

Post-Intervention Outcomes in Farmer Behaviour and Crop Diversification in Rajshahi, Bangladesh

Research note 36
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ABOUT THIS NOTE

Crop production is predominantly rice-centric in Bangladesh and, although economically rational, is risky and arguably unsustainable (Nandi et al., 2024). In response, crop diversification emerged as an important strategy for achieving sustainable agriculture in Bangladesh (Rahman et al., 2024). On-farm trials were conducted to evaluate new cropping patterns in the Rajshahi district and promote crop diversification among smallholder farmers. This brief summarizes the results from post-intervention outcomes in farmer behavior covering a) preferred cropping patterns among farmers; b) perceived benefits, challenges, and transaction costs of crop diversification, and c) market awareness among trial farmers. Data were collected through face-to-face surveys involving on-farm trial farmers in the Rajshahi district.

KEY FINDINGS

1. Nearly all farmers (99%) preferred Aman rice as their main crop during the Aman season, with minimal crop diversification and little interest in other crops.
2. Mustard was the most preferred crop for 76.78% of farmers, followed by Boro rice (40.76%) and wheat (28.91%), highlighting mustard's prominence alongside rice and wheat in Rajshahi during the Robi/Boro season.
3. A majority of farmers (78.6%) recognized crop diversification as beneficial for enhancing food availability for household consumption. Additionally, 62% reported increased income, and 59% cited the creation of diversified income streams as key benefits of crop diversification.
4. Limited knowledge about alternative crops (69.2%) and lack of agronomic skills (67.2%) were reported as the top challenges to diversification. Farmers also faced difficulties managing multiple crops (49.2%) and expressed concerns about financial risks associated with new crops.

5. Managing multiple crops was perceived as costly and time-consuming by farmers. Around 82% indicated that crop diversification demands more knowledge, 65% cited increased costs for machinery, and 53% reported higher financial burdens.
6. Despite the potential benefits, 83% of farmers were not part of farmer collectives. However, 92% expressed interest in joining collectives, which they believe could reduce production costs and improve market access.

BACKGROUND

On-farm research trials are part of TAFSSA's Work Package 2 (WP2) activities, which focus on farm and landscape-level interdisciplinary research. On-farm trials were carried out to explore crop diversification options at both field and landscape scales, supporting multiple benefits, including potential nutritional yield, across the environmental and socio-economic gradients of rice-based farming systems. The Rangpur and Rajshahi divisions in northern Bangladesh have been selected as learning sites based on critical information regarding food and nutrition security gaps, environmental stresses, climate challenges, and the presence of commodities and farming systems with the greatest potential to achieve TAFSSA's outcomes.

While exploring the options to diversify prevailing rice-based cropping systems to more diversified cropping systems through on-farm trials, it is imperative to understand farmer behavior in this transition. This shift can be complex and challenging for farmers, involving changes in practices, knowledge, and potentially economic considerations.

OBJECTIVES

To assess the cropping preferences of smallholder farmers in Rajshahi,

focusing on their transition from rice-dominant systems to diversified crops, while investigating the benefits, perceived challenges, economic, agronomic, market influences, transaction costs, and the impact of on-farm trials on their decision-making processes.

METHODOLOGY

Refer Cheesman et al. (2022, 2023) for detailed methodology followed to conduct the on-farm trial experiments. The link can be found at <https://hdl.handle.net/10568/127991>.

Surveys of on-farm trial farmers were conducted to understand the post-intervention outcomes in farmer behavior in Rajshahi, and the farmer behavior-related questions are analyzed, and the brief results are presented in this research note.

RESULTS

PREFERRED CROPPING PATTERNS AMONG SMALLHOLDER FARMERS TOWARD CROP DIVERSIFICATION

On-farm trials were conducted to explore crop diversification options. The proposed cropping patterns for different seasons are outlined by Cheesman et al. (2022, 2023). However, post-season farmer surveys revealed discrepancies between the cropping patterns preferred by the farmers and those tested in the trials.

This discrepancy underscores the complexities of cropping pattern selection in specific seasons market demand and economic viability influence farmers' preferences for cropping patterns. Besides, environmental factors such as climate, soil type, water availability, and

technological advancements are critical in determining suitable cropping patterns (Oli, L. B., 2023). Figure 1 shows the crop preferences of farmers in Rajshahi during the Robi/Boro season, based on responses from 211 farmers.

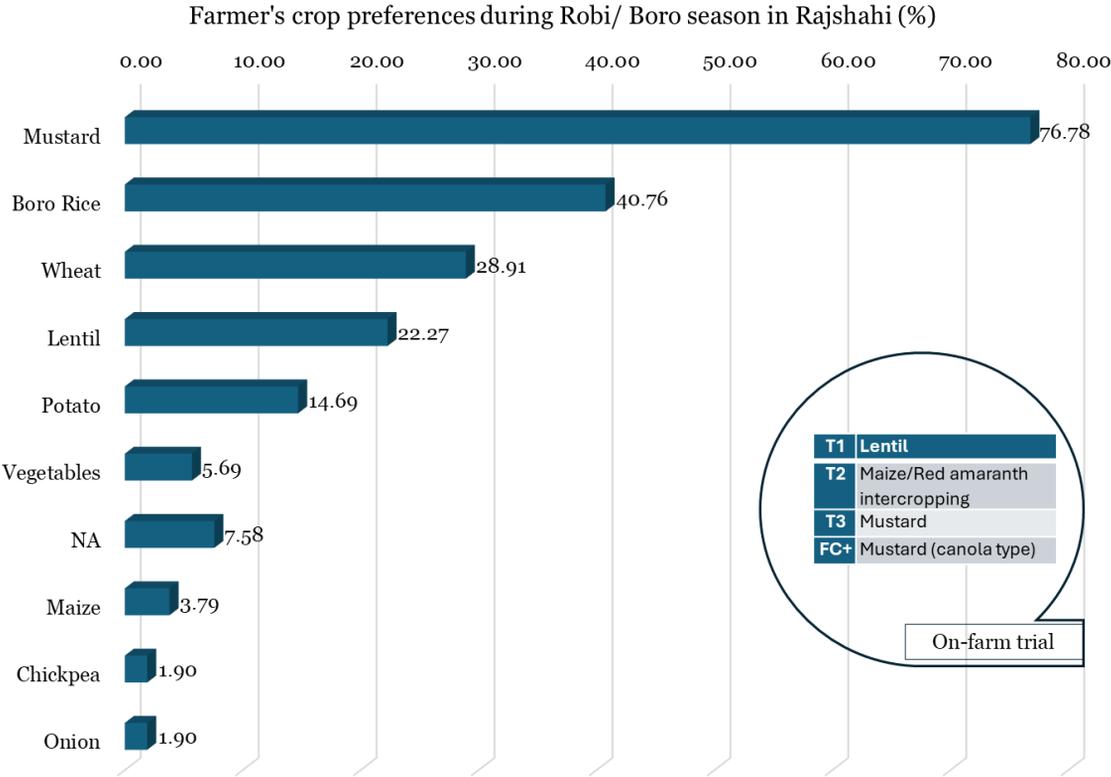


Figure 1: Farmer's crop preferences in Robi/ Boro season in Rajshahi (%) (Mentioned maximum 2 desired crops): n=211

Mustard is the most preferred crop during Boro season, with 76.78% of farmers selecting it as the first option, highlighting its significance as a preferred in the district. Following mustard, 40.76% of farmers chose Boro rice as the second option, while 28.91% preferred wheat, making these two crops also important during this season. Other crops like lentils

(22.27%), potatoes (14.69%), vegetables (5.69%), maize (3.79%), and chickpeas and onions (1.90% each) are other crops preferred in Rajshahi.

Further, Figure 2 shows farmers' crop preferences during the Aus/Kharif 1 season in Rajshahi.

A significant portion of farmers (68.72%) indicated "NA" (Not Applicable), suggesting either farmers don't grow any crop during Aus, or the land may not be suitable to grow specific crops being asked in the list. Among those who did specify a crop, Aus was the most commonly preferred, chosen by 58.77% of farmers.

Vegetables were selected by 20.85% of the farmers, demonstrating its continued relevance across different seasons in Rajshahi. A smaller portion, 7.58% each, opted for maize and mustard, showing that some farmers diversify with maize and mustard cultivation.

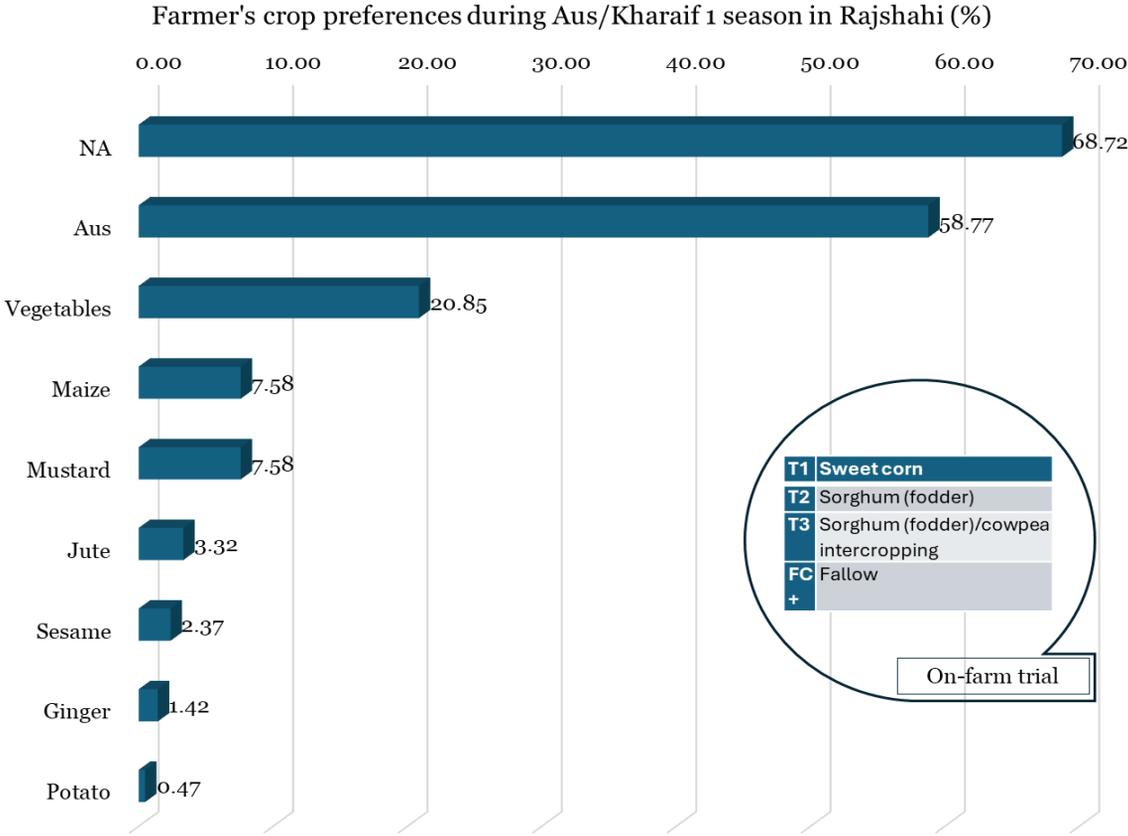


Figure 2: Farmer's crop preferences in Aus/ Kharif 1 season in Rajshahi (%) (Mentioned maximum 2 desired crops): n=211

Similarly, Figure 3 shows the farmer's crop preference during the Aman/Kharif 2 season. Aman rice is indicated by almost all the farmers highlighting the most important crop as the first option during the Aman/Kharif 2 season in Rajshahi, with 99% of farmers choosing it. A large percentage (58.77%) either did not specify a crop or chose "NA." which

means they don't prefer any other crops during this season other than Aman rice.

Besides, 35% of farmers opted for vegetables, and 6.16% for maize, indicating very limited diversification in crop selection during this season in Rajshahi.

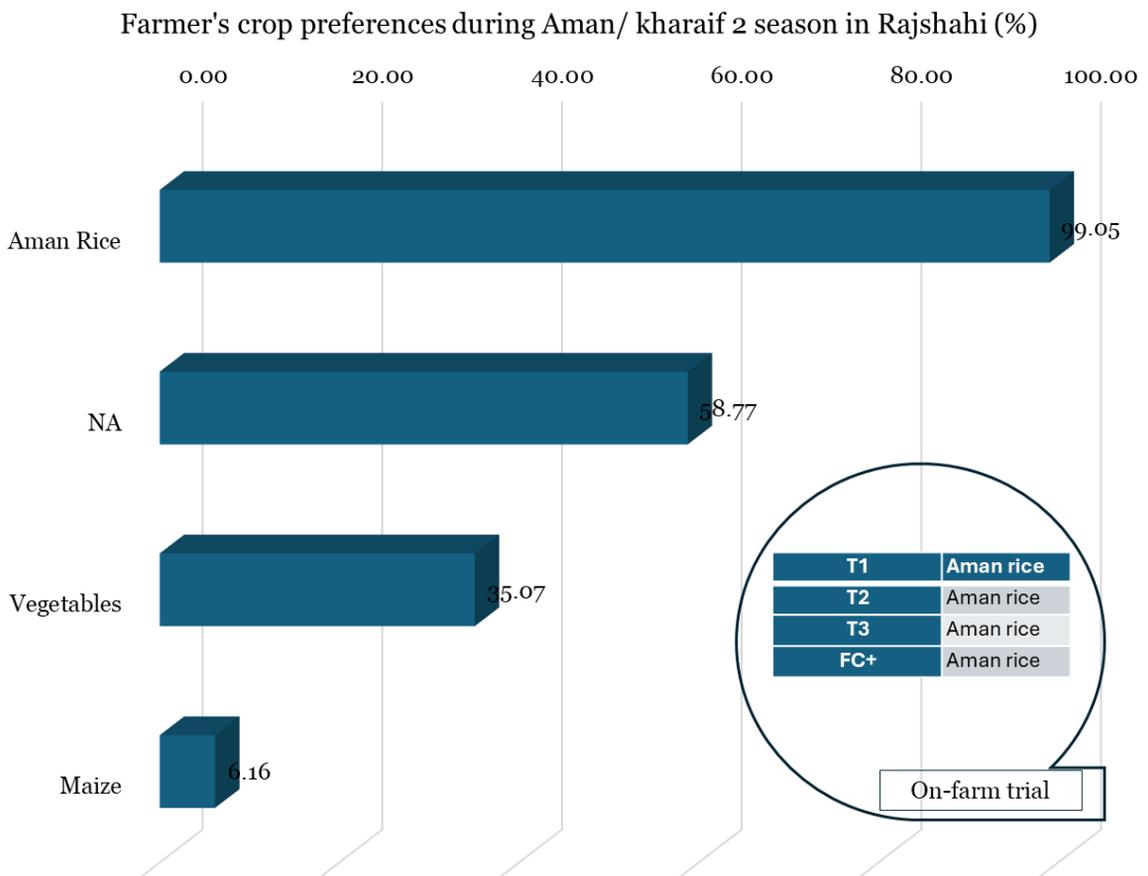


Figure 3: Farmer's crop preferences in Aman/Kharif 2 season/Rainy season in Rajshahi (%) (Mention maximum 2 desired crops)

Farmer's preferences for specific crops across the treatments and seasons. Crop preferences across four treatments (AgP+, AgP+&N, C, and N) during the Aman season in Rajshahi, based on responses from 211 farmers is as shown in Figure 4. Aman rice has the highest preference across all treatments, indicating that it is the most widely preferred crop. The response rates are slightly lower in AgP+, AgP+&N for Aman rice, indicating a preference for other crops than Aman rice which is as usual scenario for all farmers.

This reduced preference for Aman rice can be attributed to agronomic and

nutrition training to promote crop diversification. While the second option indicated as NA (Not applicable) is seen across all treatments, slightly varies across the treatments. 'NA' refers to either farmers not interested in a second crop besides Aman rice in Aman season or their land is not suitable for other crops listed due to high rainfall. The preference for Vegetables remains low across all treatments. This suggests that Aman rice remains the dominant crop choice, while a significant portion of farmers either do not specify a preference or choose no preference.

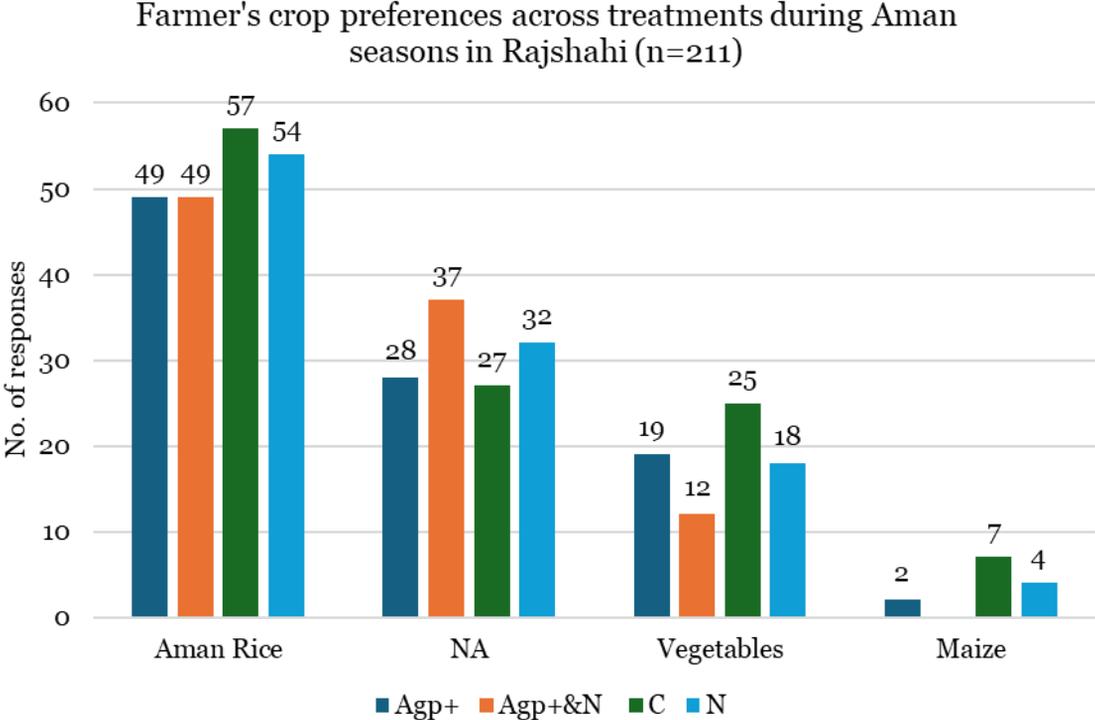


Figure 4: Farmer's crop preferences across treatments during Aman seasons in Rajshahi (n=211)

During Kharif 1, there is a noticeable difference in farmers' preferences for specific crops across the treatments (Figure 5), compared to the Aman season. NA (no preference or not applicable) dominates across all treatments, with the highest responses in AgP+N (46), followed by AgP+ (34), C (33), and N (32) which indicates no specific crop preference,

due to the land left fallow or not suitable for growing specific crops listed. Aus is the most preferred crop, particularly in the N and C treatments. Conversely, AgP+N (1) treatments have the least preference, while AgP+ (29) preference. Less preference in treatments AgP+ and AgP+N could be due to their preference for other crops.

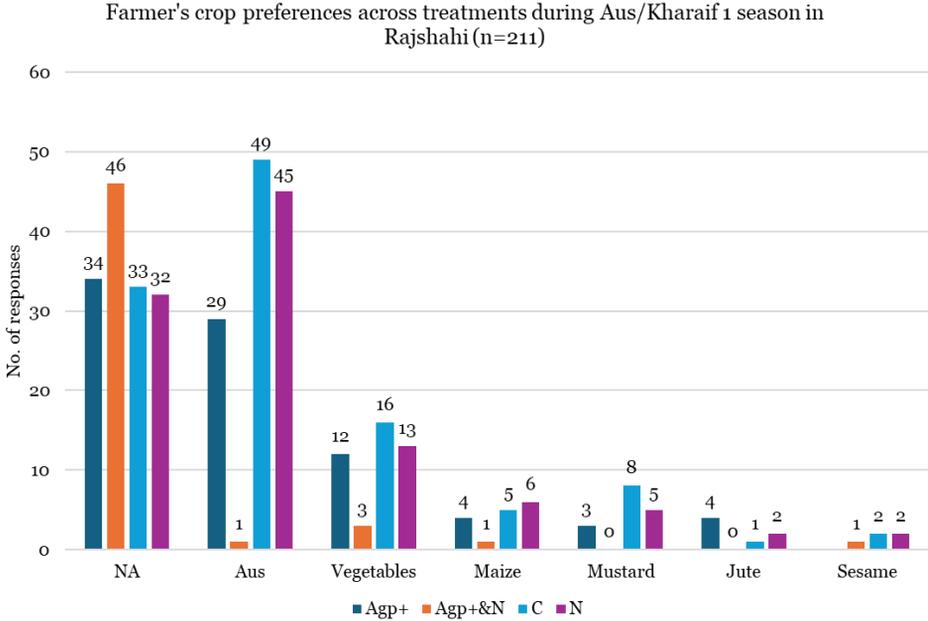


Figure 5: Farmer's crop preferences across treatments during Aus/Kharaif 1 season in Rajshahi (n=211)



Above: Farmers parboiling rice; Photo: CIMMYT

Similarly, during the Robi/Boro season, as shown in Figure 6, mustard is the most preferred crop across the treatments, particularly in the AgP+&N

and N treatments. Boro rice also popular, particularly in the AgP+&N treatment.

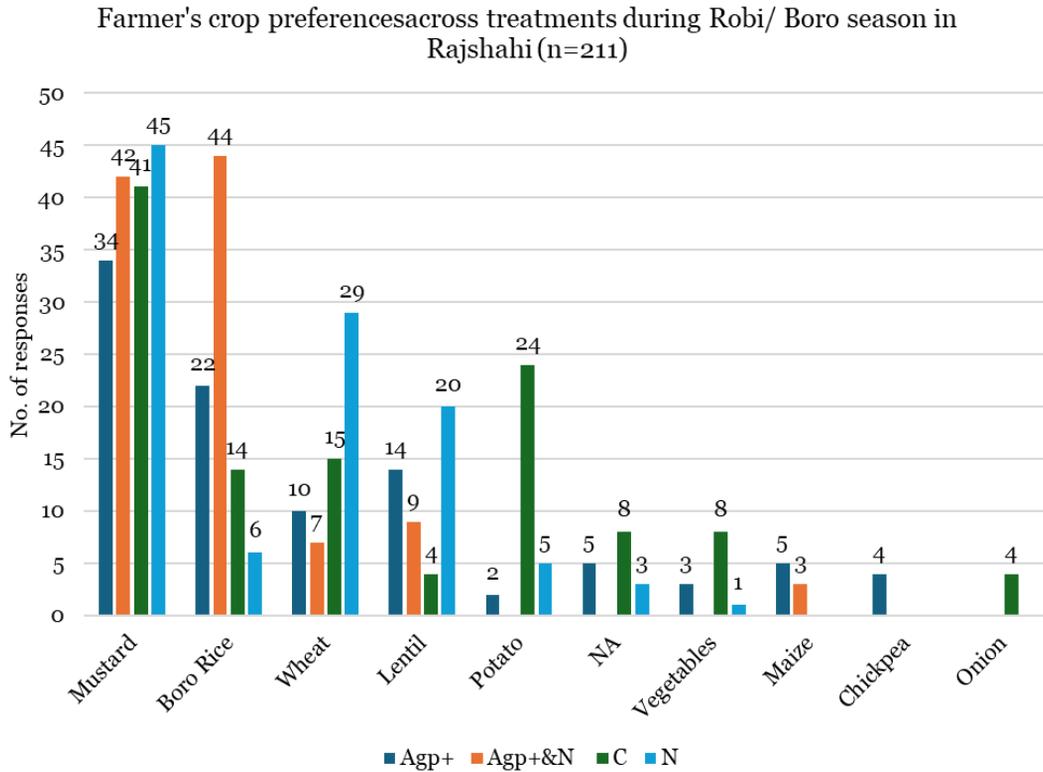


Figure 6: Farmer's crop preferences across treatments during Robi/Boro season in Rajshahi (n=211)



Above: Farmer's crop preferences; Photo: CIMMYT

FARMER'S PERCEIVED BENEFITS OF PRACTICING CROP DIVERSIFICATION IN RAJSHAHI

Farmers in Bangladesh are gradually transitioning from their historical reliance on rice to cultivating a more diverse range of crops (Nandi et al., 2023). Over the past decade, the area under high-value crops, such as fruits and vegetables, has steadily increased. Understanding the benefits that farmers derive from shifting away from intensive mono-cropping patterns to more diverse cropping systems is crucial. Crop diversification is a key approach to sustainable agriculture, offering numerous benefits, including enhanced agricultural resilience, improved farmer incomes, and better food security (Enamul H., 2022).

In the current research, on-farm trial farmers were surveyed about the benefits they experienced after adopting crop diversification on their farms. Figure 7 provides a descriptive analysis of farmers' perceptions of these benefits, as identified by farmers in the Rajshahi district of Bangladesh. The majority of respondents (78.6%) indicated that crop diversification enhances the availability of diverse foods for home consumption, suggesting that the primary perceived benefit is having a variety of crops to meet household food needs. This finding supports existing literature that farm production diversity is positively associated with dietary diversity (Nandi et al., 2021).

Additionally, 62.0% of respondents believed that crop diversification increases income, particularly on small landholdings, highlighting its economic potential. About 59.0% of farmers agreed that crop diversification creates diversified

income streams, reducing dependence on a single crop and thereby enhancing financial resilience. Regarding risk reduction, such as mitigating crop failure, pest outbreaks, or price falls, 44.1% of farmers acknowledged this benefit, reflecting their recognition of crop diversification as a strategy to manage farming risks. Moreover, 33.6% of respondents stated that crop diversification helps them better tolerate price instability for various farm products, contributing to greater economic stability. An equal percentage of farmers also noted that diversification reduces production costs, indicating its potential for promoting more efficient farming practices. In terms of environmental benefits, 28.8% of farmers mentioned that crop diversification improves soil health and fertility.

However, only 24.0% of respondents recognized its role in the conservation of natural resources, such as soil, water, and fauna, indicating that environmental benefits are less commonly associated with crop diversification among the surveyed farmers. Economic gains are prioritized over environmental benefits. Studies have shown that crop diversification enhances income streams (Enamul H., 2022), food security (Singh et al., 2022), nutritional benefits (Feliciano D., 2022), and soil health improvements (Emran et al., 2022).

Similarly, on-farm trial farmers were asked about the challenges they are experiencing in practicing crop diversification in their farms. Figure 8 shows, a descriptive analysis of farmers' perceived challenges associated with crop diversification.

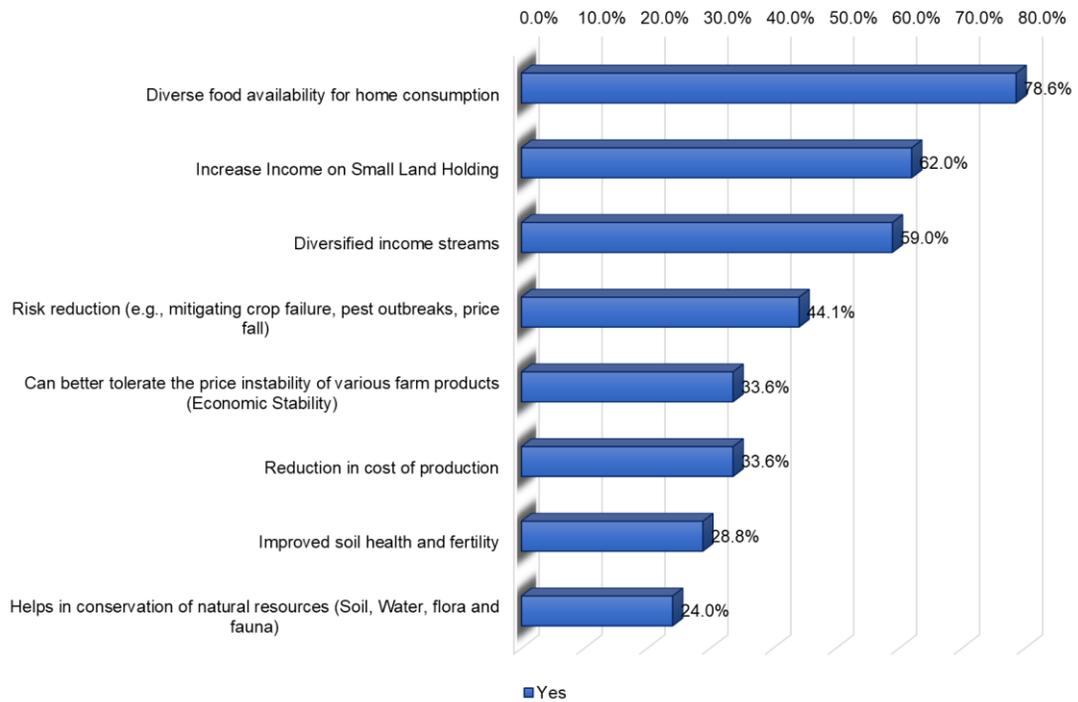


Figure 7: Farmer's perceived benefits of practicing crop diversification in Rajshahi (n=250)

Similarly, on-farm trial farmers were asked about the challenges they are experiencing in practicing crop diversification in their farms. Figure 8 shows, a descriptive analysis of farmers' perceived challenges associated with crop diversification.

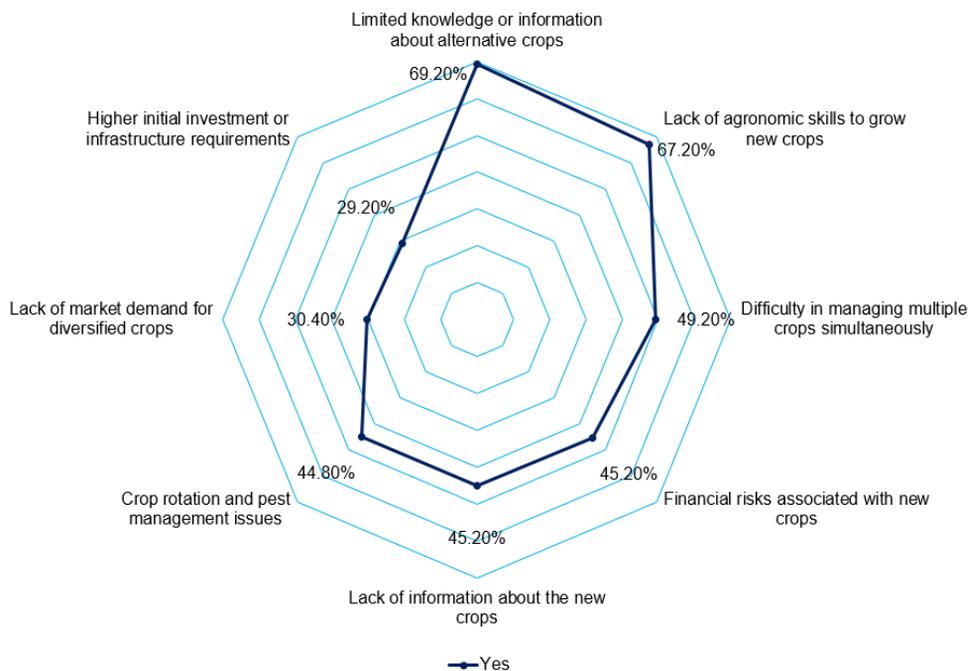


Figure 8: Farmer's perceived challenges of practicing and continuing crop diversification (n=250)

The results reveal that the most significant challenge, reported by 69.2% of farmers, is limited knowledge or information about alternative crops. This indicates that a lack of awareness or access to information is the primary obstacle to adopting new crops. Similarly, 67.2% of respondents cited a lack of agronomic skills needed to grow new crops, highlighting technical expertise as another major barrier to cultivating alternative crops. Additionally, 49.2% of farmers reported difficulty in managing multiple crops simultaneously, emphasizing the complexity of handling a diversified crop portfolio. Financial risks associated with new crops were also a concern for 45.2% of farmers, reflecting apprehension about the economic uncertainties linked to diversification. Other challenges, such as insufficient information about new crops (45.2%) and problems with crop rotation and pest management (44.8%), were also reported by a substantial proportion of farmers, underscoring the technical difficulties involved in crop diversification.

infrastructure requirements were cited by 29.2% of respondents, while 30.4% expressed concerns about limited market demand for diversified crops. Although economic and market factors are important, they pose less of a barrier compared to gaps in knowledge and technical skills. Farmers, traditionally reliant on growing rice, face substantial challenges transitioning to new crops. Studies indicate that farmers in Bangladesh often lack access to information about crop diversification techniques (Singh et al., 2022; Emran et al., 2022), which limits their ability to make informed decisions. Moreover, Bangladesh's vulnerability to climate change, including floods and droughts, negatively affects crop yields and deters farmers from adopting less resilient crops (Singh et al., 2022). These environmental uncertainties further complicate the shift to diversified systems. Coordinated efforts are essential to address these barriers and promote the adoption and scaling up of crop diversification in the Rajshahi district.



Above: A farmer putting fertilizer to maize; Photo: CIMMYT

PERCEIVED TRANSACTION COSTS ASSOCIATED WITH CROP DIVERSIFICATION AMONG SMALLHOLDER FARMERS

Transaction costs play a significant role in determining the feasibility and success of crop diversification among smallholder farmers. These include costs related to access to assets (e.g., land, machinery) and market participation. Farmers may face higher transaction costs if they lack information about market prices or if they have limited access to financial resources (Awiti et al., 2022; Pingali et al., 2005). Approximately 88.5% of farms in Bangladesh are less than 1 hectare (ha), which collectively occupies about 60% of the total farmland area. The average size of a farm is reported to be around 0.60 ha, with many farmers owning even

smaller parcels (Timsina J., 2022). Rice is the primary crop for almost all farmers, and its cultivation on a large scale reduces production costs compared to growing multiple crops on the same land (De Roest et al., 2018).

Cultivating several crops in a small piece of land may lead to higher transaction costs, due to multiple crops needing different agronomic practices at different crop cycles, different inputs, different marketplaces, and preparation of field and harvesting comes at different times resulting in higher labor costs. Studies have shown that promoting crop diversification among smallholder farmers is risky due to their exposure to several risks such as market and weather risks including higher transaction costs (Kapari et al., 2023).

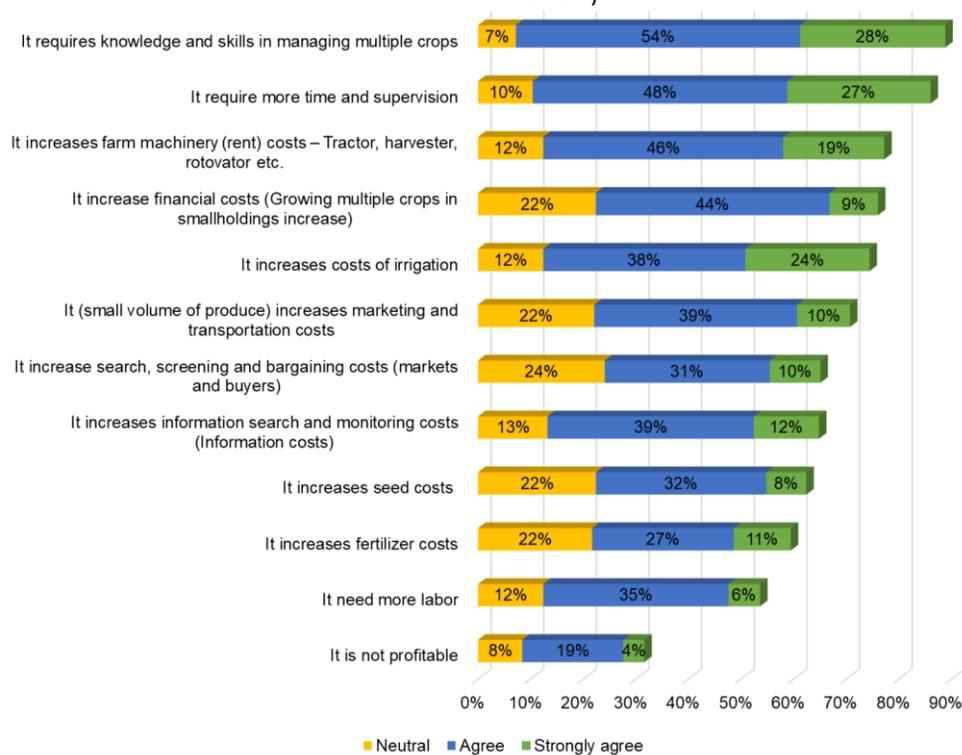


Figure 9: Farmers perceived transaction costs associated with crop diversification (n=250). Note: Responses 1 to 5 scale (1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5 strongly agree).

The current study made an effort to understand perceived transaction costs associated with crop diversification among smallholder farmers in Rajshahi. Labor demands were a concern for 41% of respondents, indicating that diversification requires more labor. However, profitability concerns were less widespread, with only 23% agreeing that crop diversification is not profitable.

UNDERSTANDING FARMERS' AWARENESS OF AGRICULTURAL MARKET FACILITIES IN RAJSHAHI

Farmers in Bangladesh face challenges in the marketing of farm produce, particularly fruits and vegetables, despite relatively being well-informed about rice marketing. The primary issues are inadequate mar

systems for these newer crops recently farmers cultivating (Quddus & Kroopp, 2020). The survey responses from on-farm trials growing vegetables highlight the marketing challenges they face with these new crops. Their responses are shown in Figure 10. Farmers exhibit relatively high awareness in several areas. For example, 67.7% of respondents are aware of the storage facilities available for their crops in the vicinity, and 64.6% know the markets where there is demand for other crops like carrots. Farmers show a reasonable level of understanding about the buyers of these crops (with 70.8% being aware) and how to prepare crops for the market (58.3%). In terms of general crop quality, quantity, and grade, about 58.3% are aware of the standards

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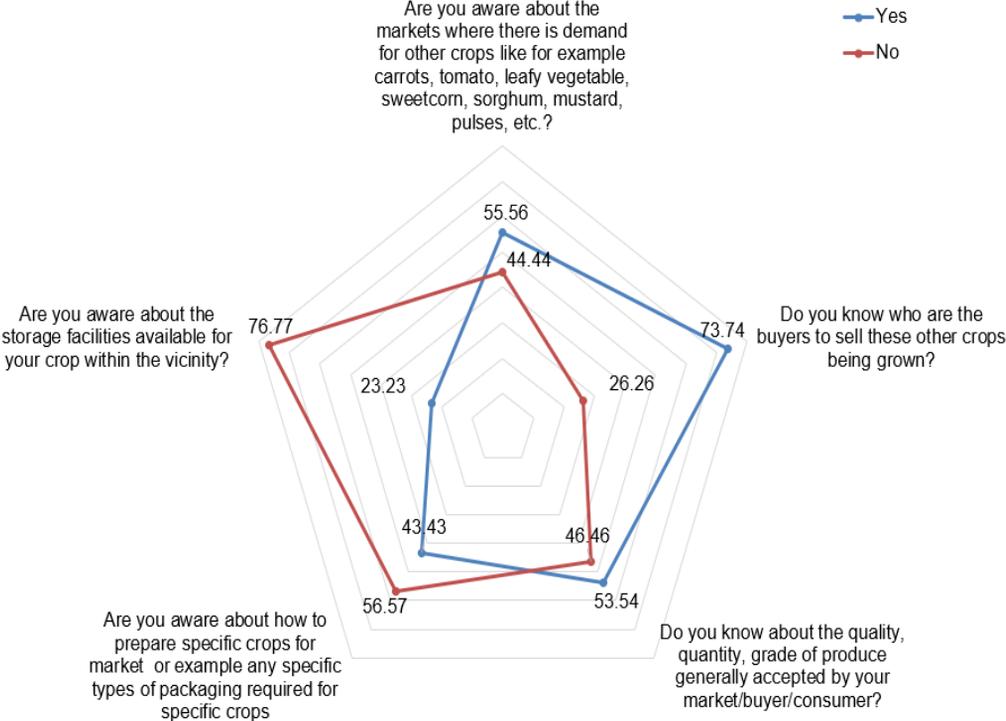


Figure 10: Farmers' awareness (%) about the marketing of new crops (n=99: Agp+ and Agp+N).

MARKETING CHANNELS USED BY FARMERS TO SELL THEIR PRODUCE

Farmers in Bangladesh use various marketing channels to sell their agricultural produce, facing challenges. The marketing system is characterized by a mix of direct sales and intermediaries, which can impact the prices that farmers receive for their produce (Rahman & Neena, 2018; Haque & Hoque, 2021). However, every year, a significant amount of harvested produce is wasted due to seasonal gluts and a lack of proper marketing networks (Haque & Hoque, 2021). For

instance, post-harvest losses of fruits and vegetables in Bangladesh are a significant concern, with estimates between 23.6% to 43.5% (5.13 million tonnes) of produce wasted after harvest worth approximately \$2.4 billion (Khatun & Rahman, 2020). The post-harvest losses and the price realization for farmers vary across marketing channels (Lutfu et al., 2019). Therefore, understanding the specific market channel farmers are using is very important.



Above: Local fruits and vegetables vendor; photo: CIMMYT

Figure 11 shows, the marketing channels used by farmers for different crops. For Aman, most farmers (57.7%) sell to wholesalers or middlemen, while 32.5% use local farmers' markets. Lentil farmers also primarily sell to wholesalers (50%), with 32.7% using farmers' markets. In contrast, Mustard is mainly sold through local markets (80.6%), with smaller numbers using direct sales or retailers (9.7% each). Both Maize and Fodder crops are evenly split between local markets and wholesalers, with 50% of farmers choosing each option. Online platforms and other methods are less commonly used across all crops. This indicates a preference for traditional sales channels over modern retail or digital platforms. Selling through the middlemen/wholesalers is an inefficient channel as farmers receive very less for their produce. Studies have shown that farmers typically

receive less than 40% of the final consumer price for their produce (varies with the type of crop). Middlemen, including merchants and retailers, capture a substantial portion of the profits, often leaving farmers with minimal returns after covering their production costs (Singha & Maezawa, 2019).

A few powerful middlemen dominate the market, dictating prices that smallholder farmers must accept. This situation is exacerbated by inadequate market infrastructure and poor transportation systems, which further limit farmers' ability to negotiate better prices. Despite the disadvantages, many farmers continue to sell through traditional middlemen (referred to as "farias") due to perceived benefits such as immediate cash payments and reduced bargaining efforts.

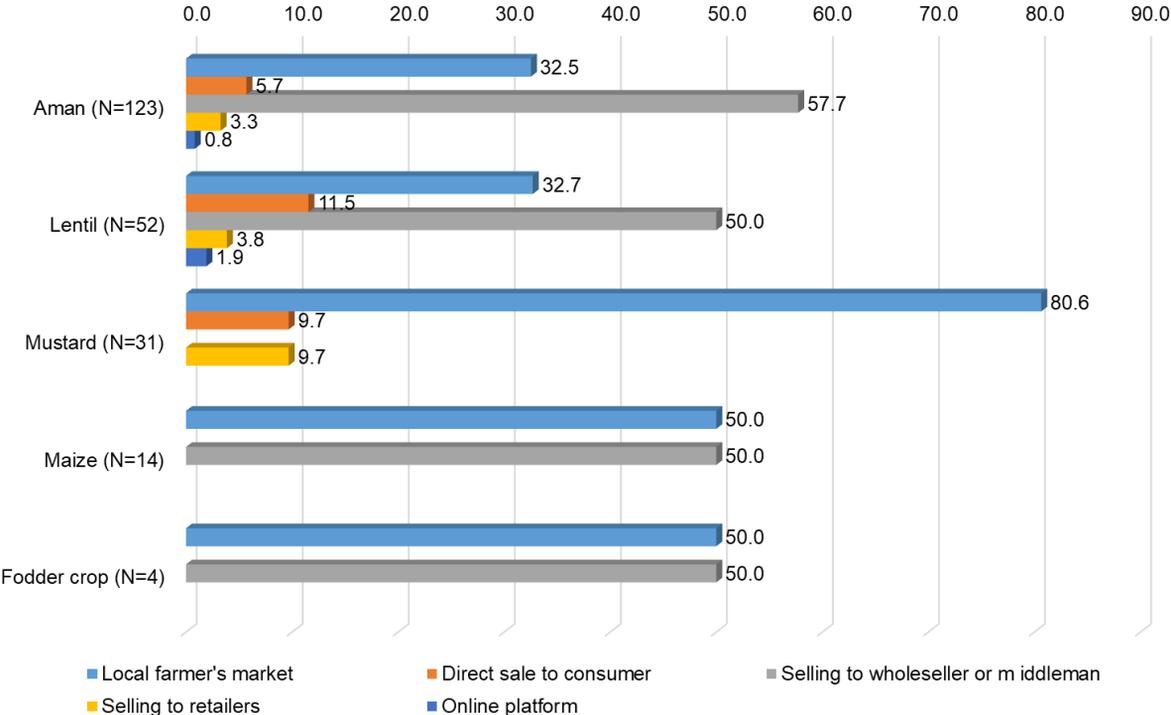


Figure 11: Various marketing channels used by on-farm trial farmers (Agp+) to sell their crops

However, studies indicate that if farmers sought alternative selling methods, they could potentially increase their profits (Singha & Maezawa, 2019). Prevailing crop-specific value chains are mapped in Rangpur district and presented in Annexure I. Due to a large number of smallholdings and resource-poor farmers with information asymmetry about the markets, there is a need for promoting farmers' collectives, such initiatives potentially empower farmers to negotiate better prices and reduce reliance on middlemen and cost of production. Additionally, establishing direct sales to e-commerce companies, and institutional buyers is a way to stabilize prices and ensure that producers receive fair prices for their crops. Studies have shown that farmers' collectives are an effective approach that increases farmers' bargaining power and can lead to better prices than individual negotiations. Besides, collectives can also help in reducing the number of intermediaries, thereby increasing the share of profits that reach the farmers (Ranjan R., 2017; Velázquez et al., 2017).

The results of this study reveal that 83 percent of the farmers mentioned they are not members of any farmer collectives, such as cooperatives, self-help groups, or producer organizations. However, 92 percent of the farmers expressed interest in joining such collectives, which they believe could reduce production costs and provide better access to market information, knowledge, experience, and bargaining power.

Additionally, 89 percent of the farmers reported that they plan to continue with crop diversification. Of the 137

farmers surveyed (Agp+ and Agp+N groups), 94 percent rely primarily on their own experience to assess market demand for specific agricultural products, while 83 percent consult with neighbors and friends. Interestingly, only 11 percent of these farmers seek advice from agricultural extension officers for market information. The least dependence on extension personnel may be their availability and technical competency.

CONCLUSIONS AND RECOMMENDATIONS

The research in Rajshahi revealed that crop diversification remains challenging for many smallholder farmers, primarily due to their strong dependence on rice, limited knowledge of alternative crops, and technical skills required for diversification. Although farmers recognize the potential economic and food security benefits of diversification, transaction costs, and technical barriers hinder widespread adoption. The study underscores the importance of addressing these barriers to help farmers transition to more sustainable farming systems. To support the farmers in Rajshahi and scale up the crop diversification efforts, the following operational recommendations may be considered.

- Expand training and educational programs focused on crop diversification, targeting both technical agronomic skills and market information. This will help overcome knowledge barriers and promote the successful adoption of new crops.

- Encourage the formation and participation of farmer groups/collectives to enhance bargaining power, reduce transaction costs, and improve access to market information and infrastructure.
- Strengthen market infrastructure and develop better marketing channels for diversified crops. This includes support for connecting farmers to institutional buyers, digital platforms, and direct sales channels to reduce dependence on middlemen.
- Address the financial risks of diversification by offering more accessible credit options and government incentives for diversifying into high-value crops such as fruits and vegetables. Support with machinery and inputs should also be increased.
- Focus on designing interventions that align with the seasonal preferences of farmers while promoting diversification beyond mustard and rice. This could include drought-resistant crops or those suited to varying soil conditions.

CROP-SPECIFIC VALUE CHAINS IN RAJSHAHI

The crop-specific value chains prevailing in the Rajshahi district are as follows:

RICE

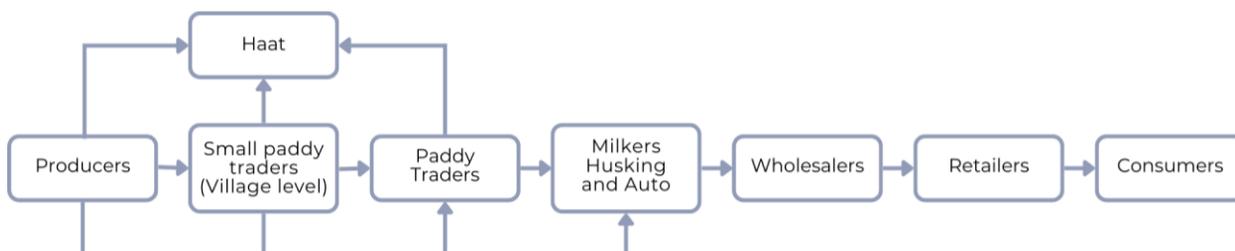


Figure 12: Rice value chain in Rajshahi. Note: The auto rice mills collect paddy directly from farmers through collection points, eliminating middlemen.

LENTIL/CHICKPEA

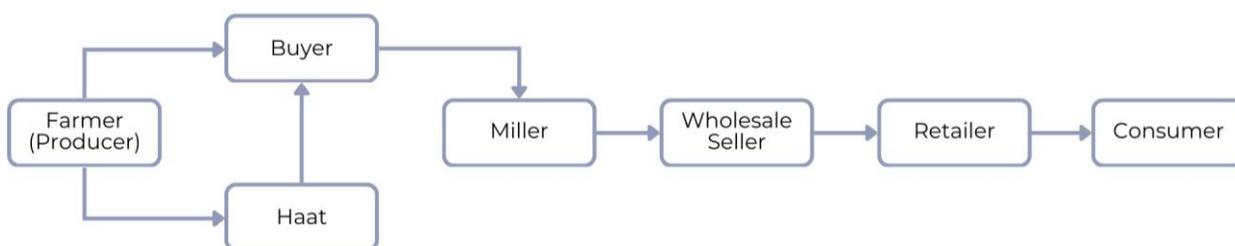


Figure 13: Lentil/Chickpea value chain in Rajshahi. Note: Local buyers collect the lentil/Chickpea from the farm gate. Some farmers sell in the local *haat* if they get a better price.

SWEETCORN

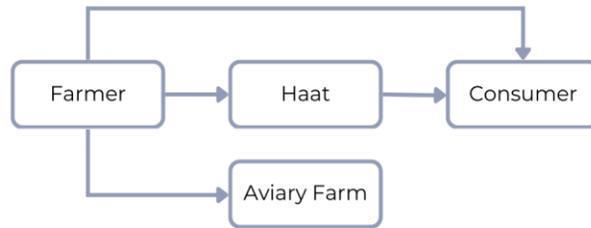


Figure 14: Sweetcorn value chain in Rajshahi. Note: Sweetcorn is relatively new in the area.

WHEAT/MUSTARD

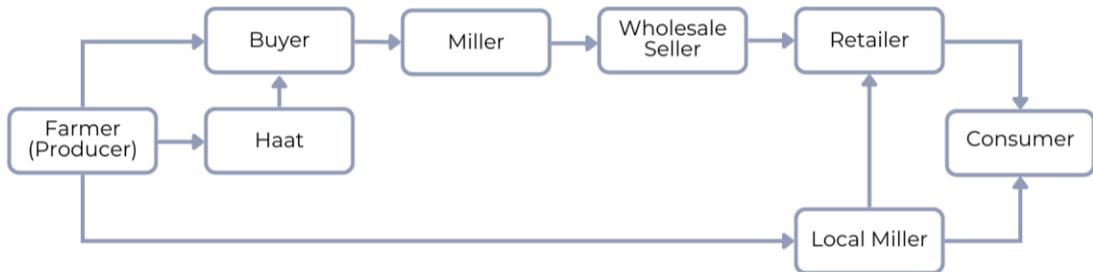


Figure 15: Wheat value chain in Rajshahi. Note: The local buyers collect the mustard and wheat from the farm gates after drying. Some farmers sell in the local market (haat) if they get a better price. Besides, some local millers collect the mustard and wheat from the farm gates and sell them to local consumers and retailers after milling.

Maize

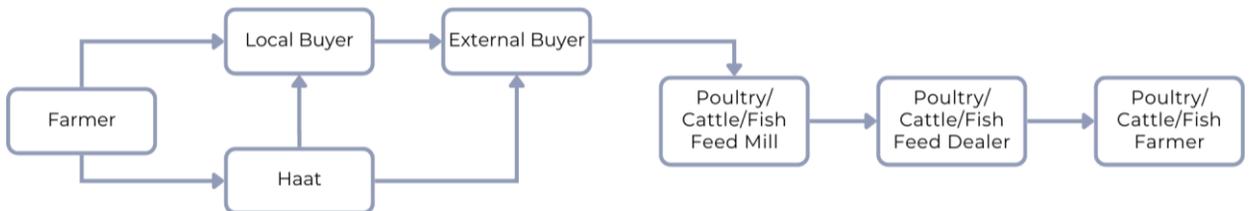


Figure 16: Maize value chain in Rajshahi

COWPEA/SORGHUM

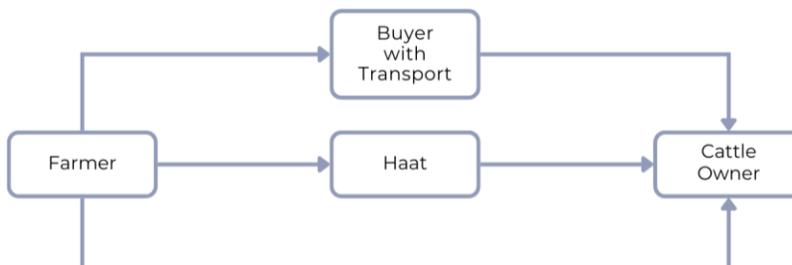


Figure 17: Cowpea/Sorghum value chain in Rajshahi.

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Above: Irrigation by Diesel Pump in Dinajpur; photo: CIMMYT

ABOUT TAFSSA

TAFSSA is One CGIAR regional integrated initiative to support actions that improve equitable access to sustainable healthy diets, improve farmers' livelihoods and resilience, and conserve land, air, and water resources in South Asia.

ABOUT CGIAR

CGIAR is a global research partnership for a food secure future. Visit <https://www.cgiar.org/research/cgiar-portfolio> to learn more about the initiatives in the CGIAR research portfolio

RUPANTAR

Rupantar explores diversification options and objectives, focusing on inclusive processes to understand the processes and practices for transforming food systems through diversification, to improve farm livelihoods while reducing inequity, production risk, and unsustainable resource use.

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