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OPERATIONAL HOLDING AND FARM CHARACTERISTICS IN BARAK VALLEY AGRO-CLIMATIC ZONE OF ASSAM

[*]Ujjal Deka Baruah, Jyotimala Doley and Nitashree Mili
Department of Geography, Cotton University, P.O Panbazar, Guwahati-781001, India
udbmail@cottonuniversity

ABSTRACT
This study provides a detailed analysis of operational holding and farm characteristics in the Barak Valley agro-climatic zone of Assam, focusing on the impact of natural factors on agricultural practices. The region's unique agricultural landscape, nourished by the Barak and Brahmaputra rivers, experiences annual floods that enrich the alluvial floodplains with vital nutrients, enabling agriculture with minimal inputs. The paper emphasises the need for farming system research in different agro-climatic regions to effectively plan for agricultural development. The study reveals significant shifts in the distribution of farmers across different operational holding classes over 20 years, indicating a drastic change in the agricultural system attributed to severe consecutive floods and low-intensity droughts. The research provides valuable data on farm characteristics, operational holding per capita, and the prevalence of rice cultivation among farmers in the Barak Valley Zone, shedding light on the dynamics of land use and agricultural practices in the region. The findings underscore the importance of understanding and leveraging the comparative technological and economic advantages of the Barak Valley agro-climatic zone. Overall, this study offers a comprehensive overview of the operational holding and farm characteristics in the Barak Valley, highlighting the unique agricultural dynamics shaped by natural factors and the need for tailored agricultural development strategies in the region.

1 INTRODUCTION
The Barak Valley agro-climatic zone of Assam is dominated by small-scale, diverse farming systems where farmers conserve agrobiodiversity by cultivating both traditional and modern rice varieties (Das & Das, 2006). Marginal landholdings, often one bigha or less, and the management of Imperata grasslands for subsistence and income are typical (Astapati & Das, 2023). Duck rearing, especially the native Nageswari breed, is important in Cachar and Karimganj districts (Zaman et al., 2005). Socioeconomic challenges such as low literacy and limited infrastructure persist (Astapati & Das, 2023), and similar constraints affect other Assam districts, where land use and agricultural schemes shape the agro-economic landscape (Das & Saikia, 2020).

Farmers have noticed significant climate changes over the last two decades, including warmer temperatures, erratic rainfall, and more frequent droughts, floods, and cyclones (Rakib & Anwar, 2016; Panda & Singh, 2016; Uddin et al., 2017). These changes have caused crop failures and increased disease incidence (Panda & Singh, 2016). Adaptations include shifting planting dates, reducing irrigation, and seeking non-farm work, but barriers such as lack of information and resources remain (Panda & Singh, 2016). Perceptions of climate change are shaped by education, farm size, income, and training (Uddin et al., 2017). Hazardous pesticide use without adequate protection is common, harming farmers' health (Dey et al., 2013).

The Barak and Brahmaputra rivers bring both fertility and destructive floods, which, despite causing losses, replenish soil nutrients and enable rice cultivation with minimal inputs. Assam's fertilizer use is much lower than in leading agricultural states (Thokchom, 2015; DoF, 2015). To address local constraints, region-specific farming research and agro-ecological zoning are needed to leverage natural endowments and improve agricultural systems (Bhowmick et al., 1999; Mawusi, 2004). However, Barak Valley's economy is predominantly agrarian, with over 70% of people relying on farming, mainly rice. Only 30.9% of the land is cultivated, resulting in high population pressure on farmland (Ghosh, 2013; Das, 2012). Agricultural productivity is higher than the Assam average but below national standards due to limited adoption of high-yielding varieties and modern inputs (Roy & Bezbaruah, 2000; Hussain, 2022). Socioeconomic obstacles like low literacy, poor infrastructure, and fragmented holdings continue to hinder progress, though improved resource management and technology could enhance efficiency

(Hussain, 2022). The link between agriculture, human development, and poverty reduction is central to the region's sustainability (Ghosh, 2013; Das, 2012).

In this study, in relation to the farm characteristics, farmers' responses are assessed to explore the status and reconstruct the past and present scenario of agricultural development in Barak Valley agro-climatic zone.

2 BARAK VALLEY AGRO-CLIMATIC ZONE

The agro-climatic regionalisation of Assam, as established by Barthakur et al. (1985), Bhowmick et al. (1999), and Phukan (1990), serves as the foundation for assessing farm characteristics (Hussain, 2022). Bhowmick et al. (1999) divided Assam into six agro-climatic zones based on factors like topography, ecology, and climate, which influence land use, crop mix, and productivity. These zones include the Barak Valley Zone, Central Brahmaputra Valley Zone, Lower Brahmaputra Valley Zone, North Bank Plain Zone, Upper Brahmaputra Valley Zone, and Hills Zone. Farming system research in these zones focuses on areas with homogeneous natural resources, cropping patterns, and socio-economic conditions (Bhowmick et al., 1999; Bora & Bhattacharyya, 2017; Das & Bhattacharjee, 2018). The Barak Valley agro-climatic zone, detailed by Bhowmick et al. (1999), covers Cachar, Hailakandi, and Karimganj districts, spanning about 6,922 km² (Choudhury et al., 2016). This region features varied physiography, such as hills, plains, valleys, and floodplains (Devi et al., 2013; Laskar & Phukon, 2014), and has a subtropical, warm, and humid climate with annual rainfall around 2,226 mm and temperatures ranging from 20.3°C to 30.5°C (Choudhury et al., 2016; Deb & Sil, 2019; Tripathi & Pandey, 2023). These conditions support diverse crops, including rice, tea, and horticultural produce (Ahmed et al., 2009; Pathak et al., 2018; Borah et al., 2016; Devi & Das, 2010).

Soils range from sandy loams to clay, with pH 4.5–6.0, and include old alluvium, red soils, and peat soils (Astapati & Das, 2015; Choudhury et al., 2016; Choudhury et al., 2020). Forests cover about 52.2% of the area, tea plantations 4.2%, and net sown area is 33.08% (Choudhury et al., 2016; Devi et al., 2012). Shifting cultivation is practiced by indigenous tribes in hill tracts, with mixed cropping of colocasia, ginger, turmeric, and spices (Astapati & Das, 2015; Mishra & Rajan, 2020; Chanu et al., 2013). The Barak Valley is further divided into five agro-ecological situations, each supporting specific cropping systems (Devi et al., 2013; Astapati & Das, 2015; Kalita et al., 2022; Chanu et al., 2023). Agricultural productivity is shaped by climate change, soil fertility, and land use, with rising temperatures and altered rainfall negatively impacting yields (Ahmed et al., 2009). Farmers' adaptation strategies to climate change are vital for sustainable agriculture in the region (Astapati & Das, 2015; Nath et al., 2012; Ghosh, 2013; Majumder et al., 2019).

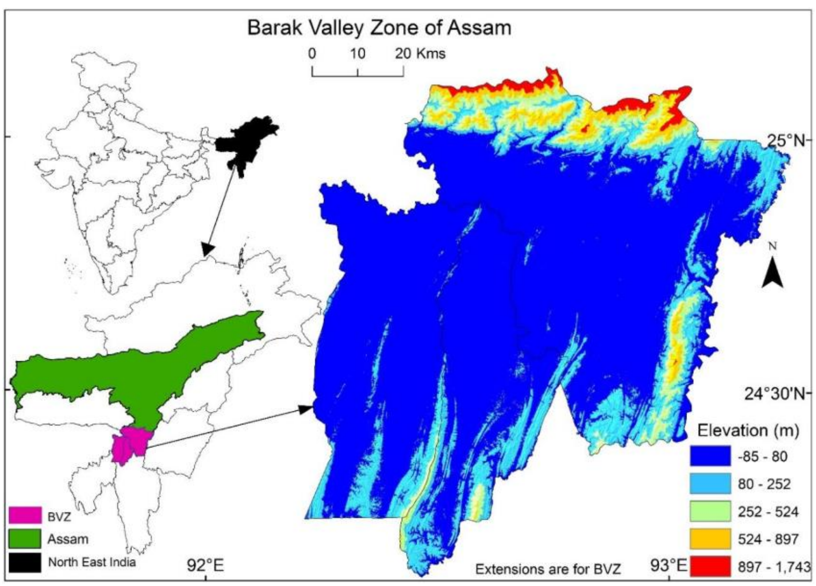

Fig 2 Location and elevation map of the Barak Valley Zone (BVZ) of Assam

3. DATA AND METHODS

3.1 Survey of Farmer Perceptions in Barak Valley

For this study, a total of 216 farmers were surveyed across two sample villages in the Cachar district of the Barak Valley agro-climatic zone of Assam.

Table 1 Sample survey farm characteristics in BVZ, 2015-16

Agro-climatic zone	Farmers (Number)	Area (Ha)	Operational holding per capita
BVZ	216	244	1.13

Source: field survey

A field survey was conducted in two to four villages per agro-climatic zone, selected for their agro-ecological representation and accessibility. The process involved collaboration with field agents, Krishi Vigyan Kendras, Assam Agriculture University, and the Assam Agricultural Department. Farm sites were chosen based on four criteria: (1) predominantly rainfed systems with minimal irrigation, (2) at least 50% of holdings under 2 hectares, (3) farmers aged 40–69 with substantial exposure to climate variability, and (4) respondents with at least 20 years of continuous farming in the locality. This focus on rainfed and smallholder agriculture reflects the vulnerability of the region to erratic monsoons and the predominance of marginal and small farmers, who comprise over 85% of Barak Valley's farming population. The age and experience requirements ensured that participants could reliably compare long-term changes in climate and agricultural practices. Farmers were classified following an adapted Primdahl and Kristensen (2011) typology: (1) full-time farmers (under 69, no non-farm income), (2) part-time farmers (under 69, non-farm income less than farm income), (3) hobby farmers (under 69, non-farm income exceeds farm income), and (4) pensioners (60+, receiving pensions). A multilingual questionnaire (Assamese, Bengali, English) was administered in 2015–2016, focusing on perceptions of climate trends, productivity, and cropping shifts. Farmers provided 20-year recall data on land, production, and cropping, with responses coded categorically ("1 = Agree", "2 = Disagree", "3 = Undecided") as per Damodaran (2014). The sample size (n = 216) was suitable for exploratory analysis, though slightly below the ideal (n = 384) for 95% confidence as per Krejcie and Morgan (1970), but still allowed for valid descriptive and inferential insights within the zone.

3.2 Agricultural operational land holding

A systematic survey was conducted during 2015–16 in two villages of Cachar district, Assam, to estimate changes in acreage, production, and landholding over a 20-year period, based on the recall and mental estimation abilities of 216 farmers. The selected villages were Kashipur and Durgapur, both located in Silchar Tehsil. Kashipur is situated 7 km from Silchar, the district and sub-district headquarters, and falls under Borkhola gram panchayat as per 2009 statistics. Durgapur, also in Silchar Tehsil, is approximately 15 km from Silchar and is administered by Barjatrapur gram panchayat. Durgapur covers a total geographical area of 204.28 hectares and, according to the latest census, has a population of 2,038 people living in about 450 households. The survey relied on primary data collection through structured interviews, allowing for an assessment of long-term changes in farm structure and productivity at the village level

Table 2 Sample village sites in BVZ

Districts	Village name	Block name	Farmers/FGD	Farmers
Cachar	Kashipur	Silchar	15	216
	Durgapur	Silchar	12	

*FGD- Focal group discussion

4. RESULTS

4.1 Pattern of Operational Holdings

The average operational holding in Barak Valley's sample villages was 1.13 hectares during the 2011 agricultural census, marginally surpassing Assam's state average of 1.10 hectares for 2010–11. Scientific scrutiny of the landholding classification (Table 3) reveals a pronounced concentration of marginal farmers, who constitute 71.76% of the 216 surveyed farmers. This overwhelming presence of marginal holders is a direct consequence of land fragmentation, a common phenomenon in regions with high population density and limited cultivable land, as is evident in Barak Valley where only 30.9% of the geographical area is net sown-significantly lower than Assam's 41.6% average (Ghosh, 2013).

Small farmers (operational holdings less than 2 hectares) comprise 14.81% of the total, and together with marginal farmers, they account for 86.57% of all surveyed farmers, aligning with land ceiling legislation definitions. Notably, there were no large farms among the sample, highlighting the structural absence of scale economies in the region's agriculture. Small farmers' land constitutes 23.33% of the total surveyed area, while semi-medium and medium farmers hold 28.65% and 22.10% respectively, indicating that a relatively small group of farmers controls a disproportionate share of land resources (Table 3). Per capita operational holding further underscores this disparity: 86.57% of farmers (small category) average only 0.64 ha each, while semi-medium (10.65%) and medium (2.78%) farmers hold 3.04 ha and 9 ha per capita, respectively. The scientific implication is clear-resource-poor farmers dominate numerically but operate at a severe land disadvantage, which constrains their ability to adopt high-cost, high-yielding technologies and limits their productivity (Hailakandi Agriculture Dept., 2022; Roy & Bezbaruah, 2000). The average per capita operational holding for all sample farmers remains at 1.13 ha, reflecting the overall small-scale nature of agriculture in Barak Valley.

This landholding pattern has significant consequences for agricultural development. Marginal and small farmers, who form the backbone of the region's agrarian structure, face systemic barriers to mechanization, credit access, and adoption of modern inputs, thereby perpetuating low productivity and rural poverty (Ghosh, 2013). Scientifically, such fragmentation leads to suboptimal land use, increased pressure on resources, and challenges for sustainable intensification. The absence of large farms also means that the benefits of economies of scale-such as efficient input use and better market access-remain largely unrealized in the Barak Valley context (Roy & Bezbaruah, 2000)

Table 3 Operational holding characteristics of sample farms in selected villages

2015-2016							
Sl.No	Class of operational holding	Size (Ha)	Farmers		Area		Per capita operational holding (Ha)
			number	in (%age)	in (Ha)	in (%age)	
		<0.5	95	43.98	37.00	15.15	0.39
		0.5-1	29	13.43	26.30	10.77	0.91
1	Marginal	<1	155	71.76	63.30	25.91	0.41
2	Small	1-2	32	14.81	57.00	23.33	1.78
3	1+2	<2	187	86.57	120.30	49.24	0.64
		2-3	15	6.94	40.00	16.37	2.67
		3-4	8	3.70	30.00	12.28	3.75
4	Semi-Medium	2-4	23	10.65	70.00	28.65	3.04
		4-5	5	2.31	26.60	10.89	5.32
		5-7.5	1	0.46	5.10	2.09	5.10
		7.5-10	0	0.00	0.00	0.00	0.00
5	Medium	4-10	6	2.78	54.00	22.10	9.00
		10-20	0	0.00	0.00	0.00	0.00
		>20	0	0.00	0.00	0.00	0.00
6	Large	>10	0	0.00	0.00	0.00	0.00
7	Total		216	100.00	244.30	100.00	1.13

Table 4 Operational holding characteristics of sample farms in selected villages in past 20 years

Past							
Sl.No	Class of operational holding	Size (Ha)	Farmers		Area		Per capita operational holding (Ha)
			number	in (%age)	in (Ha)	in (%age)	
		<0.5	65	30.09	32.500	9.08	0.50
		0.5-1	12	5.56	10.800	3.02	0.90
1	Marginal	<1	77	35.65	43.30	12.10	0.56
2	Small	1-2	92	42.59	164.00	45.84	1.78
3	1+2	<2	169	78.24	207.30	57.94	1.23
		2-3	29	13.43	81.200	22.69	2.80
		3-4	6	2.78	3.000	0.84	0.50
4	Semi-Medium	2-4	35	16.20	84.20	23.53	2.41
		4-5	9	4.17	44.10	12.33	4.90
		5-7.5	3	1.39	22.20	6.20	7.40
		7.5-10	0	0.00	0.00	0.00	0.00
5	Medium	4-10	12	5.56	66.30	18.53	5.53
		10-20	0	0.00	0.00	0.00	0.00
		>20	0	0.00	0.00	0.00	0.00
6	Large	>10	0	0.00	0.00	0.00	0.00
7	Total		216	100.00	357.80	100.00	1.66

There is a dramatic structural shift over time (Table 4). The number of marginal farmers has more than doubled (101% increase), primarily due to the downward movement of farmers from larger categories-semi-medium and medium-into marginal and small categories. This is evidenced by a 65% decline in small farmers, a 34% drop in semi-medium, and a 50% reduction in medium farmers. The area under marginal holdings increased by 46% in 2012-13, while small, semi-medium, and medium holdings shrank by 20.06%, 16.86%, and 18.55%, respectively, resulting in a net loss of 113.5 hectares or a 50.78% reduction in total operational area.

Most of the farmers made a drastic change to their farms within 20 years (Table5). The number of marginal farmers increased while the small, semi-medium, medium and large farmers decreased. Barak valley lies on foothills and has very fertile agricultural land, productivity is high. Recent years have seen drastic changes in the agricultural system in the valley due to severe consecutive floods and low-intensity droughts. The migration of medium, semi-medium and small farmers to smaller categories of farmers is due to the fragmentation of landholding, and loss of production due to floods and droughts. The farmers shifted from full-time farmers to part-time and hobby farmers due to consecutive losses during flood and drought years.

Table 5 Change in the operational holding of farmers in BVZ

Class	Group	Number		Change		Area (Ha)		Change	
		Before	2015-16	Number	%	Before	2015-16	Area (Ha)	%
I	Marginal	77	155	78	101.30	43.30	63.30	20.00	(+) 46.19
II	Small	92	32	-60	-65.22	164.00	57.00	-107.00	(-) 20.06
III	Semi-Medium	35	23	-12	-34.29	84.20	70.00	-14.20	(-) 16.86
IV	Medium	12	6	-6	-50.00	66.30	54.00	-12.30	(-) 18.55
V	Large	0	0	0	0.00	0.00	0.00	0.00	0.00
	Total					357.80	244.30	-113.50	(-) 50.78

This transformation, detailed in Table 5, is scientifically significant as it illustrates the impact of both environmental and socioeconomic stressors on agrarian structure. Barak Valley's fertile soils and high productivity have been undermined by consecutive floods and low-intensity droughts, which have not only reduced yields but also accelerated land fragmentation. The scientific argument here is clear: repeated climatic shocks cause productive assets to be subdivided among heirs or sold off, pushing medium and small farmers into marginal status. This process is compounded by economic necessity, as families unable to recover from crop losses are forced to reduce their farming scale or exit agriculture altogether.

The shift from full-time to part-time or hobby farming among these households reflects a broader trend of agrarian distress, where agriculture is no longer viable as a sole livelihood. This aligns with regional data showing high population pressure on land (8,277 persons per 1,000 hectares in Barak Valley, compared to 6,445 in Brahmaputra Valley and 4,305 nationally), and a scarcity of cultivable land that exacerbates vulnerability to poverty and food insecurity (Ghosh, 2013). These findings underscore the urgent need for policies that address both the structural and environmental determinants of land fragmentation and rural poverty, such as land consolidation, support for climate-resilient agriculture, and diversification of rural livelihoods.

Marginal farms increased by over 100% (Fig 3) , showing a massive shift due to fragmentation or migration from larger holdings. All other classes show a decrease, especially small farms (-65%).

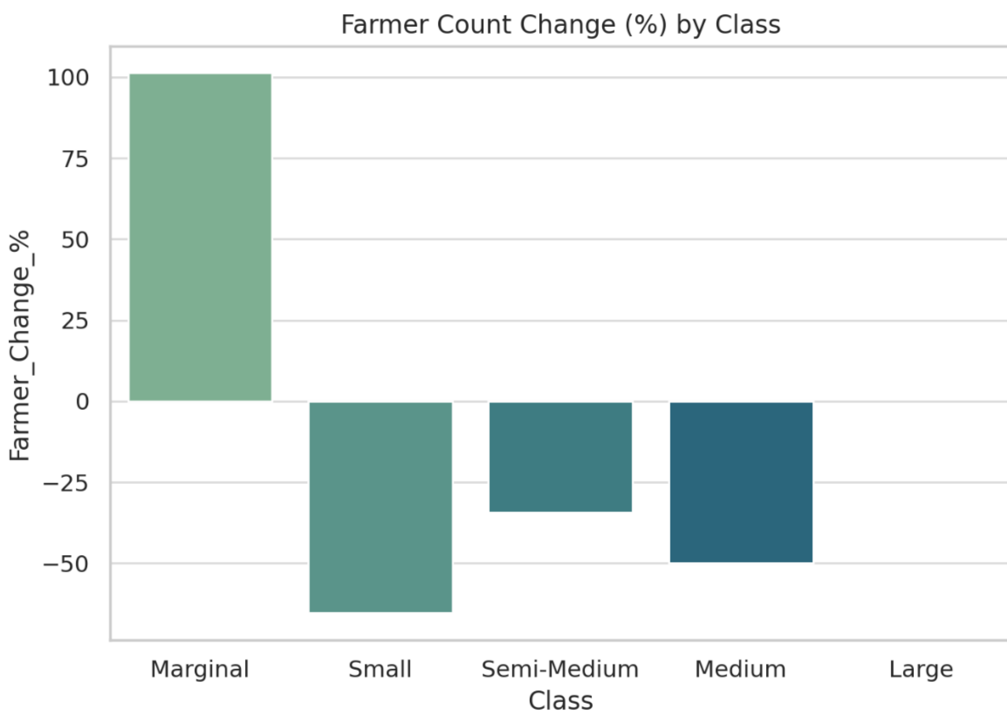

Fig. 3 Percentage of farmers who made changes to their operational

Area under marginal farms increased by 46% (Figure 4), while all other classes declined. The small farm class lost the most land area (−65.2%).

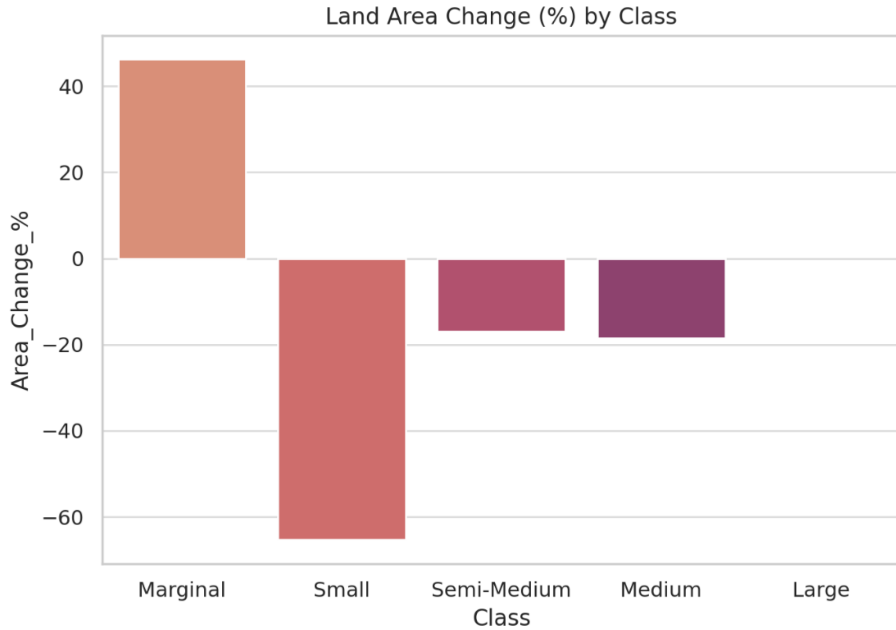

Fig. 4 Percentage of farmland operational holding area change

There is a statistically significant trend toward marginalization of farms (table 6), which suggests land fragmentation and pressure due to environmental or socio-economic stressors.

4.2 Operational holding under Rice

A survey of 216 farmers revealed that rice cultivation remains overwhelmingly dominant, with 95% (205 farmers) engaged in this activity. Notably, among marginal farmers, 75% (97 farmers) expanded the proportion of their land under rice cultivation, indicating a strong preference or necessity for rice as a staple and reliable crop. This trend aligns with regional patterns in Assam, where rice is the principal crop due to its adaptability to local agro-climatic conditions and its central role in food security (Roy, 2000). However, 13% of marginal farmers reduced their rice area, while 12% maintained their existing holdings, suggesting that even within this group, land-use decisions are influenced by factors such as resource constraints, risk aversion, or alternative livelihood opportunities.

The pattern is markedly different among small farmers: a substantial 84% reduced their land under rice cultivation, while only 16% increased it. This sharp reduction could be scientifically attributed to several factors. Small farmers may be more sensitive to declining yields, input costs, or the risks associated with monoculture under rainfed conditions, which are prevalent in Barak Valley where irrigation infrastructure is minimal and only about 5% of gross cropped area is irrigated (Roy, 2000; Table 2). The lower yields compared to state and national averages (Table 2) may prompt smallholders to diversify or reduce rice acreage in favor of other crops or off-farm activities, especially as policy and market shifts encourage diversification (Saikia et al., 2014; Table 4).

For semi-medium farmers, the response is balanced, with equal proportions expanding and reducing rice area. This likely reflects greater flexibility in resource allocation and risk management, as these farmers can better absorb shocks or capitalize on favorable conditions. Such heterogeneity in land-use decisions underscores the importance of farm size, resource endowment, and local agro-ecological realities in shaping agricultural strategies.

Scientifically, these patterns highlight that marginal and small farmers respond differently to agronomic, economic, and policy pressures. Marginal farmers’ expansion of rice area may be a survival strategy, maximizing staple food production under subsistence constraints, while small farmers' reduction may reflect a strategic shift towards diversification for income stability and risk reduction (Roy, 2000; Saikia et al., 2014; Table 2, Table 3, Table 6). These findings reinforce the need for targeted interventions-such as improved varieties, better irrigation, and diversification support-that are sensitive to farm size and local conditions to sustainably enhance productivity and resilience in Assam's rice-based systems.

Table 6 Farmers who made changes to their operational holdings in size under rice cultivation

Farmer category		Increase		Decrease		No change		Total
		Frequency	%age	Frequency	%age	Frequency	%age	Frequency
<1	Marginal	97	75	16	13	15	12	128
1-2	Small	11	16	58	84	0	0	69
2-4	Semi-Medium	2	40	3	60	0	0	5
4-10	Medium	0	0	3	100	0	0	3
>10	Large	0	0	0	0	0	0	0

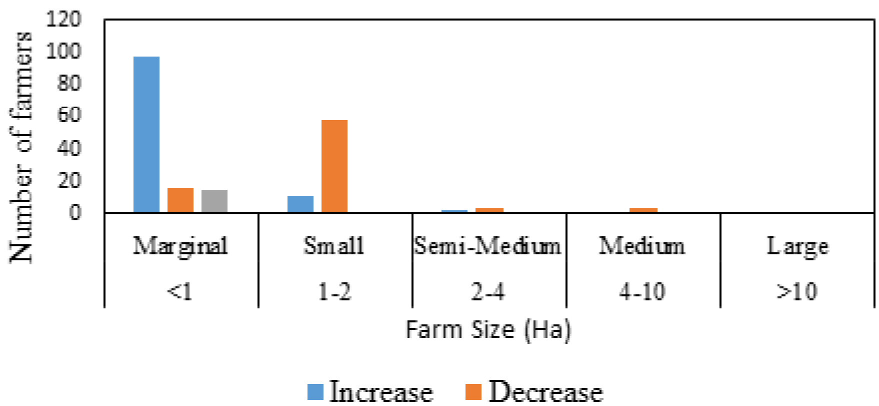

Fig. 5 Frequency of farmers who made changes to their operational holding under rice cultivation

Out of 128 marginal farmers, 97 made an increase in their farm size under rice by not more than 1 hectare, while 16 farmers decreased their land under rice by <1ha. The reduction in the size of land under rice is higher under small, semi-medium i.e. 45 small farmers and 2 semi-medium farmers reduced the land by <1 ha and 13 small farmers and 1 semi-medium farmer reduced their land by <2 ha. 4 semi-medium farmers decreased the area under rice by 204 hectares. The increase in the area under rice is less, only 13 (7+4 small farmers) and 2 semi-medium farmers increased the land size by less than 2 ha. 3 Medium category farmers reduced their land under rice by 1-4ha. Marginal farmers mostly increased their rice land. Small and Medium farmers heavily decreased rice cultivation land, indicating a stressor-driven shrinkage (possibly due to flood impacts or lower productivity). The changes in rice land use across categories are statistically significant (table 6). The chi-square test ($p < 0.00001$) on Table 7 confirmed a highly significant difference in how different farmer classes changed their land under rice. Marginal farmers expanded rice cultivation, while higher classes reduced theirs ($Chi^2 = 103.13$, p-value < 0.00001, degrees of freedom = 6).

Combined with perception and variety data, this suggests that smaller, more traditional farms are adapting or intensifying, while larger, possibly commercial farms are withdrawing from rice cultivation. Reduction in rice land is more pronounced in larger farms, while marginal farms tend to increase rice land, possibly due to switching from other crops or intensification (table 7).

Table 7 Farmer-area class wise change in area of operational holding under rice cultivation

Area Change (Ha)						
Farm Size	No change	<1	1-2	2-4	2-10	Total
Marginal	15	(-)16 &(+) 97	0	0	0	128
Small	0	(-)45 & (+)7	(-) 13 & (+)4			69
Semi-Med	0	(-)2 & (+)2	(-)1	(-)4	0	5
Med	0		(-)1	(-)2		3
Large	0	0	0	0	0	0

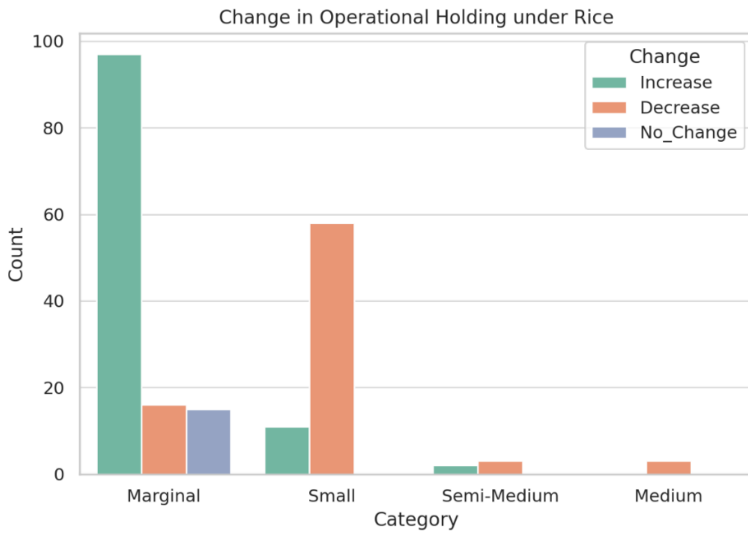

Fig. 6 Operational holding under Rice in Barak Valley

4.3 Farm characteristics

4.3.1 Cropping system

Since the region is monsoon fed, the cropping pattern is dominated by rice cultivation. Some farms engage in vegetable and pulses farming only. Therefore, a recommended sequence of cropping is observed in the region. The sequence is as seen in Table (8).

Table 8 Cropping system recommended and cultivated in Barak Valley zone

a) Situation: Medium/ medium lowland		
i) March-June	June-Oct.	Nov. Feb/March
Rice	Early rice	Oilseeds
	Early rice	Potato/Pea/vegetables
ii) April-July	July– Nov.	Nov./Dec – Feb.
Rice	Rice	Oat/ Oilseeds/Vegetables (Chilli/Radish-French bean/ Tomato/Potato/Pea
Vegetables	Rice	
a) Situation: Upland		
i) March-July	July/Aug-Oct/Nov	Oct/Nov-Feb
Rice (T)	Rice	
Early rice (T)		Pea/Toria/Niger
Rice (T)	Rice (T)	Toria/Pea

Source: (AAU, 2009a; AAU, 2009b) with field checks, 2015-16

4.3.2 Farm Varieties

The crop diversification is almost absent in the region. The entire agricultural system is dominated by rice (ahu, sali, and boro), which constitutes 90% of the total cropped varieties. 90% of farms grow only one crop, showing very low crop diversification. Very few farms attempt diversification (≥2 varieties), suggesting vulnerability to crop failure. This can make the region vulnerable to climate or market risks. Although the majority of crop production is from the paddy, still some farms practice double and multi-cropping such as vegetables/potatoes/mustard/pulses. Rice cultivation is dominated by sali rice (winter rice) followed by ahu rice and boro rice (summer rice).

Table 9 Frequency distribution of varieties of crops

No. of Varieties	Frequency	Distribution (%)
1	195	90.28
2	13	6.02
3	3	1.39
4	2	0.93
≥5	3	1.39

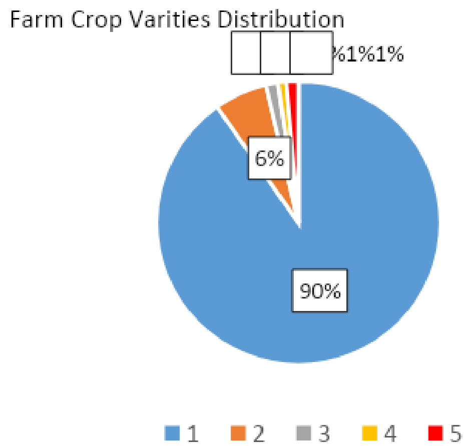

Fig. 7 Distribution of crop varieties in the surveyed sample village.

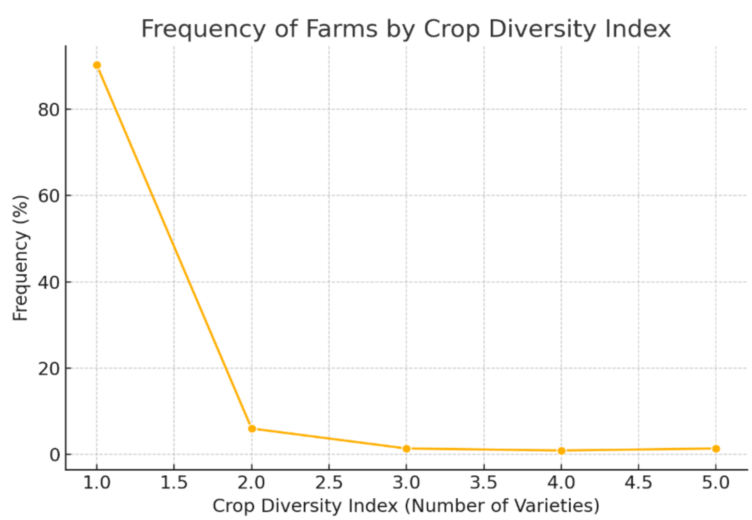

Fig. 8 Frequency of farms by crop diversity

This region is dominated by winter paddy (83.62%), whereas, summer and autumn paddy constitute only 9% and 7.33% of the total cropped area.

Table 10 Varieties of rice in sample farm of BarakValley Zone

Season	Types of Paddy	Area (Ha)	Area (%)
Kharif	Sali paddy	181.00	78.02
	Bao Paddy	13.00	5.60
	Winter paddy (i + ii)	194.00	83.62
Rabi	Early Ahu	12.00	5.17
	Boro Paddy	9.00	3.88
	Summer Paddy (i+ii)	21.00	9.05
Pre-Kharif	Autumn Paddy (Ahu)	17.00	7.33
All Season	Total	232.00	100.00

Table 11 Varieties of rice grown and recommended in sample farms of BarakValley Zone.

<table>
<tr><th rowspan="3">Type of Rice</th><th colspan="3">Varieties grown</th></tr>
<tr><th colspan="2">HYV</th><th rowspan="2">Traditional</th></tr>
<tr><th>Semi dwarf</th><th>Medium tall/Tall</th></tr>
<tr><td>Ahu</td><td>Luit, Disang, Kapili, Lachit, Chilarai, IR-36, Gobind, Rasi, IR-50, Ratna, krishna, Jaya, culture-1, Luit, Kapilee, Cauvery, Sonamukhi</td><td>-</td><td>Koimurali</td></tr>
<tr><td>Sali (Winter rice)</td><td>Ranjit, Bahadur, Kushal, Maniram, Luit, dishang Kapili, Piolee,Pankaj, Pankaj, Lakhimi,</td><td>Mahsuri, Manohar Sali, Swarnaprova, TTB 101-15, Kmj 10-2-2</td><td>Andrewasali</td></tr>
<tr><td>Sali -Glutinous B</td><td>Bhogali, Kmjj 3-144, Kmj 2-9-2</td><td>Rongalee</td><td>Bora, Chakoa</td></tr>
<tr><td>Sali-Scented</td><td>-</td><td>Keteki Joha</td><td></td></tr>
<tr><td>Boro (Summer rice)</td><td>Bishnuprasad,Jyotiprasad, Culture-1, Krishna, Cauvery, Banglami, Swarnabh, Dinanath</td><td>Kanaklata, KRH 2</td><td>Boro-1, Boro-2</td></tr>
<tr><td>Bao</td><td>-</td><td>Salibadal, Dholabadal</td><td>-</td></tr>
</table>

Source: (AAU, 2009a; AAU, 2009b) with field checks, 2015-16

4.4 Farmers perception on their farmland and climate

4.4.1 Perception on Farmland

There are 122 full time farmers, which constitute 56% of the total farmers. Out of the 122 farmers, 19% believe the region to be a good place for living, 17% acknowledge the region to be productive and good for the cultivation of crops, while 64% believe that a region is a good place for livelihood as well as productive for crops. These full-time farmers have lived in the region for a long period, with third generations in their respective families. Despite the climate vagaries, which brought flood and drought, with severe damage to the crops. The farmers still feel the region is good for their livelihood and choose to live in the place. Some of the farmers' children are well-educated and sometimes work as hobby farmers in the field. There are 50 part-time farmers in the sample site constituting 23% of the total farmers. The number of part-time farmers who believed the place was good for living was 34%, which was higher than the farmers (24%) who thought the place to be good for cultivation and productivity. Hobby farmers and pensioners were less in number and together they constitute 20% of the total farmers. The farmers who believe the place to be good for living is higher than the farmers who thought it to be productive.

Pensioners and hobby farmers report a higher perception of the land as a good place to live (possibly due to emotional or historical attachment). Older and less dependent farmers (hobby and pensioner) more often consider the land good for livelihood than strictly for productivity, hinting at non-economic attachment to land. Full-time farmers consider it more productive but are likely experiencing higher pressure from productivity demands.

Table 12 Farmers' perception on their farmland in Barak Valley zone

Categories	**Farmers**		**Farmers Perception on Farm status (%)**		
	Number	% age	Good Livelihood	Productive	Both
Full-time farmer	122	56	19	17	64
Part-time farmer,	50	23	34	24	42
Hobby farmer	29	13	41	17	41
Pensioner	15	7	53	13	33
Total	216	100	28	19	54

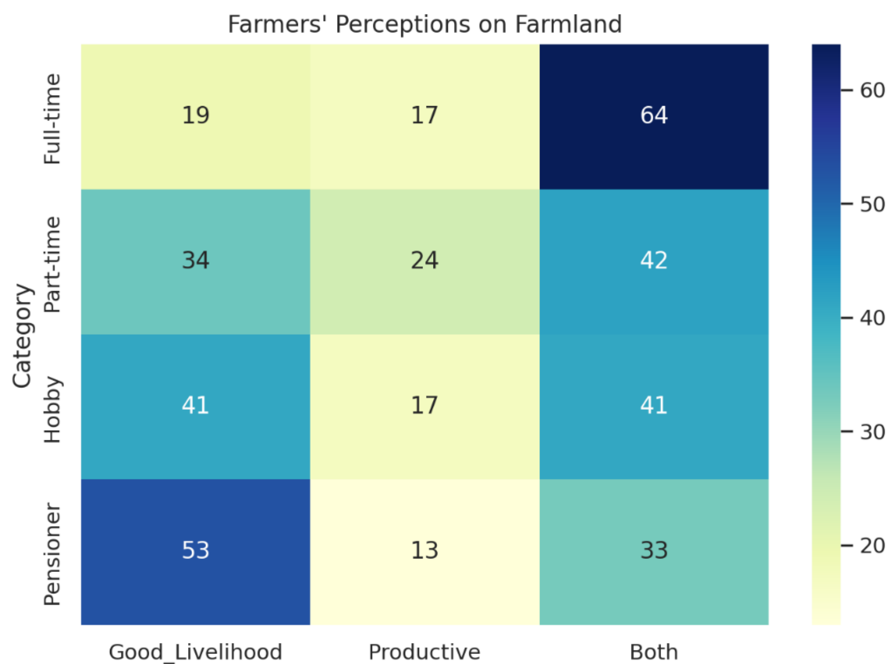

Fig. 9 Farmers' perception on their farmland in Barak Valley zone

4.4.2 Perception on Climate

Farmers of BVZ believed that the rainfall season has advanced contradictory to UBVZ agro-climatic zones. This may be because the survey was done in 2015-16, post 2012-13 had consecutive frequent severe floods in April and June 2013-17. This may lead to the assumption that rainfall has advanced in the region. Whereas the UBVZ survey was done in 2012-13, pre-2012 did not have consecutive frequent severe floods. 87 percent of the farmers believe in the rise in temperature while no farmers agreed to decrease in temperature. 11% of farmers agreed to no variation in temperature. Rainfall events always bring confusion in the minds of farmers, and the variation in rainfall activities is high. A might have heavy rainfall as well as severe drought simultaneously in the same year. Although, most farmers find the atmosphere to be moist 34% of farmers were unable to decide the moisture in the air.

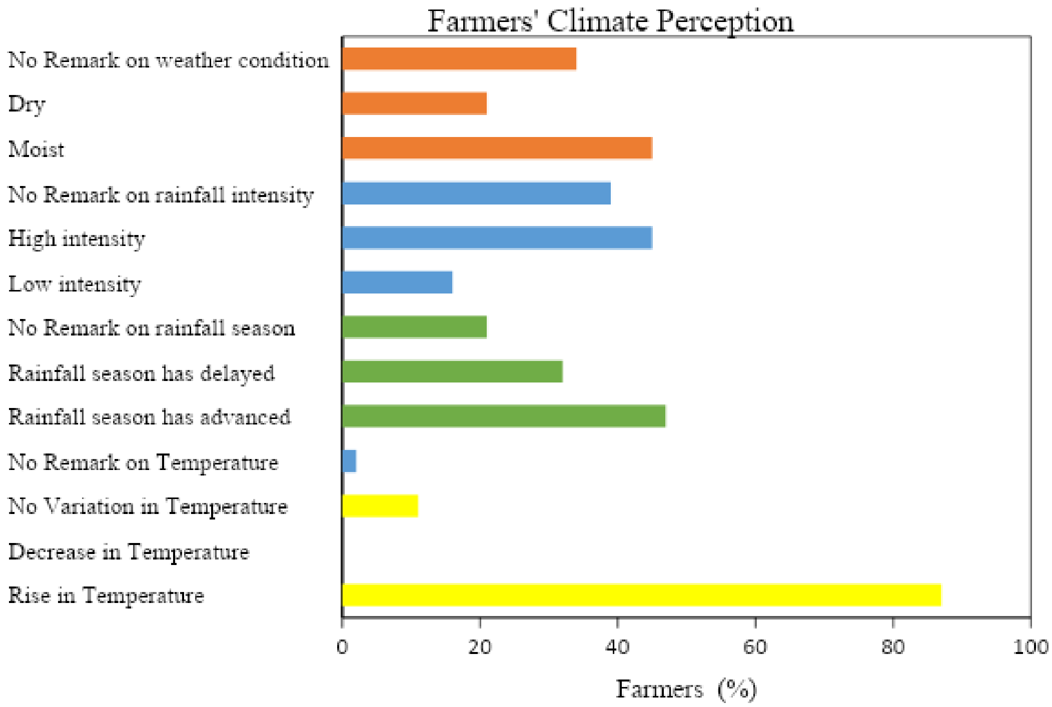

Fig. 10 Farmers' perception on Climate Change and its variability in BVZ

The farmers were asked about the probability of climate status in future. Their response to the queries was similar to the station climate data analysis results. 64% of farmers believe rainfall to be uneven in future, while 12% per cent were unable to decide the rainfall probabilities in future. The farmers aged 50-60 have a good record of climate over their lifetime. They recall the climate to be suitable for both agriculture and livelihood. The number of extreme events was lower than in the present and 675 farmers still believe that the frequency of extreme events will increase in future. 67% of farmers disagreed with the statement that it is most likely that the coming years will witness a drier type of climate.

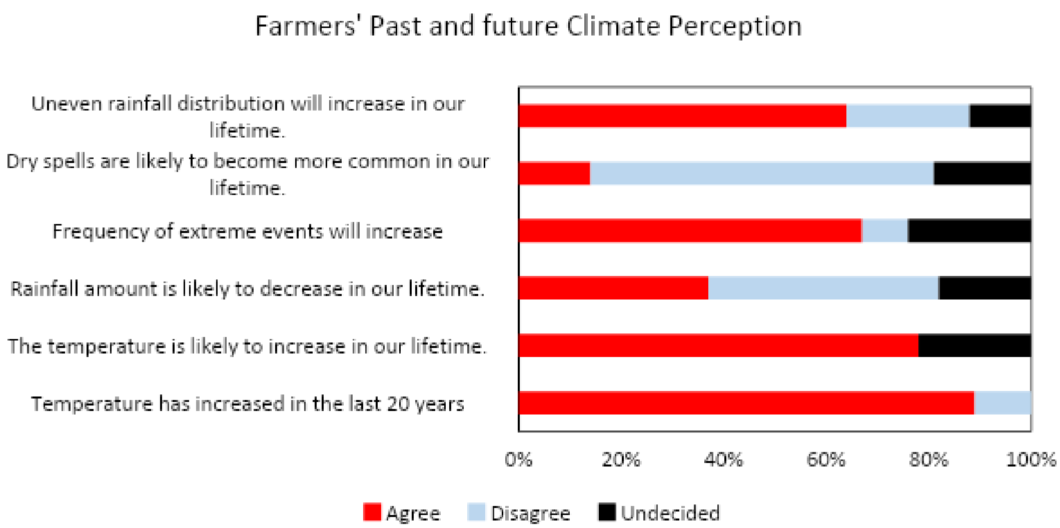

Fig. 11 Perception of farmers on past and present climate change in BVZ.

5 DISCUSSION

Future research on operational holding and farm characteristics in the Barak Valley agro-climatic zone should adopt a comprehensive and multidimensional approach to gain in-depth insights into the dynamics of agricultural practices and the livelihoods of farming communities. Longitudinal studies are essential to analyze long-term trends in operational holding, land use patterns, and the impact of external factors such as climate change and governmental policies over time. These studies can provide valuable insights into the evolving dynamics of agricultural practices and the adaptive strategies employed by farmers in response to changing environmental and socio-economic conditions. Additionally, comprehensive assessments of climate change impacts on agricultural practices in the region are crucial to understanding the specific challenges posed by shifting climatic conditions and extreme weather events. By analyzing historical climate data, farmer perceptions, and on-the-ground observations, researchers can gain a deeper understanding of the vulnerabilities and resilience of farming systems in the face of climate variability and change. Furthermore, a thorough socio-economic analysis of farming communities in the Barak Valley agro-climatic zone is imperative to comprehend the complex interplay of factors influencing the livelihoods and well-being of farmers. This analysis should encompass income levels, resource accessibility, education, social dynamics, and other socio-economic indicators to provide a holistic understanding of the socio-economic context in which agricultural activities are embedded. Understanding the socio-economic dynamics is crucial for designing targeted interventions and policies aimed at enhancing the resilience and sustainability of agricultural livelihoods in the region.

In addition, investigations into the adoption of modern agricultural technologies and innovative farming practices within the region are essential to assess the extent to which farmers are embracing new techniques, tools, and crop varieties. Understanding the factors influencing the adoption or resistance to technological innovations in the agricultural sector can provide valuable insights for promoting sustainable agricultural practices and enhancing productivity. Moreover, evaluations of existing agricultural policies and support mechanisms within the Barak Valley agro-climatic zone are necessary to assess their effectiveness in promoting sustainable agricultural development and improving the well-being of farming communities. This evaluation should involve an in-depth analysis of government interventions, subsidies, extension services, and other policy measures to understand their impact on farm productivity, income levels, and the adoption of sustainable agricultural practices. Furthermore, comparative analyses with other agro-climatic regions in Assam or neighbouring states can provide valuable insights into the unique challenges and opportunities specific to the Barak Valley. By comparing operational holding and farm characteristics across different agro-climatic zones, researchers can identify lessons learned from successful agricultural practices and tailor interventions to the specific context of the Barak Valley. Finally, the integration of participatory research methods that involve active engagement with local farming communities is essential for co-creating knowledge, identifying priorities, and developing sustainable solutions rooted in the local context. Collaborating with farmers, agricultural cooperatives, and community organizations can facilitate the development of context-specific interventions and ensure that the research findings are relevant and actionable for the local farming communities.

By addressing these specific research areas, future studies can contribute to a deeper understanding of operational holding and farm characteristics in the Barak Valley agro-climatic zone, and provide valuable insights for policy formulation, sustainable agricultural development, and resilience-building in the face of environmental and socio-economic challenges.

6 CONCLUSION

The Barak Valley agro-climatic zone of Assam is a unique agricultural landscape that is nourished by the Barak and Brahmaputra rivers. The region experiences annual floods that enrich the alluvial floodplains with vital nutrients, enabling agriculture with minimal inputs. The study provides valuable insights into the operational holding and farm characteristics in the region, highlighting the impact of natural factors on agricultural practices. The findings of the study reveal significant shifts in the distribution of farmers across different operational holding classes over a 20-year period, indicating a drastic change in the agricultural system attributed to severe consecutive floods and low-intensity droughts. The prevalence of rice cultivation among farmers in the Barak Valley Zone was high, with 98.15% of the surveyed farmers cultivating rice. The study also found that the changes in operational holding under rice cultivation were significant, with a shift towards smaller operational holdings. The study underscores the need for tailored agricultural development strategies in the region, leveraging the comparative technological and economic advantages of the Barak Valley agro-climatic zone. The findings highlight the importance of understanding and leveraging the comparative technological and economic advantages of the region.

The study provides a valuable foundation for future research in the region, focusing on the impact of climate change, government policies, and technological innovations on agricultural practices in the Barak Valley agro-climatic zone. In conclusion, the study provides a comprehensive analysis of operational holding and farm characteristics in the Barak Valley agro-climatic zone of Assam, highlighting the impact of natural factors on agricultural practices. The findings underscore the need for tailored agricultural development strategies in the region, leveraging the comparative technological and economic advantages of the Barak Valley agro-climatic zone. This analysis reveals a strong trend of land fragmentation and marginalization of farms in Barak Valley, likely due to environmental stressors like floods and climate variability. While marginal farmers have intensified rice cultivation, larger farms are reducing their holdings. The lack of crop diversification is a potential vulnerability. Tailored strategies, better crop planning, and risk-mitigation policies are essential for future agricultural sustainability in the region. The study provides valuable insights into the dynamics of land use and agricultural practices in the region, shedding light on the unique agricultural landscape shaped by natural factors.

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