INITIATIVE ON
Transforming Agrifood Systems in South Asia

CGIAR

# Post-Intervention Outcomes in Farmers Behaviour and Crop Diversification in Rangpur, Bangladesh

Research note 37
October 2024

## ABOUT THIS NOTE

Crop production is highly rice-centric in Bangladesh and, although economically rational, is risky and arguably unsustainable (1). Crop diversification emerged as an important strategy for achieving sustainable agriculture in Bangladesh (2). On-farm trials were conducted to evaluate new cropping patterns in the Rangpur 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 on-farm trial farmers. Data were collected through face-to-face interviews in the Rangpur district.

## KEY STUDY FINDINGS

1. Rangpur has experienced a significant shift from rice-dominant to diverse cropping patterns, with the crop diversity index decreasing from 0.80 in the 1970s to 0.44 in 2023, highlighting substantial progress and potential for further diversification.
2. Aman rice remains the most widely grown crop, with a 100% preference among farmers, particularly in the Kharif 2 season. Whereas potato, maize, and groundnut are highly preferred among farmers in the Robi/Boro and Kharif seasons.
3. Farmers' preferences for cropping patterns differ from those tested on-farm trials.
4. 80% of farmers agree that crop diversification increases income on small land holdings, and 73% believe it enhances diverse food availability for home consumption.
5. Limited knowledge about alternative crops and a lack of agronomic skills are the primary barriers to crop diversification.
6. Financial risks and difficulties in managing multiple crops are significant concerns among farmers.

7. Farmers perceive high transaction costs associated with managing multiple crops, including increased costs for machinery, irrigation, and accessing markets.
8. Most farmers rely on traditional sales channels and face challenges with inadequate market infrastructure and dependence on middlemen.

## 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.

**Above:** Village female workers weeding a potato field, Rangpur, Bangladesh; photo: CIMMYT

## OBJECTIVES

To assess the cropping preferences of smallholder farmers in Rangpur, focusing on their transition from rice-dominant systems to diversified crops, while investigating the benefits, perceived challenges, economic, agronomic, and environmental factors, as well as market influences, transaction costs, and the impact of on-farm trials on their decision-making processes.

## METHODOLOGY

Refer Cheesman et al. (2022) (3,4) for detailed methodology followed to conduct the on-farm trial experiments. The link can be found https://hdl.handle.net/10568/127991.

Surveys of on-farm trial farmers are conducted to understand the post-intervention outcomes in farmer behavior in Rangpur, and the farmer behavior-related questions.

### RESULTS

*Increased trend of adoption of diverse crops among farmers in Rangpur district*

Before conducting the behavioral study analysis, it is essential to understand the current state of crop diversification in the Rangpur district. Therefore, we analyzed historical cropping pattern trends using past crop data and the summary results presented in Figure 1. Rangpur district, located in the northwest of Bangladesh, has experienced significant shifts in its agricultural practices, particularly regarding cropping patterns. These changes are driven by various factors, including climate change, economic considerations, and the need for increased food security (5). Studies highlight that Rangpur now has several cropping patterns, with rice being predominant but increasingly supplemented by other new crops. This shift is driven by the need for improved economic returns and adaptation to changing climatic conditions (5). From Figure 1, it is evident that there is a clear shift from rice dominant cropping pattern to a more diverse cropping pattern. The crop diversity index has declined from 0.80 during the 1970s to 0.44 during 2023. Meaning almost crop diversification doubled in the district. The change has been very significant in the last 10 years.

**Above:** Farmers planting paddy, Bangladesh; photo: CIMMYT

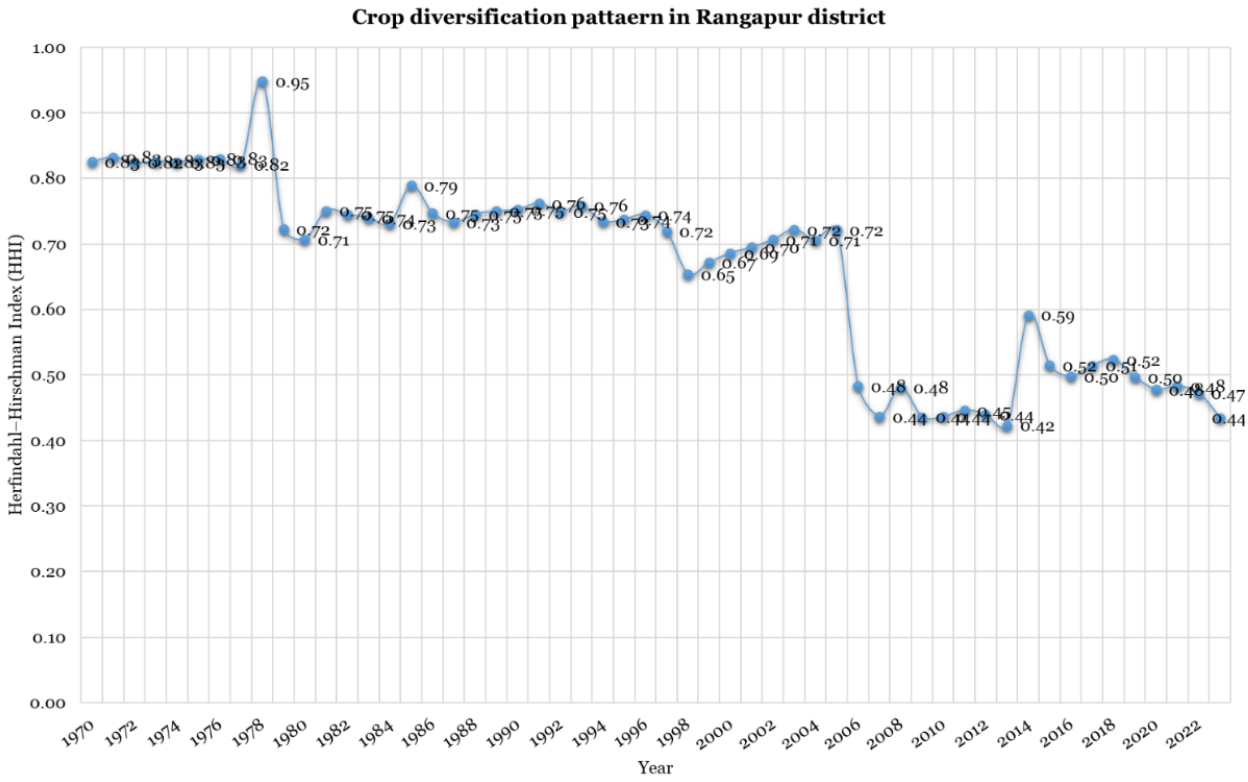


**Figure 1**: Crop diversification in Rangpur from 1970 to 2023. Source: Author's compilation using district crop statistics. Note: HHI range 0 to 1, 0 refers to perfect diversification, while 1 refers to perfect specialization (6).

The top two crops with the most significant area increase in the last 10 years are rice and mustard. The rice area expanded by 19,830 hectares, with the Aus variety increasing from 13,430 hectares to 26,300 hectares. The area under mustard saw a dramatic rise from 7,290 hectares in 2015 to 25,450 hectares in 2023, an increase of 18,160 hectares. Conversely, the bottom two crops experienced a decline in area. Jute decreased by 2,265 hectares, and wheat declined by 1,915 hectares. The area under pulses (such as lentil, mungbean, grass pea, field pea, and chickpea) is almost negligible, except for black gram. However, the area under fruits (8,300 hectares), vegetables (30,000 hectares), and onions (4,300 hectares) are steadily increasing, highlighting the potential for crop diversification in the district.

**Above:** Farmers seeding their fields, Bangladesh; photo: CIMMYT

## 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. 2023 (3,4). 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 involved in cropping pattern selection in specific seasons. Market demand and economic viability influence farmers' preferences for specific cropping patterns. Besides, environmental factors such as climate, soil type, water availability, and technological advancements are critical in determining suitable cropping patterns (7). Potato is the most preferred crop in Rangpur during Rabi, followed by Maize and Boro, with 89, 32, and 27 percent response rates respectively (Figure 2). Further, groundnut and Aus are most preferred during Kharif 1, followed by Maize and vegetables (Figure 3).

Similarly, Aman rice is widely grown, with a 100 percent response rate from farmers. Additionally, 35 percent of farmers indicated their preference for growing vegetables (Figure 4).

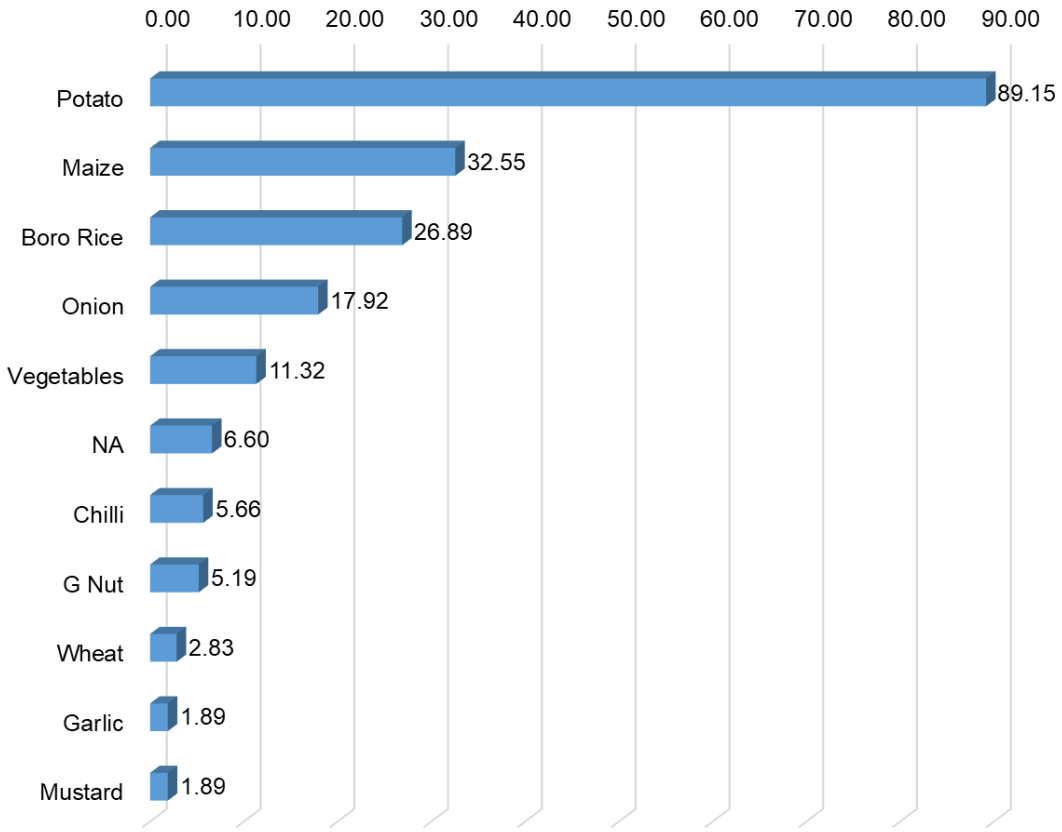


**Figure 2:** Farmer's crop preferences in Robi/ Boro season in Rangpur (%) (Mention maximum 2 desired crops): n=212

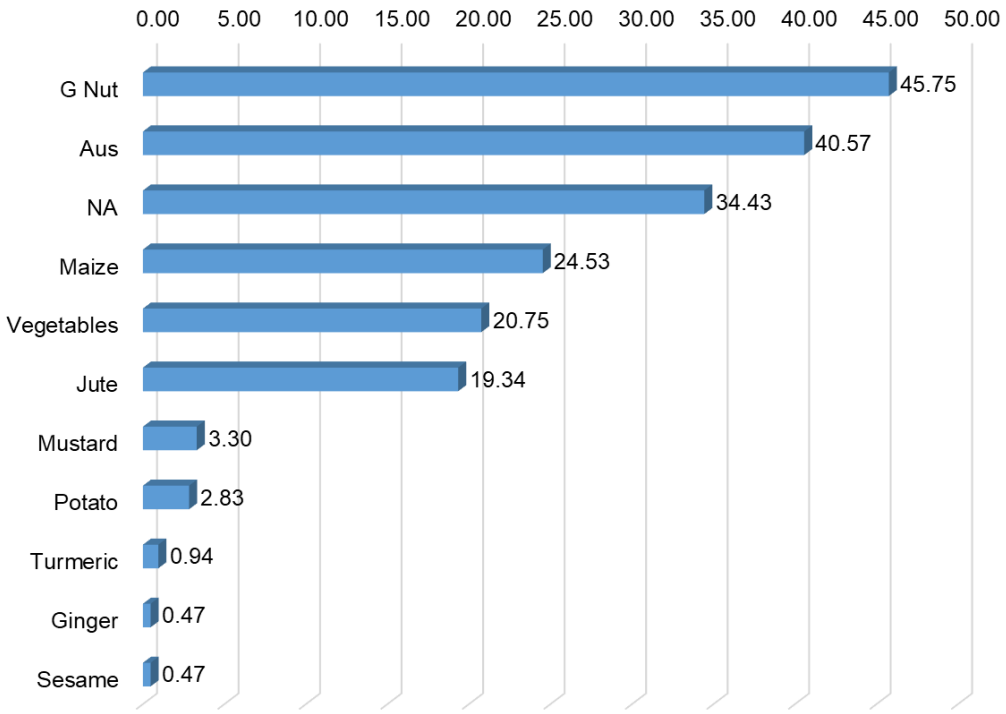


**Figure 3**: Farmer's crop preferences in Aus/Kharaif 1 season in Rangpur (%) (Mention maximum 2 desire crops crops)

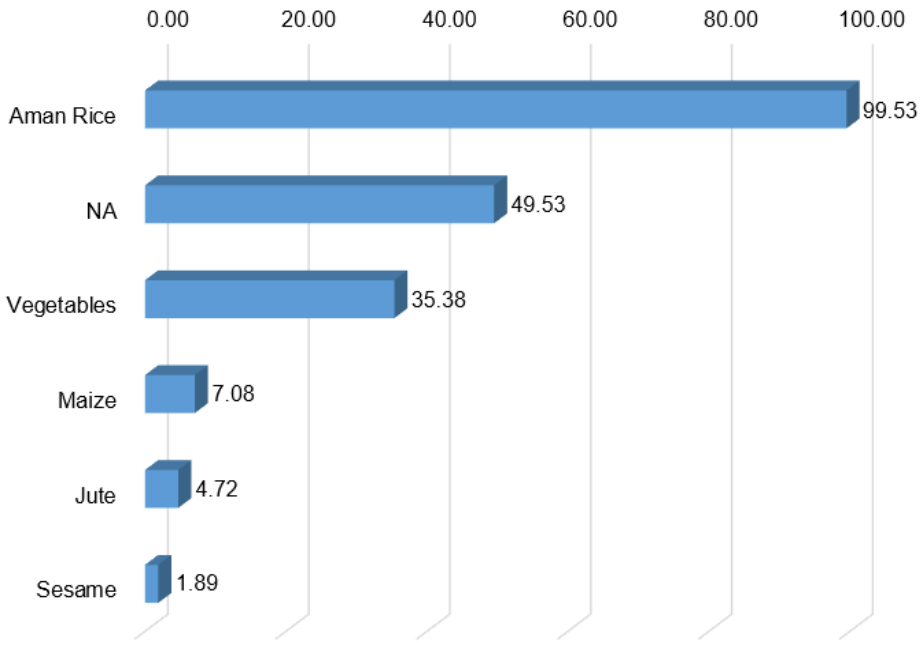


**Figure 4**: Farmer's crop preferences in Aman/ kharaif 2 season/Rainy season in Rangpur (%) (Mention maximum 2 desired crops)

## FARMER'S PREFERENCES FOR SPECIFIC CROPS ACROSS THE TREATMENTS AND SEASONS.

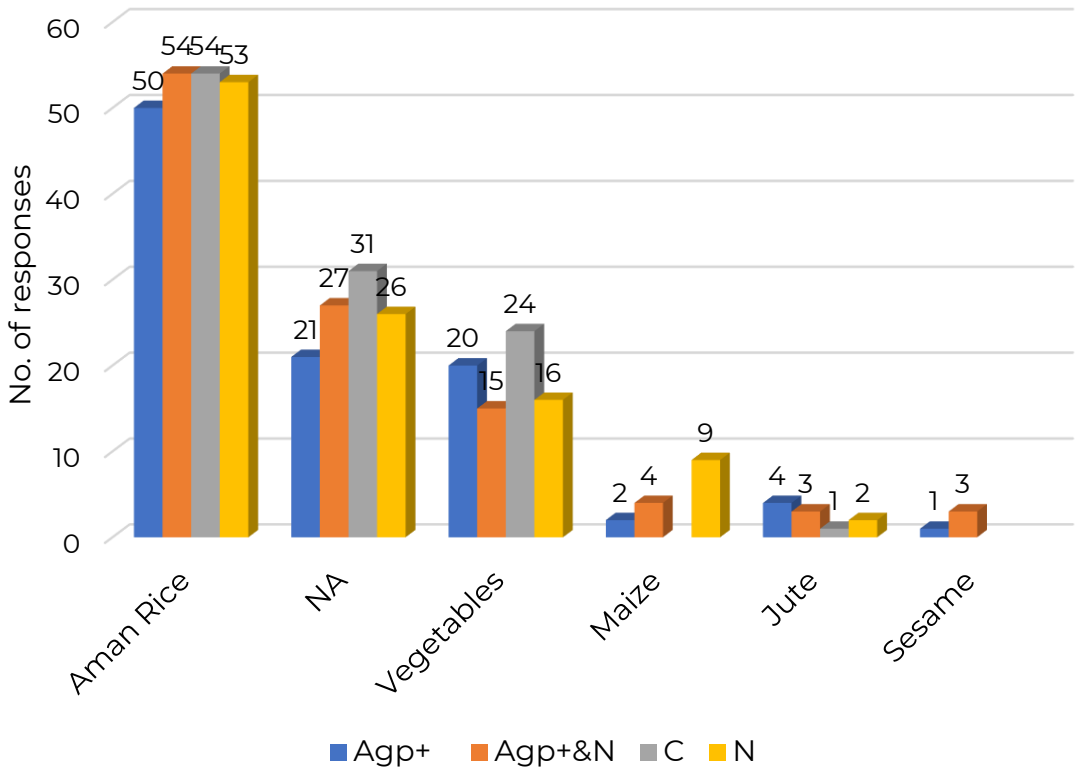


**Figure 5**: Farmer's crop preferences across treatments during Aman seasons in Rangpur (n=212)

As shown in Figure 5, Aman rice has the highest preference across all treatments, indicating that it is the most widely preferred crop. The response rates are very similar across the treatments. Whereas preference for vegetable cultivation as a second crop shows a more noticeable variation among the treatments. Though responses as NA (Not applicable) are seen across all treatments, vary 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.

**Above:** A Farmer examining his crop, Bangladesh; photo: CIMMYT

During Kharif 1, there is a noticeable difference in farmers' preferences for specific crops across the treatments (Figure 6). For instance, groundnut is most preferred among Agp+ and Agp+&N treatment groups as the first crop, whereas in the treatments where there is no agronomic training and on-farm trials farmers continue with Aus rice. This difference in preference may be attributed to the interventions. Besides, Maize emerged as the second most preferred crop after groundnut, particularly in Agp+&N treatment.

Similarly, during the Robi/boro season potato is the most preferred crop across all treatments with a strong response (Figure 7). Whereas, maize and onion are second preferred crops among Agp+ and Agp+&N treatment groups.

**Above:** Weeding maize fields, Rangpur, Bangladesh; photo: CIMMYT

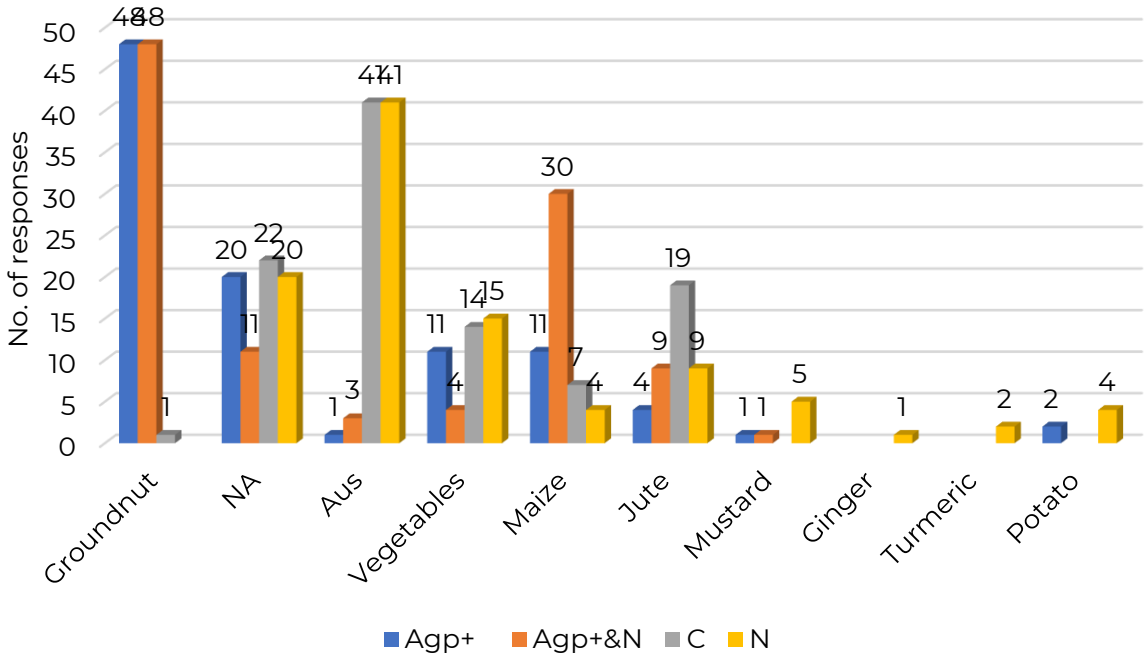


**Figure 6:** Farmer's crop preferences across treatments during Aus/ Kharaif 1 season in Rangpur (n=212)

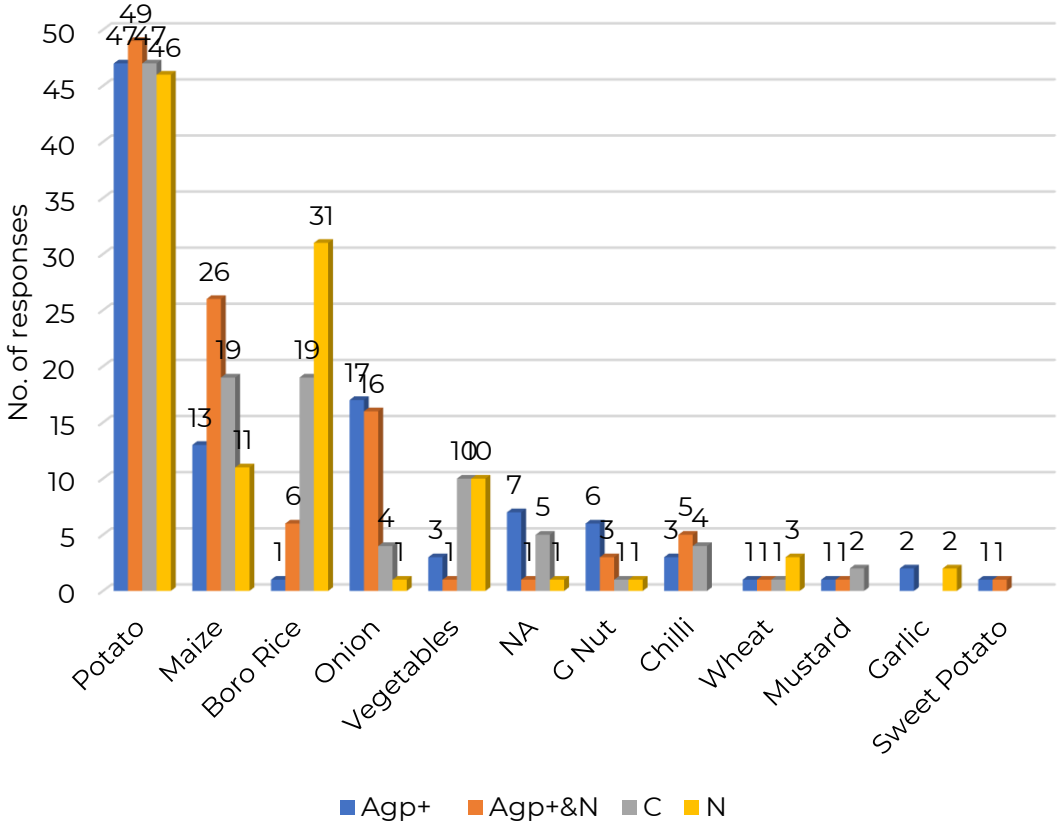


**Figure 7:** Farmer's crop preferences across treatments during Robi/ Boro season in Rangpur (n=212)

## FARMER'S PERCEIVED BENEFITS OF PRACTICING CROP DIVERSIFICATION IN RANGPUR

Farmers in Bangladesh are gradually transitioning from their historical dependence on rice to cultivating a more diverse range of crops (Figure 1). The area under high-value crops, such as fruits and vegetables, has steadily increased over the last decade. Understanding the benefits that farmers gain 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 improved food security (8,9).

In the current research on-farm trial farmers were asked about the benefits they experienced after adopting crop diversification in their farms. Figure 8 provides a descriptive analysis of farmers' perceptions of the benefits of crop diversification that reveals mixed opinions. Most farmers agree that crop diversification increases income on small land holdings (80%) and enhances diverse food availability for home consumption (73%). However, the responses are more divided regarding its role in creating diversified income streams, with a slight majority in favour (52%). Moreover, less than half of the farmers believe that diversification reduces risks such as crop failure or mitigates price instability. Notably, most farmers are skeptical about its impact on reducing production costs, improving soil health, and conserving natural resources, with strong disagreement particularly on the latter two points (77% and 86%, respectively). This mixed response may be because farmers practicing crop diversification very recent times, so experiencing the benefits such as improved soil health, and natural resources conservation may need more time. Studies have shown that crop diversification enhances income streams (8), food security (10), nutritional benefits (11), and soil health improvements (12).

**Above:** Farmer benefits from diversified crop cultivation, Bangladesh; photo: CIMMYT

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, and the results reveal that the primary obstacles faced by farmers are related to knowledge and skills.

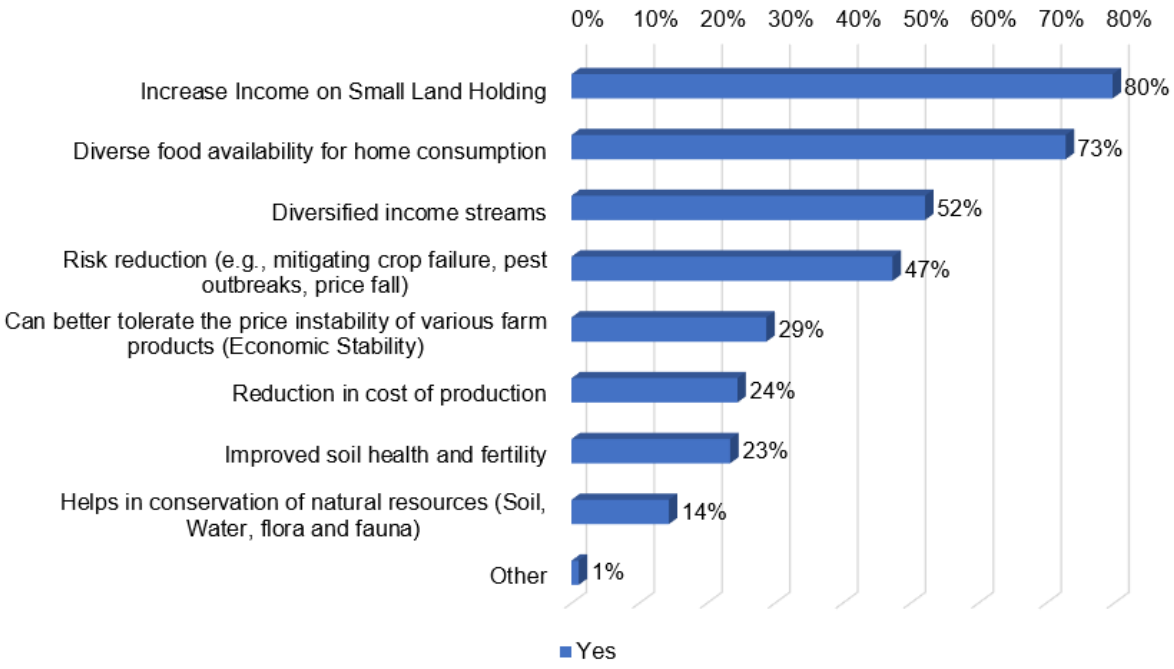


**Figure 8:** Farmer's perceived benefits of practicing crop diversification in Rangpur (n=188)

**Above:** Harvesting Napashak, Rangpur. photo: CIMMYT

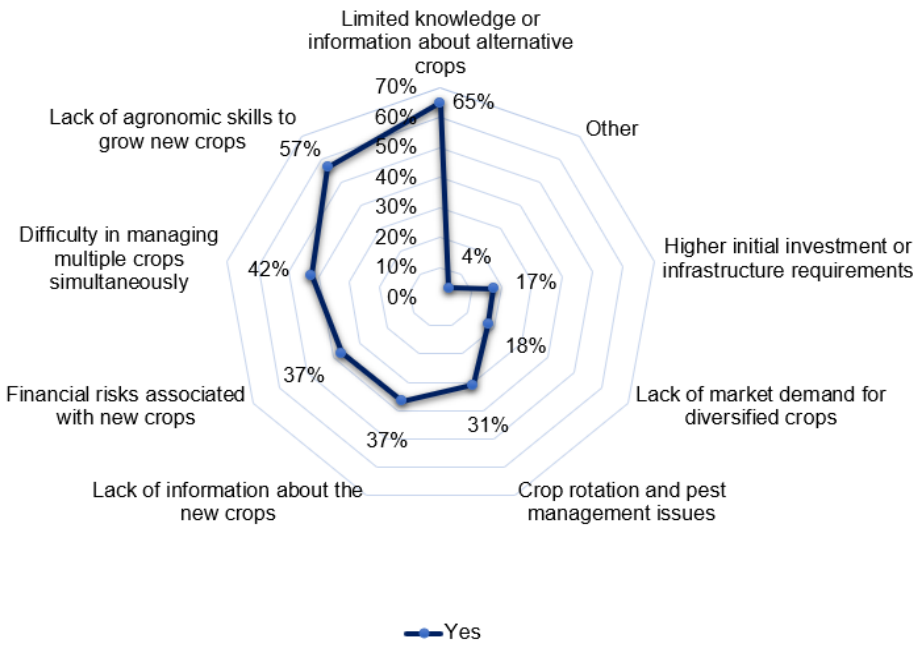


**Figure 9:** Farmer's perceived challenges of practicing and continuing crop diversification (n=219)

Figure 9 shows the responses of on-farm trial farmers to transaction cost-related statements that are associated with crop diversification.

A notable 84% of farmers agree that managing multiple crops requires additional knowledge and skills, with 58% strongly agreeing with this. Similarly, 74% recognize the need for more time and supervision. Over half (56%) report increased costs for farm machinery, and 62% acknowledge higher expenses in accessing markets and buyers. Information-related costs are seen as higher by 57%, and an equal percentage also cite increased financial burdens due to growing multiple crops. Marketing and transportation costs are a concern for 55% of respondents, while 52% mention higher irrigation costs. Seed expenses also worry 53% of the farmers. Labor requirements are emphasized by half of the respondents, and 42% see an increase in fertilizer costs. Most strikingly, 84% of the farmers believe that managing multiple crops is not profitable, underscoring significant reservations about the economic viability of crop diversification among smallholder farmers. These responses collectively highlight the challenges and doubts farmers hold regarding the profitability and management of crop diversification.

**Above:** Vegetable cultivation, Bangladesh; photo: CIMMYT

Majority of farmers indicate that limited knowledge or information about alternative crops (65%) grown to diversify their cropping pattern and a lack of agronomic skills to grow those new crops (57%) are major barriers. Other notable challenges include the difficulty in managing multiple crops (42%) and financial risks associated with adopting new crops (37%), though these are relatively less responses. Less than half of the farmers view issues such as crop rotation, pest management, market demand, and high initial investments as major challenges. This suggests a strong need for tailored training for farmers and linking farmers to markets, that provide detailed information and knowledge about new crops, management techniques, and market information to support farmers in overcoming these barriers and successfully adopting crop diversification. Farmers are traditionally familiar with growing rice, and mentioned challenges with growing new crops are the reality. Studies have shown that farmers lack access to information about the techniques of crop diversification in Bangladesh.

**Above:** Uprooting and processing carrot for selling, Rangpur, Bangladesh; photo::CIMMYT

This knowledge gap can hinder their ability to make informed decisions about transitioning to diversified systems (10,12). Besides, Bangladesh is highly susceptible to climate change impacts, including flooding and droughts, which can affect crop yields. This environmental uncertainty can make farmers reluctant to experiment with new crops that may not withstand these conditions (10).

*Perceived transaction costs associated with crop diversification among smallholder farmers*

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 (13). 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 (14). 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 (15).

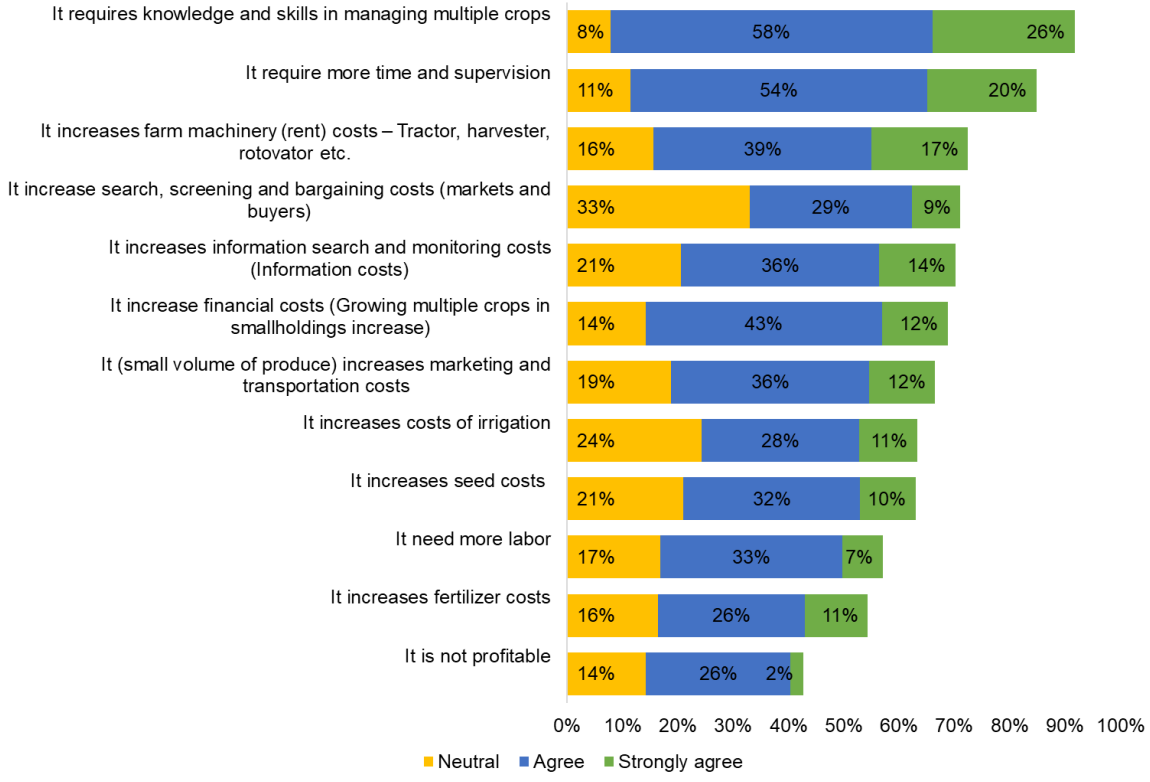


**Figure 10**: farmers perceived transaction costs associated with crop diversification (n=219). Note: Responses 1 to 5 scale (1= strongly disagree, 2= disagree, 3= neutral, 4= agree, 5 strongly agree).

## DIVERSIFICATIONUNDERSTANDING FARMERS' PERCEPTIONS OF MARKET CHALLENGES IN CROP

Farmers in Bangladesh face significant challenges in the marketing of farm produce, particularly fruits and vegetables, despite relatively being well-informed about rice marketing. The primary issues are inadequate market infrastructure and a lack of support systems for these newer crops recently farmers cultivating (16). The survey responses of on-farm trials who are growing vegetables about any marketing challenges they face with these new crops. Their responses are shown in Figure 10.

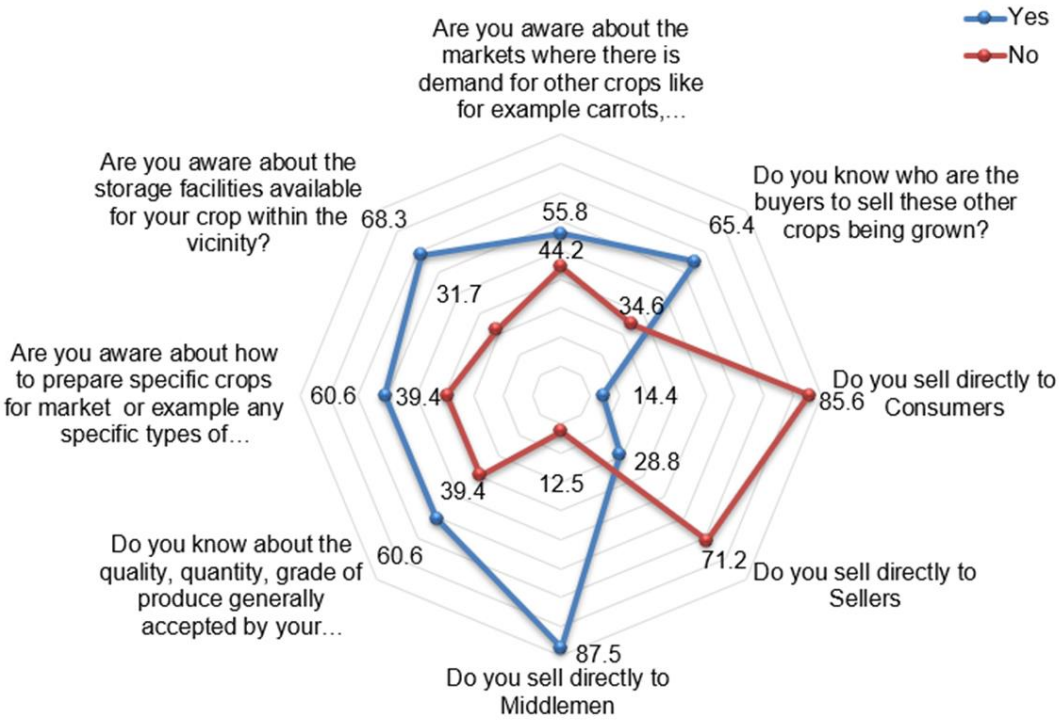


**Figure 11:** Farmers perceptions about marketing of new crops (n=104 - Agp+ and Agp+N)

About 56% of farmers are aware of markets for crops like carrots, tomatoes, leafy vegetables, sweetcorn, sorghum, mustard, and pulses, but only 65% know the buyers, revealing a knowledge gap. Only 14% of farmers sell directly to consumers, while 87% rely on middlemen, resulting in lower price realization for their produce. Awareness of local storage facilities is high at 68%, and 60% of farmers understand how to prepare and package crops for market standards. Despite prevalent sales to middlemen, there is a pressing need for better market infrastructure to shorten the value chain of key commodities. This would enable farmers to achieve better prices by reducing dependency on middlemen, who claim a significant share of the profits.

## MARKETING CHANNELS USED BY FARMERS TO SELL THEIR PRODUCE

Farmers in Bangladesh use various marketing channels to sell their agricultural produce, facing significant 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 (17,18). However, a significant amount of harvested produce is wasted every year due to seasonal gluts and a lack of proper marketing networks (18). 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 (19). The post-harvest losses and the price realization for farmers vary across marketing channels (20). Therefore, understanding the specific market channel farmers are using is very important.

Figure 11 shows various market channels on-farm trials farmers use to sell their crops. The results show that most farmers primarily sell Aman, Maize, Potato, and Groundnut through wholesalers, with percentages between 85% and 90%. In contrast, Carrot has a lower reliance on wholesalers (21%) and is mainly sold in local farmer's markets (79%). Direct sales to consumers are also notable for Carrots (26%), while Maize lacks this approach entirely. Retailers play a minimal role, with only Aman showing a small presence (6%), and none of the crops are sold online. 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. Middlemen, including merchants and retailers, capture a substantial portion of the profits, often leaving farmers with minimal returns after covering their production costs (21).

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 (22,23).

The results of this study reveal that 87 percent of the farmers have no association with any farmer collectives, such as cooperatives, self-help groups, or producer organizations. However, 94 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.

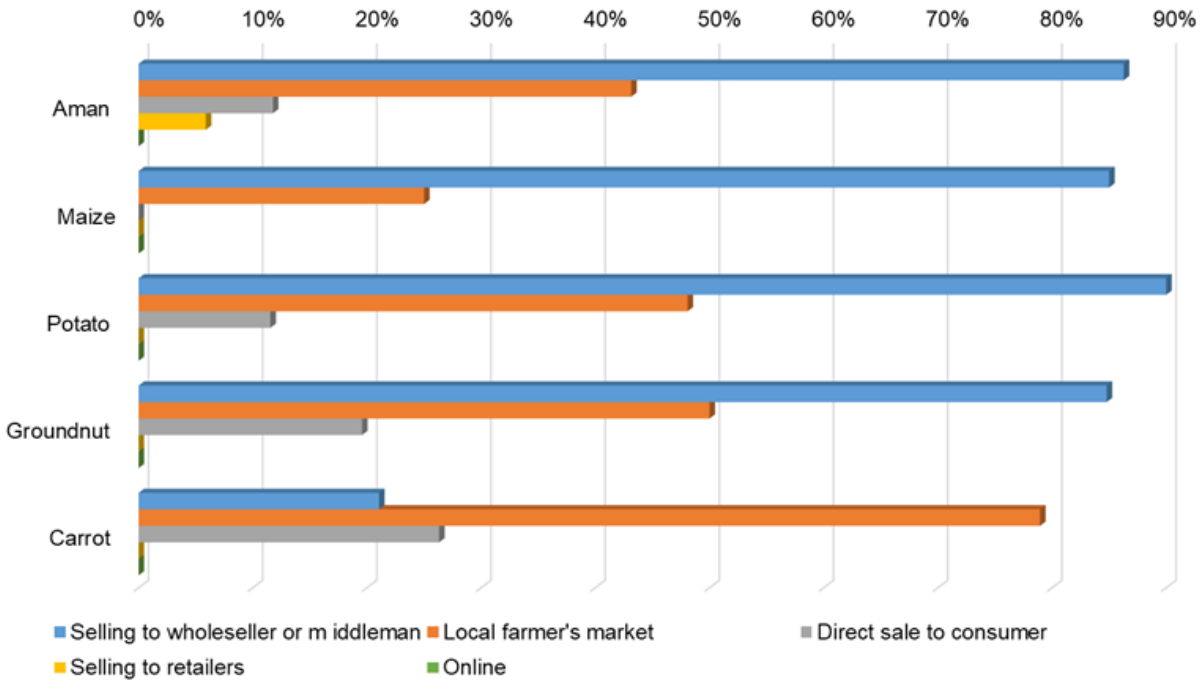


**Figure 12**: Various marketing channels used by on-farm trial farmers (Agp+) to sell their crops

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. However, studies indicate that if farmers sought alternative selling methods, they could potentially increase their profits (21). 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.

**Above:** Vegetables being sold in Bangladesh; photo: CIMMYT

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Additionally, 93 percent of the farmers reported that they plan to continue with crop diversification. Of the 111 farmers surveyed (Agp+ and Agp+N groups), 92 percent rely primarily on their own experience to assess market demand for specific agricultural products, while 74 percent consult with neighbors and friends. Interestingly, only 15 percent of these farmers seek advice from agricultural extension officers for market information.

Moreover, 82 percent of the 111 farmers expressed a desire to attend workshops or training sessions focused on marketing diversified farm produce.

Specifically, 71 percent of the farmers seek additional support in connecting with potential buyers, 53 percent are looking for help with price information, and 43 percent need guidance on understanding the quality requirements of potential buyers.

**Above:** Vendor selling vegetables in a village market, Rangpur; Bangladesh; photo: CIMMYT

## CONCLUSION AND RECOMMENDATIONS

The research note highlights significant progress in crop diversification in the Rangpur district of Bangladesh. While the shift from a predominantly rice-based agricultural system to more diverse cropping patterns is evident, with a notable increase in the crop diversity from HHI 0.80 in the 1970s to 0.44 in 2023, several challenges hinder full adoption. Farmers recognize the benefits of diversification, such as increased income and food security. However, barriers like limited agronomic

knowledge, higher transaction costs, financial risks, and inadequate market infrastructure are major obstacles. Despite these challenges, a considerable number of farmers express a willingness to continue diversifying their crops, indicating a positive behavior towards crop diversification. To support the farmers in Rangpur and scale the crop diversification efforts, the following operational recommendations may be considered.

1. For crop diversification, on-farm trials should adopt a bottom-up approach, actively involving farmers in identifying the most preferred cropping patterns, rather than relying on a top-down approach where on-station trial options are imposed on farmers.
2. Strengthen farmer training and knowledge development by implementing targeted training programs on agronomic practices for diverse crops, especially high-value ones like vegetables, fruits, and oilseeds, and by developing accessible information channels, such as mobile-based advisory services, to offer real-time guidance on crop management and market trends.
3. Facilitate farmers to the market linkages, reducing dependency on middlemen and enhancing price realization for farmers.
4. Promote awareness of crop diversification benefits by organizing field days and showcasing success stories to highlight its economic and environmental advantages, while involving agricultural extension officers to promote diversification strategies and provide personalized support to farmers transitioning from traditional rice cultivation.
5. Lastly, promoting farmer collectives is crucial for advancing crop diversification, as they help reduce information gaps, lower transaction costs, build social capital, and better bargaining power to farmers

**Above:** Diverese cropping in Bangladesh; photo: CIMMYT

## Annexure I

# CROP-SPECIFIC VALUE CHAINS IN RANGPUR

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

## RICE

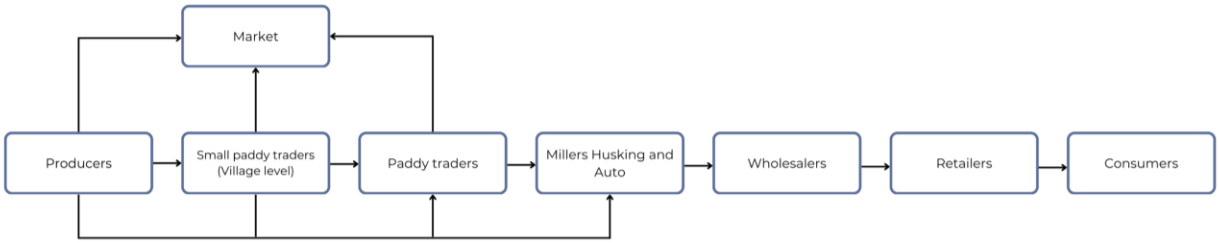


**Figure 13:** Rice value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## POTATO

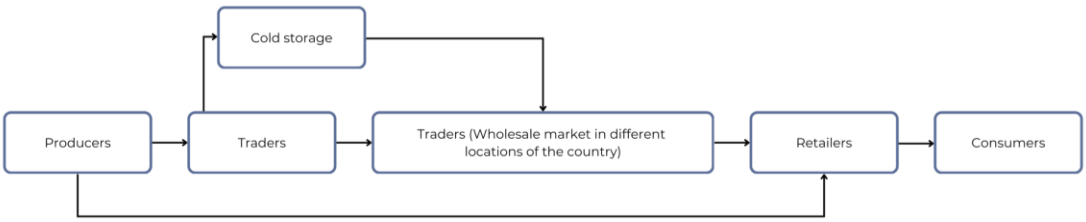


**Figure 14**: Potato value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## TOMATO


**Figure 15**: Tomato value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## MAIZE

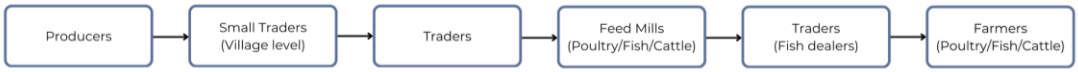


**Figure 16**: Maize value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## NAPA SHAK


**Figure 17**: Napa Shak value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## GROUNDNUT

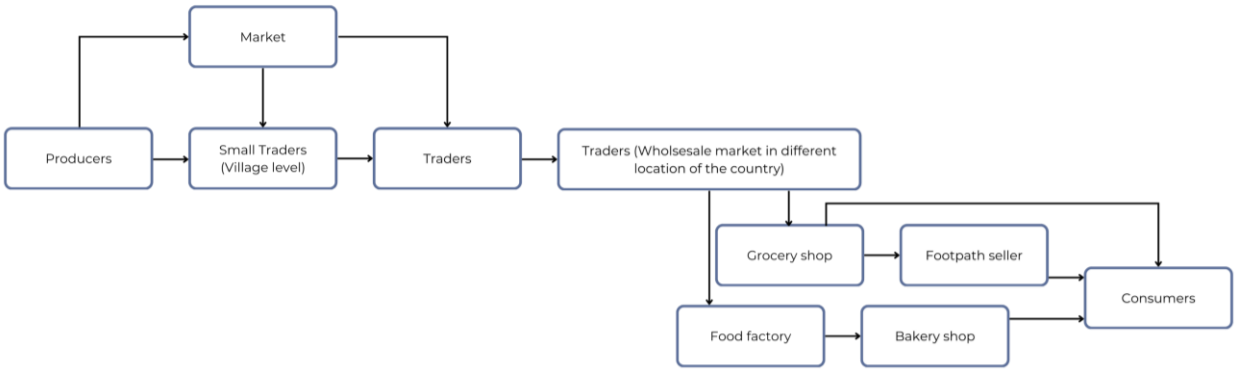


**Figure 18:** Groundnut value chain in Rangpur. Source: author's compilation based on discussion with farmers

## CARROT


**Figure 19:** Carrot value chain in Rangpur. Source: Author's compilation based on discussion with farmers

## REFERENCES


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## AUTHORS

**Ravi Nandi**, Agricultural Economist and Innovation Systems Scientist, CIMMYT
**Md. Khaled Hossain**, Research Associate, CIMMYT
**Anupama Islam Nisho,** Assistant Research Associate, CIMMYT
**A S M Alanuzzaman Kurishi**, Research Associate, CIMMYT
**Md. Saiful Islam**, Senior Research Associate, CIMMYT
**Sumona Shahrin,** Research & Development Coordinator, CIMMYT
**Mustafa Kamrul Hasan**, Agricultural Development Officer, CIMMYT
**Md. Arifur Rahaman**, Research Associate, CIMMYT
**Timothy J. Krupnik**, Regional Director, Sustainable Agrifood Systems Program, Asia, CIMMYT Country Representative for Bangladesh

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To learn more about TAFSSA, please contact: t.krupnik@cgiar.org; p.menon@cgiar.org

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TAFSSA (*Transforming Agrifood Systems in South Asia)* is a 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.

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