance (Chenoune et al., 2016).

The published SLAAS tables provide information on rice-cultivating holdings, average cycles, intervals, regional variety shares and growing periods, and national rice area, production and yield. They do not provide a complete district-specific set of rice area, output, yield, profitability and household food-security outcomes in the tables used here. The gap is therefore a lack of a complete, directly comparable district-level indicator set for judging Kono's rice productivity in its regional context.

The policy relevance of these questions is reflected in Sierra Leone's Feed Salone strategy, which places agricultural productivity and food security at the centre of national development priorities (Government of Sierra Leone, 2023). Evidence from Sierra Leone also shows that rice-farm performance depends on the interaction of farm structure, production ecosystems, labour, market orientation and crop choices rather than on a single indicator alone (Chenoune et al., 2016). Research on improved rice varieties further demonstrates that adoption is shaped by land tenure, agro-ecological conditions and farmer circumstances (Mansaray et al., 2019; Kamanda et al., 2022). Kono's wider mining landscape is a relevant local planning context because mining-edge communities in Sierra Leone have reported environmental pressures, including farmland loss and water constraints; however, the present analysis does not estimate a causal effect of mining on rice outcomes (Mabey et al., 2020).

➢ *Objectives of the Study*

The overall aim of the study is to assess agricultural land-use efficiency and cropping-system diversification as pathways to sustainable agricultural intensification in Kono District, Sierra Leone, while considering the implications of mining-related land degradation for agricultural land resources.

The study seeks to:

- Assess agricultural land-use efficiency in Kono District.
- Examine cropping systems and diversification in Kono District.
- Assess the implications of mining-related land degradation for agricultural land use in Kono District.
- Propose strategies for sustainable agricultural intensification in Kono District.

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II. STUDY METHODOLOGY

➢ *Research Design*

The study adopted a descriptive and analytical secondary-data research design. The principal quantitative data source was the 2024 Sierra Leone Annual Agricultural Survey, supplemented by peer-reviewed literature and other published evidence concerning mining-related land degradation and sustainable agricultural intensification.

A secondary-data design was appropriate because the objective was to interpret existing district-level agricultural statistics rather than generate new household observations. The approach also permits comparison between Kono and other districts using a common national statistical framework.

➢ *Study Location*

The study focused on Kono District in the Eastern Region of Sierra Leone. Kono is an agriculturally important district with a long history of diamond mining. Its agricultural landscape is therefore characterized by the interaction of farming, settlement, natural-resource use and mineral extraction.

The mining history of Kono is particularly relevant because research in mining-edge communities has documented land degradation, loss of farmland, vegetation disturbance and other environmental changes associated with mining activities (Conteh et al., 2020). The present study does not, however, assume that every difference between agricultural area and planted area in the SLAAS data is caused by mining.

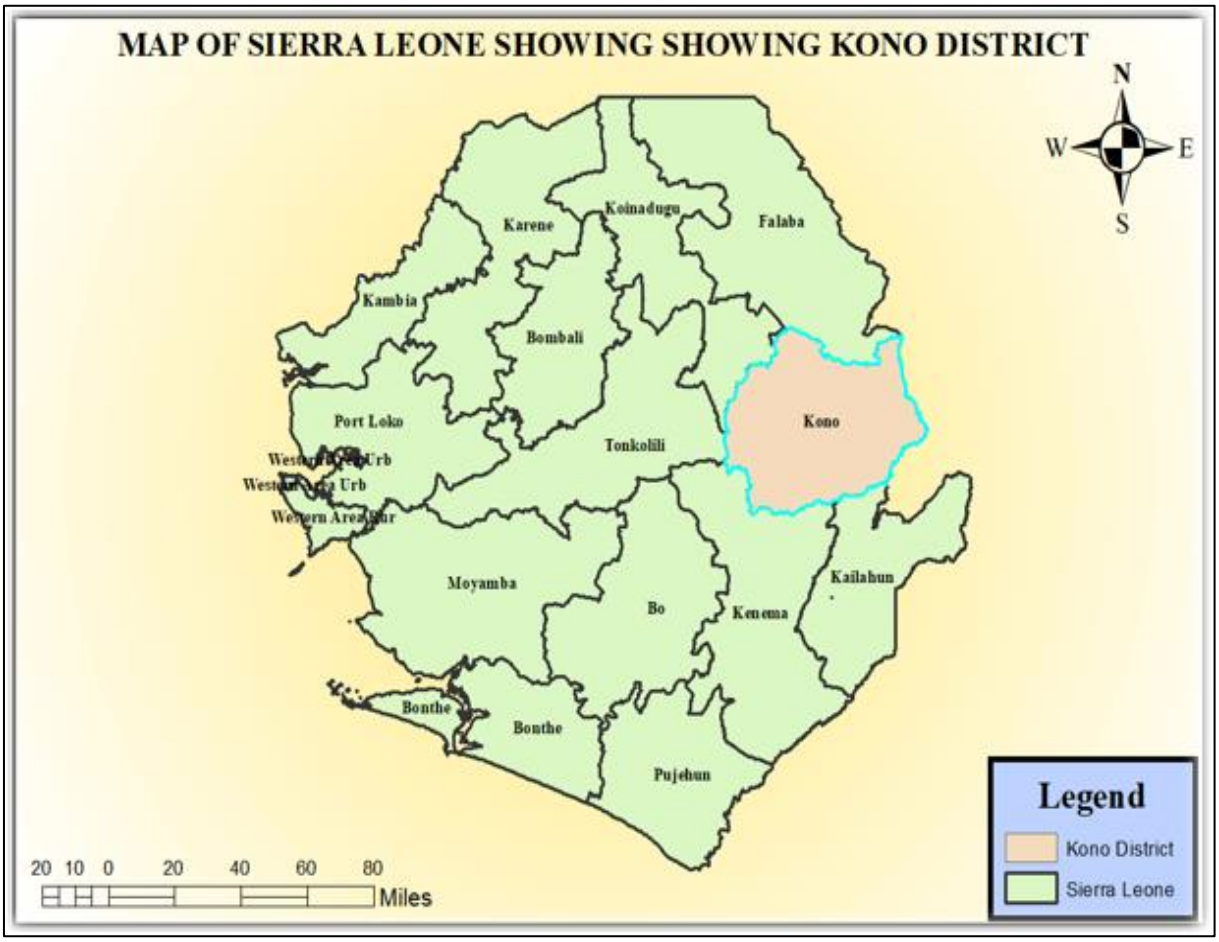


Fig 1 Map of Siera Leone Showing Kono District.

➢ *Study Population, Sample Frame and Sample Size*

The SLAAS 2024 sampling frame was derived from the 2023 Sierra Leone Listing Survey. The national survey employed a two-stage design in which enumeration areas were selected first and agricultural households or holdings were subsequently selected within the sampled areas.

Kono was represented by 65 enumeration areas, comprising 62 rural and 3 urban enumeration areas, with approximately 10 farming households targeted per enumeration area. The Kono survey design therefore provided a broad district-level representation of agricultural households.

The present research does not treat the approximately 650 targeted Kono households as 650 independent observations because the published district tables do not provide the household-level records required for such an analysis. Instead, the study uses the officially published Kono district estimates.

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➢ *Sampling Techniques*

The original SLAAS employed stratified two-stage random sampling. Stratification was used to ensure geographic representation, followed by selection of enumeration areas and agricultural households.

For this secondary-data study, no additional household sampling was undertaken. Kono was selected purposively as the analytical case because of its combination of agricultural activity and long-standing mining-related land-use pressures.

➢ *Data Analysis*

The analysis was deliberately restricted to indicators that can be calculated reliably from the published SLAAS district-level statistics. The study does not estimate technical efficiency, economic efficiency or causal effects because the published data do not contain the necessary household-level production and input variables.

- *Land-Use Ratio*

$$LUR = (APA / AAA) \times 100$$

LUR is the land-utilization ratio; APA is average planted area; AAA is average agricultural area. It measures the share of reported agricultural area planted during the reference period.

- *Apparent Unplanted Area*

$$AUA = AAA - APA$$

AUA is the difference between average agricultural and planted area. It is descriptive and does not identify why the area was not planted.

- *Apparent Unplanted Proportion*

$$AUP = [(AAA - APA) / AAA] \times 100$$

AUP expresses the apparent unplanted area as a percentage of agricultural area.

- *District Comparative Land-Use Ratio*

$$LUR^d = (PA^d / AA^d) \times 100$$

This permits comparison of Kono with other districts using the same published measures.

- *Cropping-System Diversification*

$$DCS = MC + IC$$

DCS is the diversified cropping-system share; MC is mixed cropping and IC is intercropping.

- *Diversification Gap*

$$DG = DCS_{kono} - DCS_{national}$$

A negative value indicates lower diversification in Kono than nationally.

The indicators are interpreted as descriptive measures rather than causal or econometric estimates. A complete efficiency analysis would require household-level information on output, land, labour, seed, fertilizer, pesticides, machinery, capital and production costs.

III. RESULTS AND DISCUSSIONS

This section presents and discusses the findings on agricultural land-use efficiency, cropping-system diversification, and their implications for sustainable agricultural intensification in Kono District. The analysis draws primarily on the 2024 Sierra Leone Annual Agricultural Survey (SLAAS) and compares Kono's indicators with national and district-level patterns. Particular attention is given to the extent of agricultural land utilization, the prevalence of different cropping systems, and the contextual implications of mining-related land degradation for the sustainable use of agricultural resources. The findings are interpreted in relation to the principles of sustainable agricultural intensification and relevant empirical literature.

➢ *Agricultural Land Use in Kono*

This section examines the extent to which agricultural land in Kono District is being utilized for crop production. The analysis compares the average agricultural area and planted area to determine the level of land utilization and the apparent proportion of land not planted.

Table 1 Authors' Calculations from Stats SL & MAFS (2024).

Indicator	Kono District	Sierra Leone
Average agricultural area (ha)	2.9	1.7
Average planted area (ha)	1.9	1.2
Apparent unplanted area (ha)	1.0	0.5
Land-utilization ratio (%)	65.5	70.6
Apparent unplanted proportion (%)	34.5	29.4

Kono's average agricultural area of 2.9 hectares is substantially above the national average of 1.7 hectares, while its average planted area of 1.9 hectares is also above the national average of 1.2 hectares.

The calculated land-utilization ratio is 65.5% in Kono compared with 70.6% nationally, giving Kono a gap of approximately 5.1 percentage points.

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The apparent unplanted area is 1.0 hectare, equivalent to 34.5% of the average agricultural area. This must not be interpreted as permanently idle land because the survey does not identify the reasons for non-planting.

The finding suggests that Kono's challenge is not simply lack of agricultural land. The policy question is why suitable land is not fully utilized and whether productivity can be raised on land already available.

➢ *Cropping Systems and Diversification*

This section assesses the dominant cropping systems practiced in Kono District and the extent to which farmers combine crops through intercropping and mixed cropping. The findings are compared with the national pattern to highlight Kono's level of cropping-system diversification.

Table 2 Authors' Calculations from Stats SL & MAFS (2024).

District	Agricultural area (ha)	Planted area (ha)	LUR (%)
Kailahun	3.2	2.2	68.8
Kenema	1.8	1.2	66.7
Kono	2.9	1.9	65.5
Bombali	1.4	1.0	71.4
Falaba	2.0	1.8	90.0
Koinadugu	0.9	0.7	77.8
Tonkolili	1.5	1.0	66.7
Kambia	0.8	0.4	50.0
Karene	1.2	0.8	66.7
Port Loko	1.2	0.7	58.3
Bo	1.8	1.1	61.1
Bonthe	1.7	1.0	58.8
Moyamba	1.4	1.0	71.4
Pujehun	2.2	1.6	72.7
Western Rural	0.4	0.1	25.0
Sierra Leone	1.7	1.2	70.6

The district comparison shows considerable variation in the relationship between agricultural and planted area. Kono's calculated land-utilization ratio of approximately 65.5% places it below the national average and below several districts, although it remains above some districts such as Kambia, Port Loko, Bonthe, Bo and Western Rural.

An important implication is that agricultural land availability alone does not explain differences in land utilization. For example, Kono has a considerably larger average agricultural area than several districts with lower land-utilization ratios, yet its utilization ratio remains below that of districts such as Falaba, Koinadugu, Bombali and Pujehun. This suggests that land-use intensity is shaped by multiple factors beyond landholding size.

For Kono, these factors may include the physical condition and suitability of agricultural land, access to labour and inputs, production risks, market incentives and the legacy of competing land uses. The available SLAAS data cannot identify the relative contribution of each factor. Further household-level research is therefore required to determine why some agricultural land is not planted and whether the unplanted portion represents fallow land, degraded land or land reserved for other purposes.

➢ *Implications of Mining-Related Land Degradation*

This section discusses mining as an important contextual pressure on agricultural land resources in Kono District. It relates documented evidence of land degradation and farmland loss associated with mining to the broader challenge of maintaining productive and sustainable agricultural land.

Table 3 Authors' Calculations from Stats SL & MAFS (2024).

Cropping system	Kono (%)	Sierra Leone (%)	Difference (percentage points)
Pure stand	86.5	80.0	+6.5
Mixed cropping	12.4	19.1	−6.7
Intercropping	1.2	0.9	+0.3
Diversified systems	13.6	20.0	−6.4

Government and private interventions form the backbone of livestock sector development, but their effectiveness depends on scale, coordination, and responsiveness to farmer needs. A robust regulatory environment and incentives for private investment would further stimulate competition and innovation in feed, breeding, and veterinary supplies. The data therefore call for a shift from fragmented initiatives to integrated, multi-stakeholder platforms. Pure-stand cultivation dominates Kono, accounting for 86.5% of reported plots, compared with 80.0% nationally. Mixed cropping accounts for 12.4%

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compared with 19.1% nationally, while intercropping accounts for 1.2%.

Combining mixed cropping and intercropping gives a diversified-cropping share of 13.6% in Kono compared with 20.0% nationally, a 6.4-percentage-point gap.

This indicates relatively limited plot-level diversification. It does not mean that Kono households lack diversity across plots, rotations, livestock or tree crops because the published table does not provide a household-wide diversification index.

The high prevalence of pure stands provides scope for testing appropriate mixed cropping, intercropping, rotations, crop-livestock integration and agroforestry where these systems are agronomically and economically suitable.

Diversification should not be promoted automatically. Evidence indicates potential benefits for ecosystem services, but outcomes depend on local conditions, and labour requirements and gender implications must be considered (Tamburini et al., 2020; Teklewold et al., 2013).

- *Mining-Related Land Degradation and Agricultural Land Use*

Identifying growth potential helps guide policy, investment, and practical interventions for sustainable livestock development.

Kono's agricultural land-use situation needs to be interpreted within its broader land-use history. Mining has been a major economic activity in the district for decades, particularly diamond mining. The environmental implications of mineral extraction have included land disturbance, vegetation loss and changes in the availability and quality of agricultural land.

Evidence from research conducted in mining-edge communities in Sierra Leone reports substantial perceptions of land degradation in Kono and identifies loss of farmland, vegetation disturbance and declining availability of suitable agricultural land among the environmental consequences associated with mining (Conteh et al., 2020). The study also reports that mining-related disturbances have affected local livelihoods and generated land-use conflicts.

More recent evidence focused specifically on Kono similarly reports relationships between environmental degradation, mining and livelihood losses, including reductions in the quantity and quality of land available for farming (Wilson et al., 2026). Such findings reinforce the importance of land rehabilitation and environmental management in areas where mining and agriculture coexist.

However, an important analytical distinction must be maintained. The SLAAS 2024 statistics showing a 2.9-hectare average agricultural area, a 1.9-hectare average planted area and a calculated 34.5% apparent unplanted proportion do not establish that mining caused the apparent unplanted area. The SLAAS district tables do not contain the household-level spatial or historical information required to estimate such a causal relationship.

Consequently, mining is best interpreted in this study as a contextual land-use pressure rather than as a statistically estimated determinant of the SLAAS land-utilization gap.

This distinction strengthens rather than weakens the argument for sustainable intensification. The available evidence suggests that Kono's agricultural development has to occur within a landscape where parts of the land resource have experienced historical disturbance. Sustainable intensification should therefore include not only increased production on suitable land but also restoration and protection of the natural-resource base.

The implication is particularly important because simply expanding cultivation into previously uncultivated areas may reproduce environmental pressures rather than solve the agricultural productivity problem. Sustainable intensification emphasizes increasing production while avoiding adverse environmental effects and unnecessary conversion of additional land (Pretty & Bharucha, 2014). In a mining-affected landscape, this means that agricultural intensification should be accompanied by land rehabilitation, soil restoration, erosion control, water protection and appropriate land-use planning.

IV. CONCLUSION

This study examined agricultural land-use efficiency and cropping-system diversification as pathways to sustainable agricultural intensification in Kono District, Sierra Leone, using evidence from the 2024 Sierra Leone Annual Agricultural Survey and supporting literature. The results indicate that Kono has a relatively large average agricultural land base but a lower calculated land-utilization ratio than the national average. The difference between agricultural and planted area should not be interpreted as wasted or permanently idle land because the available data do not identify the reasons for non-planting. Instead, the finding points to the need for further investigation into land suitability, fallowing, labour, inputs, market incentives, land condition and other constraints.

The study also found that Kono's cropping system is strongly dominated by pure-stand cultivation, while mixed cropping and intercropping constitute a smaller proportion than the national average. This suggests potential for appropriately designed diversification, although diversification should be based on agronomic suitability, profitability and local farmer preferences rather than treated as an automatic solution.

Mining provides an important contextual dimension. Independent evidence demonstrates that mining-related land degradation and farmland loss have affected parts of Kono, but the SLAAS data do not establish a causal relationship between mining and the district's apparent unplanted area. Sustainable intensification in Kono should therefore combine improved productivity on suitable existing farmland with

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rehabilitation of degraded land, soil fertility management, appropriate cropping diversification, stronger extension and improved market access. The central policy objective should be more productive agriculture without reproducing the environmental degradation associated with unsustainable land use.

RECOMMENDATION

The findings indicate that improving agricultural performance in Kono requires an integrated approach that combines more efficient use of existing agricultural land with soil restoration, appropriate cropping-system diversification, and measures that address the pressures associated with mining-related land degradation. Accordingly, the following key recommendations are proposed:

- Farmers should be supported with improved planting materials, soil fertility management, extension services, and appropriate technologies to increase productivity without placing additional pressure on already degraded or environmentally sensitive land.
- Government, mining companies, local authorities, and communities should strengthen the reclamation of mining-degraded land and integrate agricultural and mining activities into coordinated land-use planning to protect productive agricultural areas.
- Agricultural extension services should encourage suitable mixed cropping and intercropping systems that improve resource use, strengthen soil health, diversify production, and reduce production risks.
- Farmers should be supported to adopt soil-conservation, organic matter management, erosion-control, and water-management practices to maintain the long-term productivity of agricultural land.
- Kono District should strengthen the collection and regular updating of information on agricultural land, cropping patterns, degraded areas, and changes in land use to support evidence-based agricultural and environmental planning.

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