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RICE PRODUCTION AND MARKETING DYNAMICS IN THE TERAI BELT OF NEPAL: EMPIRICAL INSIGHTS, CONSTRAINTS, AND POLICY IMPLICATIONS

LAL KUMAR SHRESTHA*
Agriculture and Forestry University, Chitwan, Nepal.
*Corresponding Author Email: shresthalk2014@gmail.com

YAM BAHADUR THAPA
Agriculture and Forestry University, Chitwan, Nepal.

SHIVA CHANDRA DHAKAL
Agriculture and Forestry University, Chitwan, Nepal.

DEVENDRA GAUCHAN
Tribhuvan University, Kathmandu, Nepal.

Abstract

Rice is Nepal's primary food crop, central to national food security and rural livelihoods. Yet, limited research has explored farmers' perceptions of rice production trends and marketing dynamics in the Terai region. This study examined production patterns, marketing mechanisms, and major constraints in rice cultivation across Jhapa, Rupandehi, and Kailali districts. Primary data were collected in 2022 from 360 farmers, 90 traders, and 30 key informants, supported by focus group discussions and literature review. Most farmers perceived a decline in rice production and yield over the past five years, particularly in Kailali, indicating localized production stress. In contrast, the majority viewed cultivated area as stable, suggesting a perception gap with official data showing gradual area decline. Regional differences were notable: Jhapa exhibited greater adoption of collective marketing and storage, while central and western districts faced stricter buyer demands, reflecting the influence of local infrastructure and institutions. High production costs, price volatility, and limited financial access were identified as the most severe constraints, exceeding agronomic concerns such as irrigation and pest issues. The study offers evidence-based insights for policymakers, development agencies, and market actors. It highlights the need for region-specific and inclusive policies that strengthen market access, financial services, and awareness of mechanisms like the Minimum Support Price. The findings further call for government investment in storage, collective marketing, and digital systems to promote fair pricing and stable farmer incomes. Overall, the study advocates a shift from production-focused approaches to integrated value chain development for sustainable rice sector growth in the Terai region of Nepal.

Keywords: Farmers' Perception, Market Channels, Marketing Dynamics, Policy, Rice.

1. INTRODUCTION

Rice is the staple food crop of Nepal, cultivated on an area of 1.42 million hectares, production of 5.95 million MT and a yield of 4.19 MT/ha. The Terai region of Nepal is the nation's fertile grain belt with a share of a bulk of 73% of the national rice production (Thapa & Bhusal, 2020; Simkhada & Thapa, 2022; MoALD, 2025). Rice is indispensable to national food security and economic stability, providing over 50% of the caloric intake and contributing 12.8% to the national agricultural GDP. Despite the vital role of rice

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subsector, it faces persistent challenges including stagnant yields, substantial post-harvest losses, and an inefficient, intermediary-dominated marketing system that suppresses farmer incomes (Ghimire & Wen-Chi, 2017; Gautam et al., 2020). In this context, it is imperative to understand farmers' perceptions on area and production of rice cultivation, along with the marketing dynamics—such as access to market information, price determination, marketing channels, key actors, influencing factors, marketing costs, and market efficiency. This is inevitable for enhancing rural livelihoods and ensuring national food security.

Farmers' perception refers to their awareness, understanding, and interpretation of agricultural practices, production trends, and market conditions based on their experiences, beliefs, and local knowledge (Adesina & Zinnah, 1993). It reflects how farmers observe, evaluate, and respond to agricultural technologies, policies, and market opportunities within their socio-economic and environmental contexts (Rogers, 2003; Meijer et al., 2015). Farmers' perceptions about area, production and yield of rice are shaped by varietal preferences, access to inputs and information, and climate variability; these perceptions in turn strongly influence adoption decisions and observed production outcomes (Thapa & Dhakal, 2024a). A study in the Terai region found that a majority of rice farmers accurately perceived increasing temperatures, erratic rainfall, and increased frequency of droughts, which they associated with negative impacts on rice production (Dulal & Brodnig, 2018). These perceptions were a key driver for adopting adaptation strategies like switching to drought-tolerant rice varieties. Although several studies have examined rice production and marketing in Nepal, limited research has focused on farmers' perceptions of rice area, production, and yield across the eastern, central, and western Terai.

Marketing dynamics refers to the set of changing forces and relationships in a market environment that influence how products are moved from producers to consumers. These include supply and demand shifts, competition, market information flows, price signals, the behavior of actors in the channel (farmers, intermediaries, and buyers), infrastructure, institutional/regulatory frameworks, and changing preferences or conditions. These dynamics determine how market channels evolve, how prices are determined, and ultimately affect marketing efficiency (CFI Team, 2021). Several Nepalese studies show that rice marketing dynamics are shaped by fragmented marketing channels, dominant intermediaries, weak market information flows, and cross-border price linkages with India — all of which increase farm-to-retail price spreads and lower farmers' shares (Achyut, 2009; Sanogo & Amadou, 2010). Empirical farm-level analyses further indicate persistent inefficiencies and limited capture of potential output by farmers, partly driven by poor access to reliable market information and post-harvest constraints in processing and procurement (Choudhary et al., 2022; Kharel et al., 2022; Parajuli & Thapa, 2024). The FAO price-spread framework remains useful for measuring marketing costs, margins and efficiency in these contexts. However comprehensive analyses of rice marketing dynamics—covering market information, price determination, channels, and efficiency—remain scarce.

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Past literature indicates that rice production in Nepal is constrained by a combination of agronomic, institutional and climatic factors: farmers produce well below potential because of limited access to improved seed and inputs, weak irrigation and mechanization, pest and disease, labor shortages, and inefficient post-harvest processing.

These biophysical and market-policy constraints—exacerbated by climate variability—collectively reduced yields, increase production costs and weaken farmers' incentives to invest in productivity improvements (Choudhary et al., 2022; Adhikari, 2024; FAO, 2020; Regmi, 2022; Thapa & Dhakal, 2024b). Thus, it is imperative to understand the major problems of rice growers in the Terai region of Nepal.

In this context, this study provides a region-specific insight into farmers' perceptions of rice cultivation and marketing in the Terai. We explore four key questions: (i) how farmers' perceptions of production trends vary across districts and the influencing factors; (ii) which marketing channels dominate and how costs and margins affect price realization; (iii) what major production constraints exist; and (iv) how policies can be tailored to address regional disparities.

Through a comparative district-level assessment, the study analyzes farmers' perceptions, marketing dynamics, and constraints to propose evidence-based policy recommendations aimed at improving productivity, market efficiency, and food security. The findings provide actionable insights for policymakers, planners, and practitioners to identify value chain gaps and design targeted interventions such as improved technologies, post-harvest facilities, and cooperative systems to enhance farmer incomes and promote the commercial viability of Nepal's rice sector.

2. RESEARCH METHODS

This study examines Nepal's rice production and its marketing dynamics using mixed methods to determine the perception of rice growers towards area, production and yield of rice production, explore the marketing dynamics and assess the major problems in rice production by the farmers.

2.1 Study area

The study was conducted in three principal rice-producing districts of Nepal's Terai region- Jhapa, Rupandehi and Kailali. These districts are considered the storehouse of Nepal for rice production (Thapa et al., 2025) and represent location diversity as they fall along the three regions of Nepal viz. Eastern, Central and Western, respectively. Similarly, these districts account for 18.73% of the total production of rice (MoALD, 2025). This strategic selection of districts enables a comparative assessment of farmers' perceptions regarding rice cultivation (area, production, and yield) and marketing dynamics—including market information, channels, costs, efficiency, price determination, and market mechanisms—as well as the key constraints affecting rice production and marketing, to gain a comprehensive understanding of the Terai region of Nepal.

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2.2 Sample size and Sampling technique

Using the sample size estimation determined by Daniel and Cross (2013), a sample size of 360 was calculated and thereafter a simple random sampling technique was adopted to collect primary data from producers as the sample size is sufficient in case of homogenous population (Bartlett et al., 2001). Similarly, the sample size of other different value chain streams were 19 collectors, 21 retailers, 15 processors, 18 wholesalers and 30 key informants, and 17 exporters/ importers who were randomly selected from rice producers, input suppliers, collectors, processors, wholesalers, retailers, importers, and agriculture officers from study area. Details of sample size are presented in Table 1.

Table 1: Sample size based on different value chain actors

Actors	Total sample size (n)	Sample size as per district		
		Jhapa	Rupandehi	Kailali
Farmers	360	120	120	120
collectors	19	7	6	6
Retailers	21	7	8	6
Processors	15	6	5	4
Wholesalers	16	6	5	5
Key informants	30	12	9	9

2.3 Methodology

2.3.1 Farmers' perception and factors encouraging rice production

2.3.1.1 Perception of rice growers towards area, production and yield of rice

Primary data on perception of rice growers towards rice area, production, and yield over the last five years were obtained through a structured questionnaire. Rice growers were asked if they felt their area under rice production, total production and yield were increasing, decreasing, or constant over the last five years (2018-2022). The responses obtained from the survey was triangulated by Focus Group Discussion (FGDs) with a group of 11 farmers from the study area. The frequency of responses for perception (increasing, decreasing or constant) were converted into percentage to identify the perceived trend. The perceived trends were then compared with the actual trend of area, production and yield of rice over last five years MoALD (2025) so as to identify consistency or differences.

2.3.1.2 Priority factors for encouraging rice production

Respondents were asked to identify and rank the key factors that encourage rice cultivation, such as access to inputs, irrigation, credit, technology, labor, and government support. Data were analyzed using descriptive statistics, including mean and percentage, while a ranking index was employed to determine the relative importance of each factor. Results were presented through tables and charts for clarity and comparison across districts. The ranking index (I) used (Adhikari & Thapa, 2023) is shown in Equation 1 below.

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$$I = \sum_{i=1}^{n} \frac{S_i f_i}{n} \qquad \text{Equation (1)}$$

Where,

I am the index of importance

S_i = i^{th} scale value (0.2, 0.4, 0.6, 0.8 and 1 for Rank 5,4,3,2 and 1, respectively)

f_i = frequency of i^{th} importance given by respondents

n = total number of respondents

2.3.2 Marketing Dynamics

Marketing dynamics refer to the interactions among market forces shaping the flow of agricultural products from producers to consumers. In this study, they include farmers' access to market information, price determination, advertising methods, marketing channels and actors, transaction costs, and efficiency within the rice value chain across the eastern, central, and western Terai regions of Nepal. Analyzing these dimensions helps identify structural bottlenecks and regional disparities, providing empirical insights to improve market performance, enhance farmers' income, and promote the commercialization and competitiveness of Nepal's rice sector. The scope of marketing dynamics in this study include.

2.3.2.1 Marketing channels, actors in marketing channels and factors influencing channel selection

Data on rice market information, advertising methods, marketing channels, their actors, and the factors influencing channel selection were collected through survey of rice growers, key informants' interview and triangulated by Focus Group Discussion (FGDs) with a group of 11 farmers from each study area. The survey data, analyzed as multiple-response sets, were expressed in percentages. The results pertaining to the factors influencing marketing channel choice were visualized using a spider chart. The FGDs provided qualitative insights to verify the survey findings and explore the underlying reasons for channel variations and decision-making.

2.3.2.2 Marketing cost, marketing efficiency, and mode of payment

For marketing cost, packaging cost, transportation cost, loading/unloading cost were included. Data were analyzed using mean and Standard Deviation (SD). The mean difference among the marketing costs in the three districts were statistically analyzed by Analysis of Variance (ANOVA) and Least Significant Difference (LSD) test. Marketing efficiency was calculated by using Acharya's method and expressed as a percentage. The different modes of payment used in the market were also determined.

Marketing efficiency reflects the overall performance of a market. It refers to the process of moving goods from producers to consumers at the minimum possible cost while effectively meeting consumer service expectations. According to Acharya (2003), an ideal

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measure of marketing efficiency for comparing alternative market channels should include all of the following factors:

a) Total marketing costs (MC)

b) Net marketing margin (MM)

c) Prices received by the farmer (FP)

d) Prices paid by the consumer (RP)

We use the following formula (Equation 2) as given by Acharya (2003).

$$Marketing\ Efficiency\ (ME) = \frac{FP}{\sum(MC+MM)} \qquad \text{Equation (2)}$$

Where,

ME = Marketing Efficiency,

MC = Marketing cost,

MM = Marketing margin,

FP = Prices received by the farmers

Higher marketing efficiency index shows that the value chain is performing well and efficiently.

2.3.2.3 Marketable and marketed surplus

The information on production, consumption, marketable and marketed surplus, and buyers' requirements was obtained through interview. Marketable and marketed surplus were computed based on total production, household use, seed retention, and post-harvest losses. Data were analyzed using descriptive statistics, including mean, percentage, and frequency, with tabular and graphical presentation. Marketable surplus and marketed surplus were calculated using Equation 3 and 4, respectively.

$$Marketable\ Surplus\ (MS_1) = Total\ Production(Qp) - Household\ consumption\ (Qc) \qquad \text{Equation (3)}$$

$$Marketed\ surplus\ (MS2) = Actual\ quantity\ sold\ (Qs) \qquad \text{Equation (4)}$$

2.3.2.4 Government intervention and support

Information on government support in marketing and processing, and the Minimum Support Price (MSP) was obtained through face-to-face interview. Data were analyzed using descriptive statistics such as mean, percentage, and frequency, and results were presented in tabular form for clear interpretation.

2.3.2.5 Post harvest losses

Data on farmers' awareness and perception of post-harvest management was obtained through face-to-face interviews. Data were analyzed using descriptive statistics such as

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mean, percentage, and frequency, and results were presented in tabular form for clear interpretation.

2.3.3 Challenges in rice production and marketing

To assess the challenges in rice production and marketing, both primary and secondary data were used to identify key challenges in rice production and marketing. Primary data were collected through household surveys, key informant interviews (KIIs), and Focus Group Discussions (FGDs) involving farmers, traders, millers, and agricultural officers. A semi-structured questionnaire captured information on production constraints, buyer requirements, marketing bottlenecks, and post-harvest losses.

Secondary data were obtained from government reports, journals, and records from the MoALD, National Statistics Office (NSO), and Nepal Agriculture Research Council (NARC). Collected data were analyzed using descriptive statistics such as frequency, percentage and index, while qualitative responses were thematically summarized to support quantitative findings. A ranking index technique was applied to determine the relative severity of each constraint, and results were presented in tabular form for clear interpretation.

The following equation was used as an index of severity for identifying major problems (Adhikari & Thapa, 2023):

$$I = \sum_{i=1}^{n} \frac{S_i f_i}{n} \qquad \text{Equation (5)}$$

Where,

I is the index of severity

S_i = i^{th} scale value (0.2, 0.4, 0.6, 0.8 and 1 for Rank 5,4,3,2 and 1, respectively)

f_i = frequency of i^{th} importance given to the problem by respondents

n = total number of respondents

2.3 Data Collection

This study used a mixed-methods approach. Primary data were collected between February and May 2022 using a pre-tested semi-structured interview schedule. The questionnaire was pre-tested on 24 respondents, and necessary modifications were made to address the issues identified during the pre-test. Data were gathered from 360 rice producers and further validated through triangulation using Focus Group Discussions (three per district, each comprising 8–10 participants), Key Informant Interviews, and direct market observations. These methods captured socio-economic factors, production practices, and marketing dynamics. Written consent was obtained from all respondents prior to the survey to ensure data confidentiality. Secondary data from journals, reports, and publications provided data on area, productions, literature review, enabling a comprehensive analysis of Nepal's rice marketing dynamics.

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2.4 Data analysis

The data was carefully entered and validated in MS Excel. The data was curated and analyzed using descriptive and inferential statistics through Statistical Package for Social Sciences (SPSS) Version 24.

3. RESULTS AND DISCUSSION

3.1 Farmers' perception and priorities in rice production

3.1.1 Farmer's perception towards area, production and yield of rice over last five years

The perceptions of farmers regarding trend of area, production and yield of rice production were analyzed for last five years (2018-2022). The results revealed statistically significant inter-district differences in perceived trends, as shown in Figure 1.

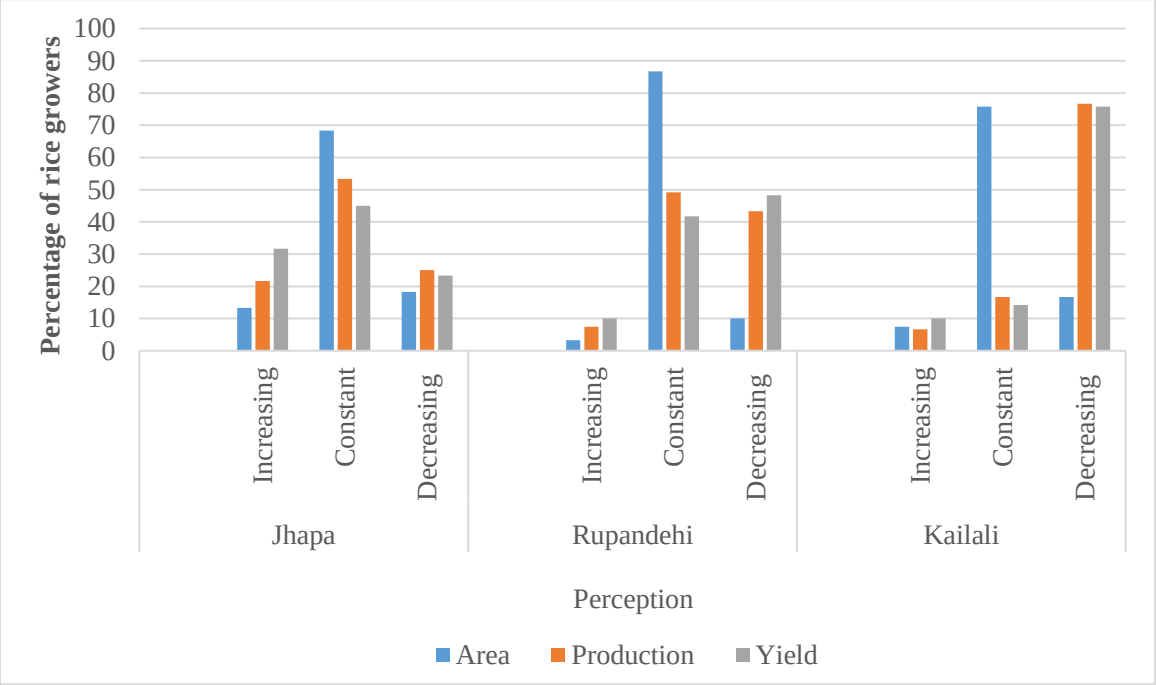

Figure 1: Perception of rice growers towards area, production and yield of rice over last five years (2018-2022)

Across three districts in Nepal, a majority of farmers (76.9%) perceived the area for rice cultivation to have remained constant in recent years, with only 8.1% reporting an increase. However, perceptions of rice production and yield showed nearly half of all respondents (48.3% and 49.2%, respectively) perceiving a decreasing trend. These trends varied significantly by district, as Kailali had the highest proportion of farmers reporting declines in production (76.7%) and yield (75.8%), while Jhapa was the most optimistic, having the highest shares perceiving increases. All inter-district differences

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were found to be statistically significant, highlighting notable spatial variations in agricultural performance.

To critically evaluate these perceptions, it is essential to compare them against official statistical trends (Annex 1). While the majority of farmers perceived the area under rice cultivation as constant, national data often reveals a contrasting reality of a declining trend in rice area due to urbanization, land fragmentation, and labor migration (MoALD, 2021b). This indicates a potential perception gap, where gradual changes over years may not be immediately salient to farmers.

Conversely, the widespread perception of declining production and yield, particularly in districts like Kailali, frequently aligns with empirical reports. Studies attribute such declines to climate change-induced erratic rainfall, pest outbreaks, and soil fertility degradation (Gauchan et al., 2021).

The significant inter-district variation in perception further validates this link, as it reflects the localized impact of agro-ecological and socioeconomic factors documented in agricultural studies (Joshi et al., 2020). Therefore, farmers' perceptions of yield and production are often a reliable indicator of on-the-ground challenges, whereas their perception of a stable cultivation area may mask a slower, yet critical, long-term structural shift.

Overall, the data indicated a consistent perception among farmers that rice production and yield were more likely to have declined or remained stagnant, with only a minority perceiving improvements. Jhapa appeared relatively more optimistic in terms of area stability and productivity gains, whereas Kailali reflected greater pessimism, particularly concerning production and yield.

3.1.2 Priority factors for encouraging rice production

The survey data revealed that the primary factors encouraging rice production are predominantly economic and productivity-driven, with higher yield ranking first, closely followed by high price and return and government support and subsidy (Figure 2). This underscores that while the crop's status as a staple is acknowledged, practical economic incentives are top in farmers' decision-making.

This finding aligns with recent studies; for instance, the pursuit of higher yield remains critical for income and food security, a drive now focused on climate-resilient and input-efficient varieties (Kumar et al., 2021).

Furthermore, the importance of government support and Minimum Support Prices (MSP) is consistent with research highlighting their role in stabilizing farmer incomes and incentivizing production, especially in the face of market volatility (Patel et al., 2023). Ultimately, the synergy between achieving higher on-farm productivity and having guaranteed market returns through effective policies forms the most powerful combination for encouraging rice cultivation (Gautam & Paudel, 2022).

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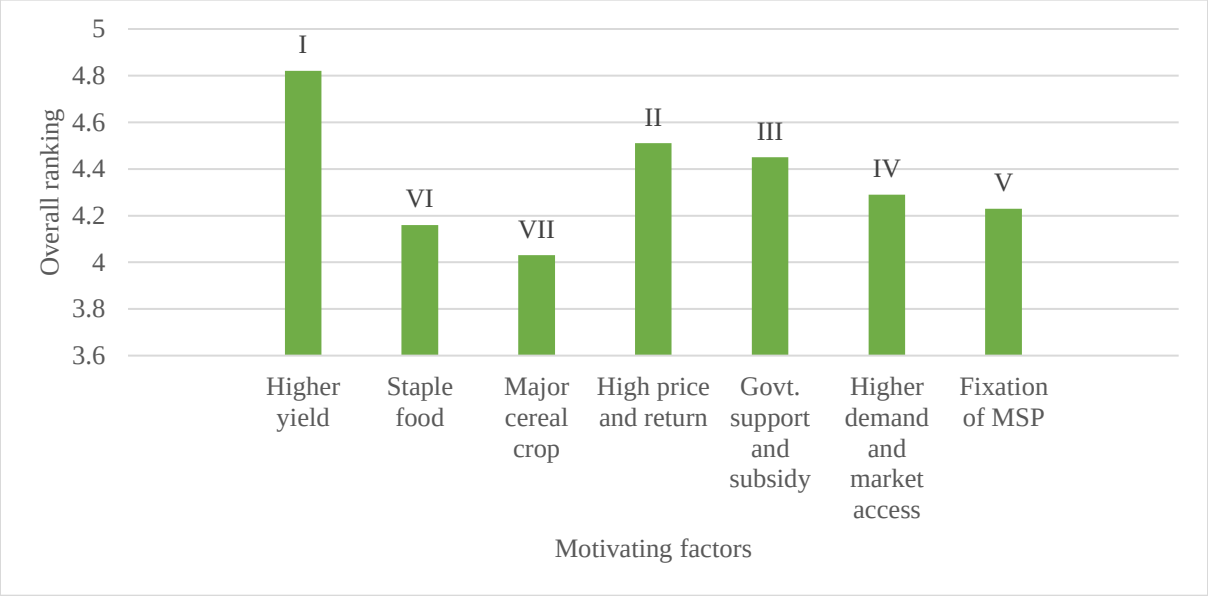

Figure 2: Factors encouraging rice production in Terai region of Nepal

While being a staple food is important, the data shows practical economic and productivity concerns are significantly more influential in farmers' decision-making than the crop's traditional status. In the same line, government policies like Minimum Support Prices (MSP) significantly influence rice production by ensuring price stability and incentivizing cultivation (Mishra et al., 2018). The pursuit of higher yield is the primary factor influencing rice production, driven by its direct impact on farmer income and food security (Khush, 1995). The adoption of high-yielding varieties during the Green Revolution remains a foundational factor for increased rice production, significantly boosting output and farmer incentives (Pingali, 2012). Market volatility and government trade policies are critical factors influencing rice production decisions, as they directly impact price stability and farmer profitability (Poudel et al., 2024).

3.2 Marketing Dynamics

The marketing dynamics of rice commodity in the study area is studied with respect to sources of market information, price determination mechanism marketing channels, actors in marketing channels, factor affecting marketing channel, marketing efficiency, mode of payment, and post-harvest losses.

3.2.1 Sources of market information

The sources of market information used by rice farmers across three districts—Jhapa, Rupandehi, and Kailali were different. Overall, the majority (81.4%) obtained information directly from the market, followed by neighbors or friends (65.8%) and other producers (49.2%). Media (38.6%), producer organizations (3.6%), and government offices (2.2%) were relatively fewer common sources.

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Significant differences were observed among districts for most information sources except government offices. Direct market information was most common in Kailali (89.2%) and least in Rupandehi (70.8%). Rupandehi farmers relied more on other producers (68.3%) and media (87.5%) compared to the other districts, while Jhapa and Kailali farmers more often depended on neighbors or friends. These differences were statistically significant at the 1% or 5% levels, indicating notable variation in information access patterns across regions.

Gautam and Andersen (2016) found Nepalese rice farmers rely on informal market observation and social networks for information due to the weak reach and inefficiency of formal government extension services, making interpersonal channels the most accessible and trusted option. Media use for market information is highly uneven, concentrated in developed areas like Rupandehi. Research confirms higher adoption is linked to better infrastructure, connectivity, literacy, and targeted local programming, while less developed regions with poorer infrastructure and connectivity lag significantly (Kharel et al., 2022). Due to under-resourced and fragmented government services, Nepalese rice farmers distrust formal institutions and rely mainly on direct observation and social networks for market information (Tiwari et al., 2020).

Advertising methods serve as vital sources of market information, primarily used to build and maintain a mill's reputation, facilitate negotiations, and coordinate logistics. In the study areas, rice marketing mainly relies on word-of-mouth and personal networks (40–45%), followed by mobile communication through calls and SMS (25–30%). On-site signage (8–10%), social media, and branded packaging (5–10%) enhance brand visibility for larger mills, while traditional media like radio ads and fairs (3–7%) support wider promotion. Overall, trust-based personal communication dominates, with digital and formal advertising emerging as supplementary tools.

3.2.2 Role of actors in price determination

Table 2 shows the role of actors in price determination mechanisms in the rice market. The figures reveal a highly fragmented and geographically distinct structure, with the involvement of all major actors showing statistically significant variation across districts ($p<0.01$). The role of rural collectors is particularly significant in Rupandehi, where they are involved in 70.0% of cases, a prevalence nearly double that of their involvement in both Jhapa and Kailali, where it stands at 39.2% in each district.

Producers themselves exert minimal influence over pricing in the overall market, with only 8.9% participating in price determination. However, an exception exists in Rupandehi, where 24.2% of producers are involved in setting their own prices. Wholesalers emerge as the most influential actors overall, involved in 69.4% of transactions, with particularly high dominance in Jhapa (73.3%) and Kailali (76.7%). Processors and brokers show an extreme concentration of influence, with their role being overwhelmingly dominant in Rupandehi (42.5% and 40.8% respectively) while remaining minimal in the other two districts. In the same line, Adhikari and Bohara (2018) reported that paddy prices are

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largely set by traders, millers, and wholesalers, reflecting an oligopsonistic market where concentrated buyers dominate and farmers have minimal bargaining power.

Retailers maintain considerable influence in Jhapa (57.5%) and Rupandehi (54.2%), but play a much-reduced role in Kailali (25.0%). Most notably, collective negotiation between all actors is virtually non-existent at just 1.4% overall, clearly indicating a fundamental lack of transparent, multi-stakeholder price-setting mechanisms in these markets. Sah and Devkota (2024) found smallholder farmers are price-takers, not setters, due to information gaps, immediate cash needs, and weak cooperatives, explaining their negligible role as producers outside of moderate influence in Rupandehi. Ghimire and Wen-Chi (2017) conclude that Nepal's agricultural markets are not uniform, as key actors and price discovery vary significantly by district due to local infrastructure, large mills, and regional trade practices, explaining the unique dominance seen in each region.

Table 2: Involvement of various actors in price determination

Variables	Overall (n=360)	District			χ^2-value	p-value
		Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)		
Rural collector (Yes=1)	178 (49.4)	47 (39.2)	84 (70.0)	47 (39.2)	30.426***	0.001
Producer self (Yes=1)	32 (8.9)	3 (2.5)	29 (24.2)	0 (0.0)	52.340***	0.001
Wholesaler (Yes=1)	250 (69.4)	88 (73.3)	70 (58.3)	92 (76.7)	10.787***	0.005
Retailer (Yes=1)	164 (45.6)	69 (57.5)	65 (54.2)	30 (25.0)	30.933***	0.001
Processor (Yes=1)	61 (16.9)	3 (2.5)	51 (42.5)	7 (5.8)	84.005**	0.001
Broker (Yes=1)	52 (14.4)	3 (2.5)	49 (40.8)	0 (0.0)	101.733	0.001
Negotiation between all actors (Yes=1)	5 (1.4)	2 (1.7)	1 (0.8)	2 (1.7)	0.406	0.816
Do not know (Yes=1)	21 (5.8)	8 (6.7)	13 (10.8)	0 (0.0)	13.047***	0.001

Notes: Figures in parentheses indicate percent. '***' and '**' denote significant at 1 and 5 percent level of significance, respectively.

3.2.3 Marketing channels of rice value chain in the study area

Table 3 illustrates the marketing channels of the rice value chain across Jhapa, Rupandehi, and Kailali. Six major channels were identified, showing clear regional variations. The most dominant channel overall is Marketing Channel I (Producer–Collectors–Processor–Wholesalers–Retailers–Consumers), accounting for 41.6% of total transactions, and similarly prevalent in Jhapa (44.4%) and Rupandehi (43.4%), but lower in Kailali (33.7%). Marketing Channel II (Producer–Processors–Wholesalers–Retailers–Consumers) follows with 20.3%, being more common in Kailali (28.0%). Marketing Channel III (Producer–Collectors–Processor–Retailers–Consumers) represents 16.9%, with relatively even distribution across districts. This long channel dominates likely because it ensures better market access, efficient distribution, and risk sharing among intermediaries. Farmers may rely on collectors and wholesalers due to limited market information, capital, and transport facilities.

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Shorter chains, such as Marketing Channel IV (Producer–Cooperatives–Consumers, 10.3%), Channel V (Producer–Rice Millers–Consumers, 8.2%), and Channel VI (Producer–Consumer, 2.8%), indicate limited instances of direct or cooperative marketing. Overall, the results suggest that rice marketing in the study area is dominated by multi-intermediary channels, highlighting a complex and intermediary-driven value chain structure. The details of the marketing channels are mentioned in Table 3. In the same line, Nainabasti and Bai (2010) reported that wholesalers handle a large amount (56.4%) of rice distribution; it distributes 35.8% to the consumer and 20.6% to the retailers. Retailers obtained 20.6% from wholesalers, 11.8% from rice millers and 4% from rice brokers.

Table 3: Market channel of rice value chain in the study area

Value chain type	Overall frequency (f)	Overall percentage (%)	District					
			Jhapa		Rupandehi		Kailali	
			Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)	Frequency (f)	Percentage (%)
Marketing Channel I (Producer- Collectors- Processor- Wholesalers- Retailers- Consumer)	239	41.6	91	44.4	89	43.4	59	33.7
Marketing Channel II (Producer- Processors- Wholesalers- Retailers- Consumers)	117	20.3	39	19.0	39	19.0	49	28.0
Marketing Channel III (Producer- Collectors- Processor- Retailers_ Consumer)	97	16.9	31	15.1	36	17.6	30	17.1
Marketing Channel IV (Producer- Cooperatives- Consumers)	59	10.3	30	14.6	18	8.8	11	6.3
Marketing Channel VI (Producer- Rice Millers- Consumers)	47	8.2	10	4.9	17	8.3	20	11.4
Marketing Channel V (Producer-Consumer)	16	2.8	4	2.0	6	2.9	6	3.4
	575*	100.0	205.0	100.0	205.0	100.0	175.0	100.0

Source: Computed from field survey data, 2022 (* *multiple responses were recorded*)

The data indicates a highly fragmented rice value chain, dominated by Channel I (41.6%) with multiple intermediaries. This reflects farmers' limited market access and dependence on middlemen due to inadequate infrastructure and capacity for direct marketing, leading to reduced profit margins for producers (Ghimire et al., 2021). This finding is supported by studies across South Asia, which note that traditional, multi-tiered supply chains dominate due to economies of scale in handling and transport, even though they often reduce the producer's share of the consumer price (Minten et al., 2020). In contrast, the least used channel is the direct Producer-Consumer link (2.8%), highlighting a significant

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gap in short food supply chains. The key implication is a strong need for institutional interventions to improve market efficiency. Promoting farmer cooperatives (Channel IV) and collective marketing can reduce the number of intermediaries, thereby increasing farmers' profit margins and strengthening their bargaining power, as demonstrate d in studies on collective action in Nepal (Shrestha et al., 2022).

Thus, the dominance of longer channels suggests farmers receive lower profit margins, as multiple intermediaries capture value along the chain. Strengthening shorter and cooperative-based channels could improve farmers' income and enhance market efficiency in the rice sector.

3.2.4 Actors involved in marketing channels of rice across the study area

The study assessed the marketing channels used by rice producers among the three districts of Terai region. The finding was a case of multiple response selected by the respondents. The results revealed statistically significant inter-district differences in marketing of rice produced by farmers (Table 4).

Table 4: Prevalence of marketing channels among farmers by district (n=360)

Variables	Overall (n=360)	District			χ^2-value	p-value
		Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)		
Cooperative (Yes=1)	56 (15.6)	39 (32.5)	15 (12.5)	2 (1.7)	44.704***	0.001
Local trader (Yes=1)	244 (67.8)	109 (90.8)	99 (82.5)	36 (30.0)	119.534***	0.001
Mandi (Yes=1)	209 (58.1)	18 (15.0)	89 (74.2)	102 (85.0)	139.921***	0.001
Feed mill (Yes=1)	33 (9.2)	18 (15.0)	14 (11.7)	1 (0.8)	15.813***	0.001
Grain mill (Yes=1)	102 (28.3)	24 (20.0)	76 (63.3)	2 (1.7)	118.523***	0.001
Neighbor/relatives (Yes=1)	48 (13.3)	13 (10.8)	26 (21.7)	9 (7.5)	11.394***	0.003

Notes: Figures in parentheses indicate percent. *** denote significant at 1 percent level of significance. # Refer multiple responses were allowed.

The findings revealed significant district-wide differences in rice marketing channels ($p < 0.01$). Local traders (67.8%) and mandis (58.1%) dominate overall, with Jhapa farmers mainly selling to local traders, Rupandehi to grain mills, and Kailali to mandis. Cooperative involvement was generally low, particularly in Kailali, indicating uneven access to organized markets and a reliance on informal or private channels. Overall, rice marketing structures vary notably across districts. Local traders are the main outlet in Jhapa and Rupandehi, while mandis play a central role in Rupandehi and Kailali. Grain mills are prominent in Rupandehi but limited elsewhere, and cooperatives remain marginal overall. This pattern highlights a fragmented market landscape where farmers' access to organized markets is constrained, reinforcing dependence on intermediaries.

These results emphasize the need for district-specific market interventions, including strengthening cooperative networks, improving infrastructure, and enhancing farmers' direct market participation to boost bargaining power and overall value chain efficiency.

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In the same line, Gautam and Poudel (2022) reported that the heavy reliance on local traders over formal institutions like cooperatives is a common feature in Nepal's agricultural landscape, often attributed to inadequate market infrastructure and farmers' limited capital, which forces them to sell to intermediaries for immediate cash.

The significant spatial variation in channel use, with the dominance of Mandi in western districts, reflects the uneven development of market institutions across Nepal, a finding consistent with other studies on regional agricultural trade patterns (Shrestha et al., 2021).

The minimal role of cooperatives, particularly in Kailali, underscores the challenges of collective action and the underdevelopment of farmer-oriented institutions in the region, which has been identified as a key constraint to improving farmers' market power and income (Chaudhary et al., 2020).

3.2.5 Factors influencing the marketing channel

The spider chart illustrates key factors influencing marketing channel selection, based on insights from interviewees. The spider chart shows that channel buying capability (41.11), transportation cost (40.28), and personal relationships (39.72) are the most influential factors in farmers' choice of marketing channels, while production (19.72) and incentives (31.39) are least influential.

The findings suggest that farmers prioritize buyers' financial strength, ease of logistics, and trusted relationships over price incentives. Strengthening these aspects—such as improving buyer reliability, transport facilities, and relationship networks—can enhance market efficiency and farmers' decision-making power in the rice value chain.

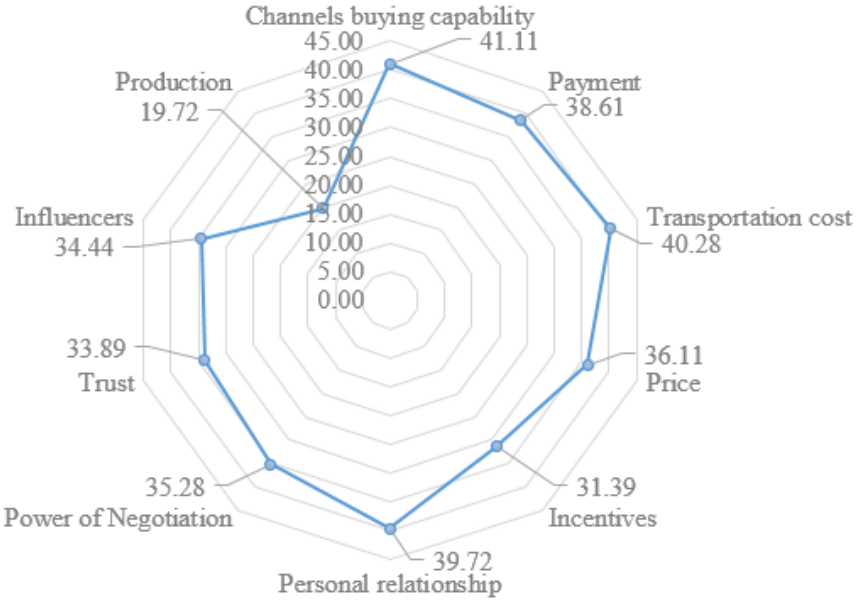

Figure 3: Priority of factors by actors

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3.2.6 Marketing Cost and Marketing Efficiency

Table 5 below analyzes marketing costs across three districts: Jhapa, Rupandehi, and Kailali. The analysis revealed that packaging and transportation costs show statistically significant variation ($\chi^2 = 12.366$, p=0.001) between districts. Jhapa consistently incurs the highest mean costs for both packaging and transportation (NPR 4,769 and NPR 3,363, respectively), followed by Rupandehi, with Kailali reporting the lowest. In contrast, the analysis found no statistically significant difference (p=0.491) in loading/unloading costs across the districts, suggesting these expenses are relatively uniform regardless of location.

Table 5: Cost associated with marketing (NPR)

Variables	Overall (n=360)	District			F-value	p-value
		Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)		
Packaging cost (n=89)	2878.51 (3733.25)	**4769.04[a]** (4445.20)	3353.05 [b] (3766.71)	661.49[c] (402.91)	12.366***	0.001
Transportation cost (n=155)	1354.59 (1570.92)	**3363.33[a]** (2719.39)	1797.43[b] (2320.24)	1102.25[b] (578.72)	9.643***	0.001
Loading/Unloading cost (n=88)	976.48 (650.39)	**1446.43[a]** (984.90)	770.90[a] (448.38)	975.05[a] (653.74)	0.717	0.491

Notes: Figures in parentheses indicate standard deviation. *** denote significant at 1 percent level of significance. Means followed by different letters a, b and c differ significantly at $p < 0.001$ (LSD test). Means with the same letter are not significantly different.

The significant differences in packaging and transportation costs suggest that geographic and infrastructural factors are major cost drivers. Potential reasons include Jhapa and Rupandehi's greater distance from supply hubs, poorer road conditions increasing transport fees, or less competitive local markets for packaging materials and freight services. The uniformity in loading/unloading costs implies a standardized labor market for this service, where rates are not significantly influenced by the specific district. Paudel and Shrestha (2019) reported that their study on rice marketing in Nepal's Terai region found that the cost of transportation and packaging varied significantly across different districts, with eastern districts often incurring higher costs. The study concluded that remoteness from major milling centers and wholesale markets was a primary factor, forcing traders to travel longer distances and incur greater packaging expenses for protection during transit. Research on the rice value chain specifically identified Jhapa as a production surplus area. While it produces high volumes, traders there face higher "costs for transporting rice to deficit areas in the hills and other regions," which aligns with your finding of Jhapa's highest mean transportation cost (Ghimire & Wen-Chi, 2017). This is often due to longer haulage distances and less competitive freight availability for outbound goods. A study on agricultural labor in Nepal noted that rates for manual tasks like loading/unloading sacks of paddy and rice are remarkably consistent within the Terai's agricultural belts. The author states that these "wage rates are largely determined

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by local market norms and the physical nature of the work," rather than the specific district, leading to the non-significant variation you observed (Sugden, et al. 2020).

Transportation costs constitute a major operational expense for rice traders in Nepal's Terai, significantly affecting profitability. These costs vary with distance to major markets, fuel prices, road conditions, and vehicle type or capacity. The study found that shared truck use (saajha) is the most cost-effective strategy, adopted by 58% of large traders, followed by individual truck hires (23%) and owned vehicles (19%). Transporting full 8–10 ton loads lowers per-unit costs, while poor road conditions increase expenses. The cost of transporting rice from the Terai to Kathmandu ranges between NPR 1,500 and NPR 6,000 per metric ton. Findings align with K.C. and Sah (2019), Thapa et al. (2025), and Bassey et al. (2013), all emphasizing that shared transportation effectively reduces marketing costs and enhances trader profitability. In conclusion, while transportation costs in the Terai are variable, they are a major factor in the profitability of rice traders. The prevalent use of shared trucks is a direct strategy to mitigate this high operational expense. The marketing efficiency index for the paddy-rice value chain as given by Acharya (2003) was calculated to be 0.58, indicating suboptimal performance (Annex 2). This metric served as a proxy for overall value chain efficiency in the analysis. The result revealed that rice marketing in the study area is poor or inefficient. Similarly, Bidyasagar and Nicra (2017) in their study in India reported that marketing efficiency ranges from 0.675 to 0.880, depending on the marketing channel. Valery et al. (2022) in their study in Cameroon reported that market structure and conduct have a positive and significant influence on the performance of the Ndop rice marketing. Thus, strengthening farmers' cooperatives, streamlining the supply chain, promoting value-added products, and leveraging technology are essential to improve the rice value chain.

3.2.7 Mode of payment in rice marketing

The results show significant district-wide variation in payment modes ($p < 0.01$). Down payment (61.4%) is the most common method overall, followed by payment within one week (37.8%). Jhapa shows higher use of advance and short-term payments, Rupandehi relies more on delayed payments, and Kailali predominantly uses down payments. These differences indicate uneven cash flow and trust dynamics across regions. Strengthening timely payment systems and transparent agreements could improve farmers' financial security, trust in buyers, and overall market efficiency in the rice value chain. In the same line, Adhikari and Bohara (2018) found advance payments secure supply in high-production areas like Jhapa, while down payments ensure sellers' immediate liquidity, explaining their prevalence in local markets such as Kailali. Long-term credit in Rupandehi likely reflects the presence of larger agri-businesses, as such terms are typically extended by big millers and traders to trusted suppliers (Ghimire & Wen-Chi, 2017), consistent with findings on rice value chain finance. Variation in payment modes reflects regional differences in market structures and trust levels, as credit terms are localized and shaped by power dynamics, trust networks, and commercial practices unique to each area (Poudel & Matsuoka, 2008).

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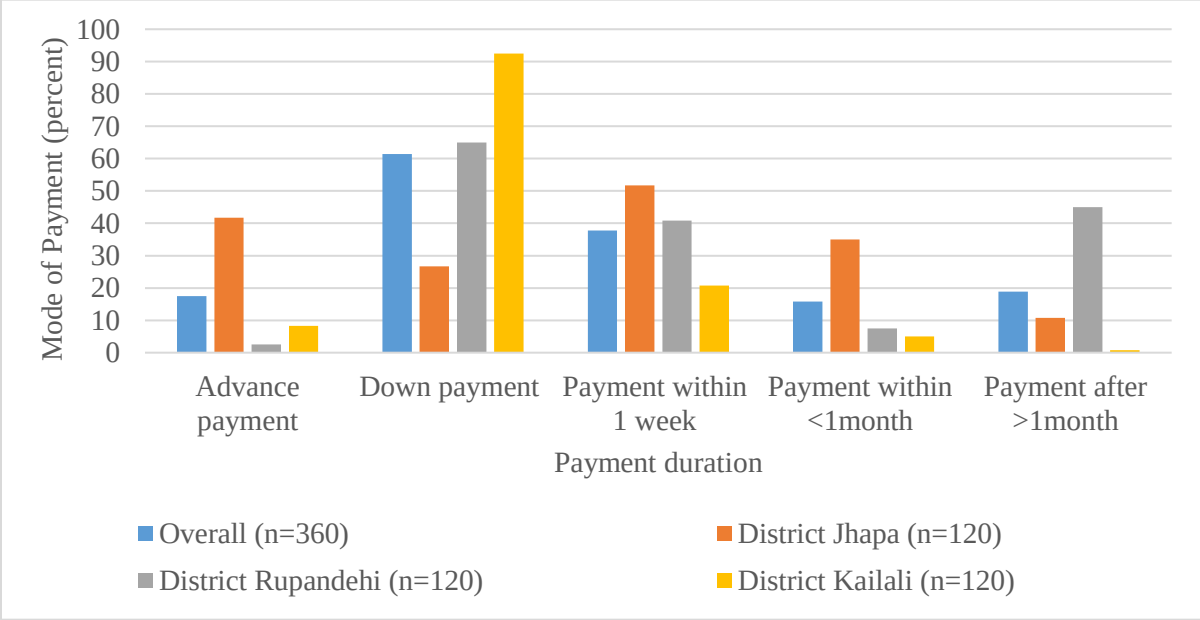

Figure 3: Mode of payment (multiple response)

3.2.8 Marketable and marketed surplus in the study areas

In the study areas, the marketable surplus was 15,665 tons (total production minus household consumption), while the marketed surplus—the quantity actually sold is 12,781 tons, indicating a portion of the available surplus was retained for other uses.

3.2.8.1. Marketable Surplus

This is the total quantity of production that remains available for sale after deducting what is kept for the producer's own use (household consumption, seeds, feed, etc.). Of the total production of 18,731 tons, the amount kept for the producer's own household consumption was 3,066 tons. This leaves a marketable surplus of 15,665 tons available for sale.

3.2.8.2. Marketed Surplus

This is the quantity from the marketable surplus that is actually sold in the market, this is 12,781 tons. The key implication is that the marketable surplus of 15,665 tons significantly exceeds the marketed surplus of 12,781 tons, revealing a gap of 2,884 tons. This indicates that while this quantity of rice was theoretically available for sale, it was not commercially transacted. Instead, it was likely allocated for other critical on-farm uses such as seed for the next season, animal feed, payment-in-kind to laborers, building a household buffer stock, or lost to post-harvest spoilage and pests. Consequently, the marketed surplus ratio stands at 68.2%, meaning just over two-thirds of the total production was actually sold in the market.

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Figure 6 below shows that total rice production across districts is 18,731 MT, of which 3,066 MT (16.4%) is used for household consumption, leaving a marketable surplus of 15,665 MT. Out of this, 12,781 MT (81.6%) is actually marketed. Kailali has the highest marketed surplus (5,310 MT), followed by Jhapa (4,553 MT) and Rupandehi (2,918 MT). The findings indicate a strong market orientation of rice farmers, particularly in Kailali, suggesting better commercialization potential. However, differences in marketed surplus highlight the need for improved market access, infrastructure, and value chain linkages to enhance sales efficiency across districts.

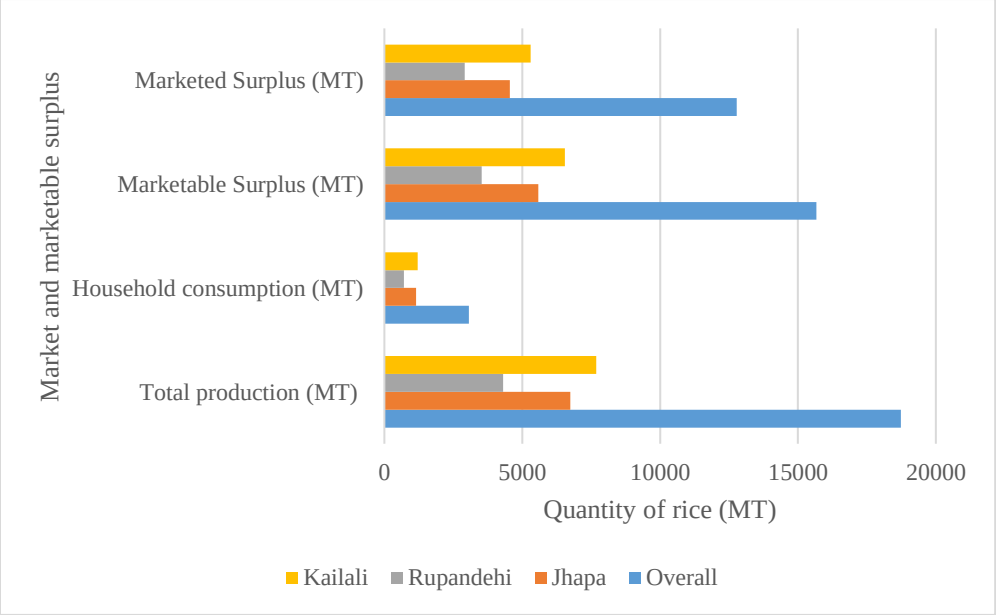

Figure 4: Marketable and marketed surplus of rice across the three districts

3.2.9 Buyer requirements, Value addition, and Marketing practices of rice farmers

The results show significant district-wide differences in buyers' requirements, value addition, and marketing practices ($p < 0.01$). Overall, only 26.1% of farmers reported buyer quality specifications, and 15.6% added value before selling. Jhapa and Rupandehi were more involved in value addition and collective marketing, while Kailali showed minimal participation. About 58.6% sold to the same buyer annually, indicating stable trading relationships. Storage facilities were more common in Jhapa (72.5%) than in Rupandehi (43.3%) and Kailali (23.3%), with most farmers gaining higher prices after storage.

The findings highlight uneven market development across districts. Enhancing collective marketing, storage access, and value addition can improve farmers' market participation, bargaining power, and income in the rice value chain. Finally, marketing practices and farmer awareness are highly heterogeneous, indicating that localized factors and infrastructure play a critical role in shaping market participation and outcomes.

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Table 6: District-wise comparison of buyers' requirements, value addition, and marketing practices of rice farmers

Variables	Overall (n=360)	District			χ^2-value	p-value
		Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)		
Do buyer demands specifying quality and technical specification (Yes=1)	94 (26.1)	14 (11.7)	28 (23.3)	52 (43.3)	31.905***	0.001
Add value before selling (Yes=1)	56 (15.6)	26 (21.7)	27 (22.5)	3 (2.5)	23.388***	0.001
Buy back arrangement (Yes=1)	5 (1.4)	1 (0.8)	1 (0.8)	3 (2.5)	1.623	0.444
Sell to same buyer every year (Yes=1)	211 (58.6)	84 (70.0)	43 (35.8)	84 (70.0)	38.497***	0.001
Follow collective marketing with provision of collection center (Yes=1)	64 (17.8)	47 (39.2)	16 (13.3)	1 (0.8)	62.749**	0.001
Storage facility (Yes=1)	167 (46.4)	87 (72.5)	52 (43.3)	28 (23.3)	58.997***	0.001
Get high price while selling after storage (Yes=1)	117 (70.1)	66 (75.9)	25 (48.1)	26 (92.9)	20.314***	0.000

Source: Computed from field survey data, 2022

*Notes: Figures in parentheses indicate percent. *** and ** denote significant at 1 and 5 percent level of significance respectively.*

3.2.10 Government support and interventions

In the study areas, government support for rice marketing and processing firms focuses on financial, infrastructural, technical, and policy measures to enhance competitiveness and reduce post-harvest losses. Financial aid includes subsidized loans, investment grants, and support through programs such as the Prime Minister's Agriculture Modernization Project (PM-AMP), which funds warehouse construction, drying floors (10 MT/day), and custom hiring centers. It also provides machinery, vehicles, and packaging materials. Technical support involves technology transfer, training in quality control, value addition, and business management. Policy incentives include tax relief, export promotion, and cooperative strengthening. Market linkage initiatives such as Market Information Systems (MIS) and trade fairs improve information flow and access to broader markets. Key institutions; MoALD, MoICS, NARC, and PM-AMP jointly implement these programs to improve efficiency, transparency, and value addition across the Terai's rice value chain. Furthermore, knowledge of the Minimum Support Price (MSP) is generally low across all districts at 18.6%. While knowledge is similar in Jhapa (23.3%) and Rupandehi (22.5%), it is significantly lower in Kailali (10.0%). Among those aware of the

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MSP, a majority (65.7%) believe it is effective, with farmers in Rupandehi (85.2%) perceiving it as most effective and those in Kailali (50.0%) perceiving it as least effective.

3.2.11 Post-harvest losses

3.2.11.1 Farmer Awareness and perceptions of post-harvest losses

The survey data reveals significant regional disparities in post-harvest knowledge and perceptions among rice farmers. Overall awareness of post-harvest losses stands at 57.2%, but this varies dramatically by district. Jhapa demonstrates the highest awareness level at 79.2%, followed by Kailali at 64.2%, while Rupandehi shows a markedly lower awareness at just 28.3%. This difference is statistically highly significant.

Table 7: Post-harvest information (categorical variable)

Variables	Overall (n=360)	Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)	χ^2-value	p-value
Aware about post-harvest losses (Yes=1)	206 (57.2)	95 (79.2)	34 (28.3)	77 (64.2)	66.884***	0.001
Know about MSP (Yes=1)	67 (18.6)	28 (23.3)	27 (22.5)	12 (10.0)	8.839**	0.012
Is MSP effective (Yes=1)	44 (65.7)	15 (53.6)	23 (85.2)	6 (50.0)	7.686**	0.021

Post-harvest information (continuous variable)

Variables	Overall	Jhapa (n=120)	Rupandehi (n=120)	Kailali (n=120)	F-value	p-value
Opinion on post-harvest losses in rice (%), n=206	6.04 (3.30)	4.57 (1.86)	8.29 (2.70)	6.86 (4.03)	24.244***	0.001

Source: Computed from field survey data, 2022

Finally, among aware farmers, the average estimated post-harvest loss is 6.04%. However, the perceived magnitude of loss also differs significantly by location. Farmers in Jhapa, who are most aware of losses, report the lowest estimated rate (4.57%), whereas farmers in Rupandehi, who have the lowest awareness, report the highest estimated losses (8.29%).

3.2.11.2 Grading, standardization and labelling of rice

In the Terai region, grading, standardization, and labelling are key components for rice quality assurance. The Nepal Bureau of Standards and Metrology (NBSM) regulates grading under NNS 400:1992, classifying rice into Special, Grade 1, Grade 2, and Grade 3 based on purity, type, and moisture. While large mills and exporters comply, local markets rely on visual grading and traditional names like Mansuli and Basmati. Standardization and labelling—overseen by NBSM and Department of Food Technology and Quality Control (DFTQC)—require quality, hygiene, and product details, but compliance among small millers is weak due to low awareness, poor facilities, and

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enforcement gaps. Overall, challenges include widespread informal trade and high compliance costs. Yet, increasing consumer awareness and initiatives like geographical indication (e.g., Nepali Basmati) are gradually promoting formalization in rice marketing.

3.3 Challenges in Rice Production and Marketing

3.3.1 Major constraints in rice production

Nepal's Terai region, the nation's rice hub, faces multiple challenges from input access to post-harvest losses and weak market linkages. Socioeconomic and institutional barriers further hinder productivity and sustainability. Identifying and ranking these issues is vital for informed policymaking and targeted interventions to strengthen the region's rice sector resilience.

This study revealed that post-harvest and socioeconomic constraints outweigh traditional agronomic issues in rice production. The lack of drying facilities ranked as the most severe problem (Index = 0.547), followed by labor shortages (0.513), limited access to improved seed (0.498), low mechanization (0.498), and poor storage facilities (0.497). Irrigation, pests, and climate risks were less critical. The study underscores the need for policies focusing on post-harvest infrastructure and labor management to enhance farmers' income stability and overall production resilience in the Terai (Bhattarai et al., 2024). In the same line, Choudhary et al. (2022) find that while input access has improved, post-harvest handling and market access remain key limits to raising rice productivity in Nepal. Likewise, Thapa et al. (2022) and Lamichhane et al. (2022), document labor shortages from out-migration and show adoption of scale-appropriate mechanization improves rice outcomes. The findings imply that improving post-harvest infrastructure, labor availability, and mechanization should be prioritized over traditional agronomic interventions to enhance rice production efficiency and sustainability in Nepal's Terai region.

Table 8: Ranking of major constraints in rice production

Constraints	Index value	Rank
Lack of drying	0.547	I
Shortage of labor	0.513	II
Availability of improved seed	0.498	III
Lack of mechanization	0.498	IV
Lack of storage facility	0.497	V
Lack of insurance/ loans/ securities	0.482	VI
Delay in fixation of MSP	0.478	VII
Lack of improved technology/ training	0.464	VIII
Low production/ yielding varieties	0.458	IX
High incidence of disease and pests	0.458	X
Lack of irrigation	0.437	XI
Lack of implementation of MSP	0.428	XII
Climatic hazards	0.394	XIII
Lack of government support	0.365	XIV

Source: Computed from field survey data, 2022

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3.3.2 Marketing bottlenecks

Farmers in the study areas face significant price volatility and lack of access to real-time market information, which consistently puts them at a disadvantage during negotiations and sales. This uncertainty is compounded by high post-harvest losses due to inadequate storage facilities, such as dryer facilities, lack of modern warehouses and silos. This often forces them into distress sales immediately after harvest, leading to both quantitative and qualitative losses. Poor rural infrastructure raises transport costs, while a fragmented supply chain dominated by intermediaries shrinks farmer profits. This perpetuates a focus on selling raw paddy instead of value-added processed rice. The lack of organized marketing and direct market access traps farmers in dependence on local markets and middlemen, severely limiting their potential for higher, more stable incomes and stifling investment in branded products.

3.3.3 Post-harvest losses

In the study area, post-harvest losses in rice were found to rice occur at various stages due to traditional practices, inadequate infrastructure, and limited access to modern technologies. The major stages where post-harvest losses in rice occur were harvesting, threshing, drying, storage, milling, transportation and market handling. At harvesting stage, 2-4% losses through delayed harvesting, grain dropping and manual handling in the study areas. In the same line, Gautam et al. (2020) reported that premature/delayed harvesting and manual sickle use cause 2-5% losses. Labor shortages often force rushed harvesting, worsening grain losses. During threshing stage, a total loss of 4-6% occurs, attributable to scattering, grain breakage and animal trampling. According to Karkee and Paudel (2016) traditional methods involving animal trampling cause 4-7% losses through grain breakage and scattering during threshing. Although mechanical threshers are available, they remain unaffordable for most of the farmers (MoALD, 2021a). In the study areas, open-air sun-drying results in 5-7% losses from birds, rodents, pests and wind during drying stage. In the same line, Shrestha and Mishra (2018) reported that the drying stage accounts for 4-11% losses as sun-drying on open surfaces exposes grains to birds, rodents, and wind scatter. Uneven drying promotes mold growth and aflatoxin contamination, while sudden rainfall often damages unprotected grains before collection (USAID, 2019). During the storage, due to limited storage facilities, pest and moisture damage result in 6-10% losses in the study areas. Inadequate storage facilities like bamboo bins and mud granaries result in 5-12% losses from pest infestations and moisture damage (Shrestha & Mishra, 2018). Without hermetic storage, many Nepalese farmers are forced to sell their rice immediately to avoid spoilage (MoALD, 2021a). Rice milling in Nepal's Terai region suffers from significant losses due to outdated machinery and traditional practices, leading to high grain breakage, poor quality output, and reduced economic returns for farmers. A study found that losses during the milling stage account for 4-8% of the total yield. In the same line, Traditional hullers and outdated milling machines cause 5–11% losses through excessive grain breakage and inefficient polishing, which significantly reduces the market value of Nepalese rice (Ghimire et al.,

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2022; IFPRI, 2017). Inadequate packaging, improper handling, and a lack of storage facilities cause a 2-4% post-harvest loss during transport and market handling in the study area. Furthermore, inadequate market storage facilities contribute to additional spoilage, compounding post-harvest losses in Nepal's rice value chain (FAO, 2018). The study revealed 20-25% post-harvest rice losses in Nepal's Terai, driven by outdated technology, manual labor, weak infrastructure, and climate risks. Essential interventions include improved drying, hermetic storage, mechanization, farmer training, and upgraded milling and market facilities to significantly reduce these losses. The rice market in Nepal's Terai is characterized by a fragmented supply chain dominated by local traders and middlemen, leading to low price realization for farmers. Farmers often sell their paddy immediately after harvest due to a lack of storage and urgent cash needs, which forces them to accept lower prices. This traditional system is inefficient, with poor market information and weak integration between producers and larger consumer markets or processors.

4. POLICY IMPLICATIONS AND RECOMMENDATIONS

The analysis of production challenges and marketing bottlenecks in the Terai highlights the urgent need for policies that go beyond simply increasing production. A more integrated approach is required—one that strengthens the entire value chain from input supply to market access. To achieve this, several key measures are recommended. First, enhancing production efficiency and resilience is essential. This can be achieved by providing targeted subsidies for climate-resilient seeds and water-efficient irrigation technologies to help farmers cope with high production costs and climatic risks. Strengthening agricultural extension services is equally important to ensure that farmers receive timely, localized advice on pest control, water conservation, and modern production practices. In addition, greater investment in research and development is needed to produce high-yielding and disease-resistant rice varieties that suit the diverse agro-ecological conditions of the Terai. Second, improving market access and reducing transaction costs should be prioritized. Expanding rural infrastructure such as roads, collection centers, and warehouses will lower transportation expenses, minimize post-harvest losses, and improve farmers' connection to markets. Supporting farmer cooperatives can further help smallholders achieve collective bargaining power, benefit from economies of scale, and reduce reliance on intermediaries. Furthermore, developing user-friendly digital platforms that share real-time price information and link farmers directly with buyers will enhance market transparency and access to finance. Third, reducing post-harvest losses through modernization is critical. This can be done by promoting improved storage technologies—such as hermetic silos and metal bins—through subsidies or credit support, helping farmers preserve quality and avoid distress sales. Investments in local processing and value addition, including rice branding and packaging, will also allow farmers to retain a larger share of the final market value within the region. Finally, strengthening value chain linkages will ensure better returns for farmers. Creating opportunities for contract farming and procurement agreements between cooperatives and large buyers can secure stable prices and consistent demand.

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Effective implementation of the Minimum Support Price (MSP) is also vital; it should be announced in a timely manner, clearly communicated, and reliably enforced to provide a guaranteed price floor. In addition, building farmers' capacity through training on quality standards, grading, and buyer-specific requirements will help them access premium markets and improve their overall competitiveness. Together, these actions form a comprehensive strategy to make the Terai's rice value chain more efficient, resilient, and equitable—benefiting both producers and the broader agricultural economy.

5. CONCLUSION

This study examined rice growers' perceptions in Nepal's Terai region regarding changes in area, production, yield, and marketing dynamics of rice. Farmers widely perceived declining rice production and yield across the Terai, particularly in Kailali, indicating localized production stress, while their belief in stable cultivation area suggests a perception gap with official data showing gradual area decline. A distinct regional difference was observed in the study as eastern districts like Jhapa showed stronger collective marketing and storage, while central and western areas face tighter buyer demands. These patterns highlight the influence of local infrastructure and institutions. Farmers reported that high production costs, price instability, and limited access to finance are more serious constraints than agronomic issues such as irrigation and pests. The study provides practical insights for farmers, traders, and policymakers by identifying key barriers and priority areas for intervention. Its findings call for region-specific and inclusive policies that strengthen market access, improve financing, and enhance awareness of support mechanisms like the Minimum Support Price. For government institutions, the evidence supports investment in storage, collective marketing, and digital systems to promote fair pricing and stable incomes for rice farmers.

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Competing interests

Authors have declared that no competing interests exist.

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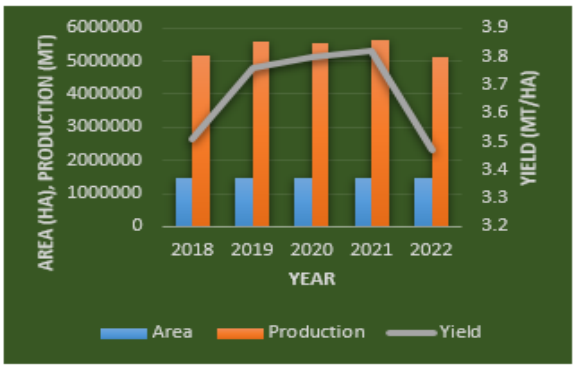
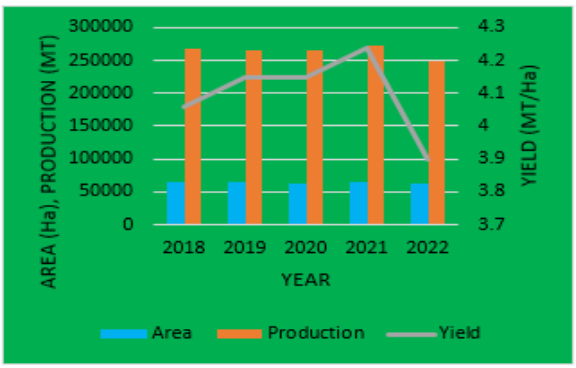
Annex

Annex 1: Trend of area, production and yield of rice in Jhapa, Rupandehi and Kailali over the period of 2018 to 2022

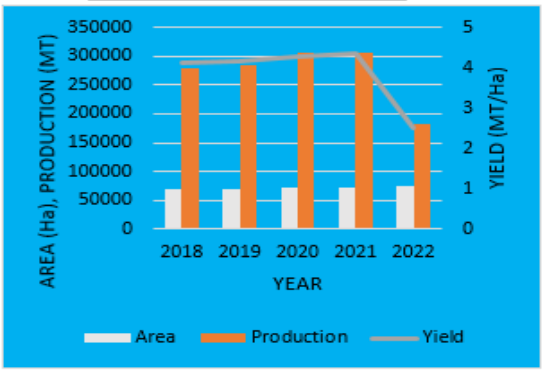


National

District: Jhapa



District: Rupandehi



District: Kailali

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Annex 2: Marketing cost and marketing margin distribution and marketing efficiency among rice value chain actors in Nepal

Particulars	Total	Producer	Collector	Processor	Wholesaler	Retailer
Net price received by farmers	30					
buying cost / Kg		20.75	30.00	32.00	68.00	69.02
Marketing Cost (MC)/kg	8.5	1.5	0.5	5	0.5	1
Total cost/Kg		22.25	30.5	37	68.5	70.02
Sales price /kg		30	32	68	69.02	72.47
Marketing Margin	43.22	7.75	1.5	31	0.52	2.45
Producer's share (%)		41.40				
Price Spread (NRs)		51.72				
Marketing Efficiency		0.58				