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Rice Farmers' Use and Preference of Information Sources for Adopting Agrochemicals in Selected Regions of Bangladesh

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A B S T R A C T

The reckless use of agrochemicals can damage the environment and threaten the sustainability of rice farming. Employing a quantitative research design, the study surveyed 402 farmers using a structured interview schedule from four selected districts: Barisal, Bagerhat, Dinajpur and Gaibandha of Bangladesh from February to April 2022. The study's findings indicate that, according to the weighted mean, farmers rely on input dealers (3.13), other farmers (1.77), and extension officers (1.57) as the primary sources for determining agrochemicals. In terms of preference for various sources, most farmers (WM = 3.08) prefer dealers, followed by experienced farmers (WM = 1.77) and extension officers (WM = 1.62). The findings also show that farmers prefer input dealers and experienced farmers for increased availability and accessibility, although many consider these sources less reliable. Although perceived as more experienced and dependable, the government extension service is less preferred due to limited availability and accessibility. Regression findings show that land area under cultivation, awareness of the adverse effects of agrochemicals, participation in training, and district location can significantly influence farmers' use of formal information sources. This study recommends increasing availability and access to formal extension sources like government extension agents, television, newspapers, and printed materials. It also suggests strengthening the credibility and capacity of informal extension sources such as input dealers and advanced farmers. Additionally, the study emphasizes training farmers on the safe use of agrochemicals and raising awareness about the adverse environmental effects of agrochemicals.

1.1 Introduction

Bangladesh ranked 3rd in global rice production (FAO, 2022). Rice cultivation is a cornerstone of the country's agricultural sector and is pivotal in addressing food security and ensuring sustainable livelihoods. Chemical inputs can increase productivity and improve economic prospects for rice farmers, especially in countries like Bangladesh, where rice is a staple food and a key driver of the agricultural economy. (BBS, 2022). However, in rice farming, the judicious use of agrochemicals, including weedicides and pesticides, is crucial for optimizing crop yields and ensuring food production (Sarwar, 2024).

Over the past thirty years, the introduction of high-yielding rice varieties in developing countries, such as Bangladesh, aimed at supporting the rapidly growing human population, has led to an increase in agrochemical use (Ali et al., 2021). This heavy reliance on agrochemicals raises significant concerns

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about excessive usage and its associated negative consequences for farmers, ecosystems, and the broader environment. Excessive agrochemical use leads to soil degradation and water contamination, thereby reducing natural pest enemies and promoting pest outbreaks (Heong et al., 2015; Narayanan et al., 2022). These issues, in turn, pose a grave threat to the long-term sustainability of rice farming, endangering the environment and the health of farmers and consumers alike (Horrigan et al., 2002).

The effective and sustainable use of agrochemicals depends on their availability and farmers' knowledge and understanding of their application (Akinlolu Olalekan Akanmu et al., 2023). Farmers need to rely on credible media that provides high-quality information to make informed decisions and apply agrochemicals accurately for rice production. However, currently, information on farmers' accurate selection of pesticides and their corresponding doses is scarce. It is also unclear what sources farmers use to determine their pesticide doses for rice production. Therefore, it is essential to conduct a study that explores the use and preference of information media for adopting agrochemicals in rice production.

1.2 Conceptual Framework

Agrochemicals encompass a broad range of pesticides, including insecticides, fertilizers, herbicides, fungicides, and other growth regulators. They are used to enhance crop productivity and protect crops from pests and diseases (Mandal et al., 2020; Mitra et al., 2021). Furthermore, agrochemicals help crops withstand extreme weather conditions (Koli et al., 2019) and address various challenges to ensure the successful production of rice (Hossain & Fischer, 1995). Among all types of information that rice farmers seek, agrochemical information is the most in demand (Rahaman, 2018).

Information plays a crucial role in farmers' decision-making regarding the use of agrochemicals, influencing their choices for sustainable and effective practices (Rose et al., 2018). Information provided by extension, research, education, and agricultural organizations helps farmers choose among alternatives and make better decisions concerning their specific needs and targeted objectives. Farmers in Bangladesh seek expert guidance regarding the selection, application techniques, recommended dosages, and precise timing of various agrochemicals to optimize their agricultural practices (Javaid et al., 2023; Warra & Prasad, 2020).

Farmers in Bangladesh and other developing countries utilize various information sources due to the multifaceted nature of rice farming to inform their agricultural practices and decision-making processes (Kumar et al., 2020). Among information sources, neighbors, television, experienced farmers, radio, input dealers, newspapers, local extension agents, and farm laborers were primary sources preferred by most farmers for receiving information (Imran et al.,2015). These sources can be categorized into formal and informal information sources, each offering unique advantages (Raith et al., 2019). The information-seeking behavior of farmers depends on two variables: the nature of the crisis and the reliability of the available information. Farmers rely on personal experience and informal networks when the nature of the crisis is familiar or non-critical; they rely on multiple external sources when the nature of the crisis is critical and personal knowledge proves inadequate (Mew et al., 2004). An informal information source is the system of friends, neighbors, shopkeepers, traders, and other people who move in and out of smallholder communities and interact with both smallholder and large farm agricultural communities (Tarek, 2019). On the other hand, formal information sources for farmers typically include government agricultural services, research institutions, extension agencies, agricultural universities, and non-governmental organizations (NGOs) that provide structured and reliable information on farming practices, technologies, and market trends. Information specifically created for farmers through media, such as radio and television-based agricultural programs and tele centers, is also included in formal information sources (Kalanda et al., 2012). Formal sources undergo a rigorous review and revision process before being forecasted and shared (FSJC, n.d.). Therefore,

adopting formal information sources can help us use agrochemicals with caution and precision, thereby protecting the environment and human health.

Various factors, including demographic, socio-economic, institutional, and psychological variables, can influence farmers' use of agricultural information outlets (Shitaye et al., 2024). A study of sorghum farmers in Ndhiwa Sub-County, Western Kenya, found that age, education, farm size, access to credit, and group membership were significant determinants of media choice. Mishra & Singh (2025) found, in a study in Nepal, that gender, age, education, income, farm size, and group membership were significant factors shaping farmers' choices of agricultural information sources. In Vietnam, a study found that household income, farm size, education, and off-farm jobs were significant factors affecting farmers' use of media and personal information sources (Linh, 2016). In the USA, Mohammadi et al. (2019) found trust in local sources, age, and educational background as significant factors influencing farmers' choice of information sources. A study in Bangladesh identified age, farm size, training, and access as significant determinants of the use of ICT in adopting climate-smart agricultural technologies (Mamun-ur-Rashid, 2020). The farmer's choice of information sources can also vary depending on their level of environmental concern. Lichtenberg and Zimmerman (1999) found that farmers who are more concerned about environmental issues use information from the news media and extension. In contrast, those who are more concerned about wildlife injury and pesticides in drinking water, but less concerned about general environmental quality problems, seek information from chemical dealers.

2. Methodology

2.1 Study location

The study was conducted in several villages of four districts in Bangladesh, namely Barisal, Bagerhat, Dinajpur, and Gaibandha. The districts were selected as they were geographically diverse in terms of social, economic, political, and other external environmental contexts. Barisal, situated in the southern part of the country, is renowned for its extensive rice paddies and distinctive ecological features, including its low-lying agricultural land, warm climate, and fertile soil (FAO, 2017). Bagerhat, situated in the southwestern coastal region, provides insight into the challenges posed by climate change, saline intrusion, and their effects on rice cultivation (Haque et al., 2021). Gaibandha and Dinajpur, located in the northern part of the country, are influenced by a comparatively arid climate. Hence, including these four diverse districts allows the research to capture a broad spectrum of information media use and preferences among the rice farmers in the varied agricultural landscapes of Bangladesh.

2.2 Population and sampling

The study population consisted of all farmers engaged in rice cultivation in the selected districts. To choose the study sample, this study used a sampling frame. The list of rice farmers collected from the Upazila Agriculture Office constituted the sampling frame. The sample size was determined using Yamane's formula (1973), with a 5% margin of error. According to the formula, the required sample size was 400. This research collected data from 422 farmers, proportionate to the population of ten selected villages, using a random sampling method (Table 1). However, 20 respondents were excluded due to inconsistent responses, and finally, 402 farmers were considered for statistical analysis.

2.3 Study design

This study adopted a quantitative approach and a cross-sectional research design to achieve study objectives. Cross-sectional research collects data from a sample or population during a specific period, providing a snapshot of the population's attributes or behaviors and allowing researchers to analyze the prevalence or relationships of variables within that time frame (Schulsinger et al., 2012). Quantitative research enables precise and structured data collection, resulting in statistically valid and reliable

results. Additionally, this approach enables researchers to identify patterns, relationships, and trends within large datasets, making it ideal for hypothesis testing, drawing evidence-based conclusions, and informing policy development (El Benni et al., 2023).

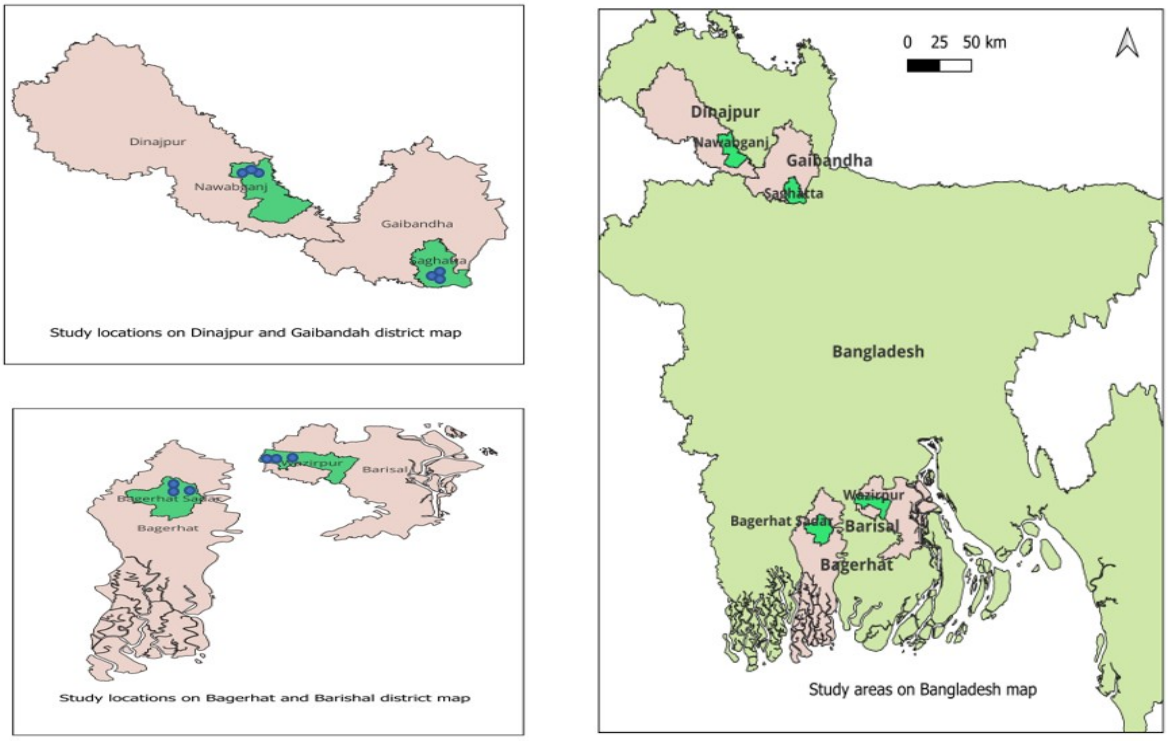


Figure 1. Maps showing study locations, Source: Authors.

Table 1. Sampling frame of the study

District	Upazila name	Village	Sampling frame	Selected sample
Barisal	Wazirpur	Kashobkathi	130	39
		Gojalia	126	38
		Jambari	120	37
Bagerhat	Bagrhat sadar	Ranjitpur	112	34
		Hakimpur	216	64
Dinajpur	Nawabganj	Mithapukur	122	37
		Jagannathpur	115	35
		Jambari	108	36
Gaibandha	Saghata	Raghabpur	227	67
		Padumshahor	115	35
		Total	1,391	422

2.4 Structured interview

This research used a structured interview schedule comprising two sections to collect quantitative information. The first section of the instrument comprised sociodemographic variables (Table 2), and the second section contained information related to the uses and preferences of various information sources, as well as the reasons behind using these sources. To ensure the validity and reliability of the data collection instrument, the questionnaire was prepared based on published literature (Column 5 of

Table 2), and a pre-test was also conducted with 40 similar respondents who were not included in the final data collection. Moreover, the face validity of the questionnaire was ensured by seeking expert opinions.

Table 2. Measurement of predictor and criterion variables

Variables	Explanation	Types	Measurement	Reference
UIS	Use of information sources for agrochemical information	Continuous	Always (4) …. Do not use (0) against eight selected sources	Mamun-ur-Rashid et al., (2019) Mamun-ur-Rashid et al., (2016); Hossain et al. (2011)
PIS	Preference of information sources	Continuous	Very high (4)….Do not prefer (0) against nine sources	Yaseen et al. (2020)
RPR	Reason for the preference of the information source	Nominal	Yes = 1, no = 0 against five reasons	(Bolarin, Komolafe and Kolade, 2022)
AGE	Age of the respondents in the year	Continuous	A score of 1 for each year	Yaseen et al. (2021)
EDU	Formal education attainment in year	Continuous	Year of formal schooling	Yaseen et al. (2021)
RFZ	Farm area under rice cultivation	Continuous	Farm size in ha	Lowder et al., (2016)
IANS	Income from agricultural and non-agricultural sources	Continuous	'000' Taka	Mamun-ur-Rashid et al., (2019)
TPA	Participation in agricultural training	Dummy	Yes=1, No= 0	Mamun-ur-Rashid et al., (2020)
AWAD	Awareness regarding the adverse effects of agrochemicals	Continuous	Strongly agree (4).. Neural (2).. Strongly disagree (0) against eight questions	Mondal et al. (2022)

2.5 Data analysis

At the preliminary stage, the collected data were identified and rectified for any errors, outliers, or inconsistencies, and then subjected to rigorous quantitative analysis to address the research objectives. The numerical information was presented using descriptive statistics, including means, medians, standard deviations, and frequencies. To find out farmers' use and preference of information sources, this research adopted weighted means, which were derived using the following formula:

$$Weighted\ Mean\ (WM) = \frac{W_1 * X_1 + W_2 * X_2 + \cdots + W_n * X_n}{W_1 + W_2 + \cdots + W_n}$$

Where, X1, X2, X3, … , Xn is a set of numbers; W1, W2, W3,…, Wn is the corresponding set of weights (Lind, William, and Samuel 2016).

To identify the factors influencing the use of formal information sources, this study employed multiple regression analysis. In the regression model, the criterion variable was adoption of formal information

sources (Y) and the predictor variables were farm size (X_1), Awareness regarding the adverse effects of agrochemicals (X2), Training participation (X3) and Farm location (X4). All statistical analyses in this study were conducted using SPSS Version 23.

3. Result and discussion

3.1 Socio-demographic characteristics of the respondents

The data reported in Table 3 indicate that the average age of the respondents was approximately 47 years, and the average number of completed schooling years was around six years. On average, farmers have 1.17 ha of land and earn 2.45 thousand TK per year. However, the table provides details of other variables of the study.

Table 3. Socio-demographic characteristics of the farmer

Variables	Mean/Frequency (%)	Standard deviation
District		
Dinajpur	100 (24.95%)	
Bagerhat	100 (24.95%)	
Gaibandha	102(25.41%)	
Barishal	100(24.95%)	
Age	46.54	13.56
Education level	6	5.41
Rice farm size	1.17	4.36
Income from farming	2.45	1.16
Receive training		
Yes	304(75.6%)	
No	98(24.4%)	
Awareness of the adverse effects of agrochemicals	25.39	3.186

3.2 Farmers' use of information sources

Figure 2 illustrates that farmers utilize multiple sources of information to inform their decisions regarding the use of agrochemicals. Based on the weighted mean, the most frequently used information source is the agricultural retailer and dealer (WM = 3.50), followed by the experienced farmer (WM = 1.72), extension officer (WM = 0.88), and relatives (WM = 0.85). A few farmers also use radio & television (WM = 0.72) and representatives from private companies (WM = 0.47). This finding is in line with a study titled "Bangladesh: Desk Study of Extension and Advisory Services" conducted in 2017 by Feed the Future, which stated that most farmers in Bangladesh get their information from local agro-input retailers and experienced farmers (Huber & Devis, 2017). Some also get information from the government extension workers. The International Rice Research Institute (IRRI) reported in a study that agricultural dealers play a central role in disseminating agricultural information (Parven et al., 2023).

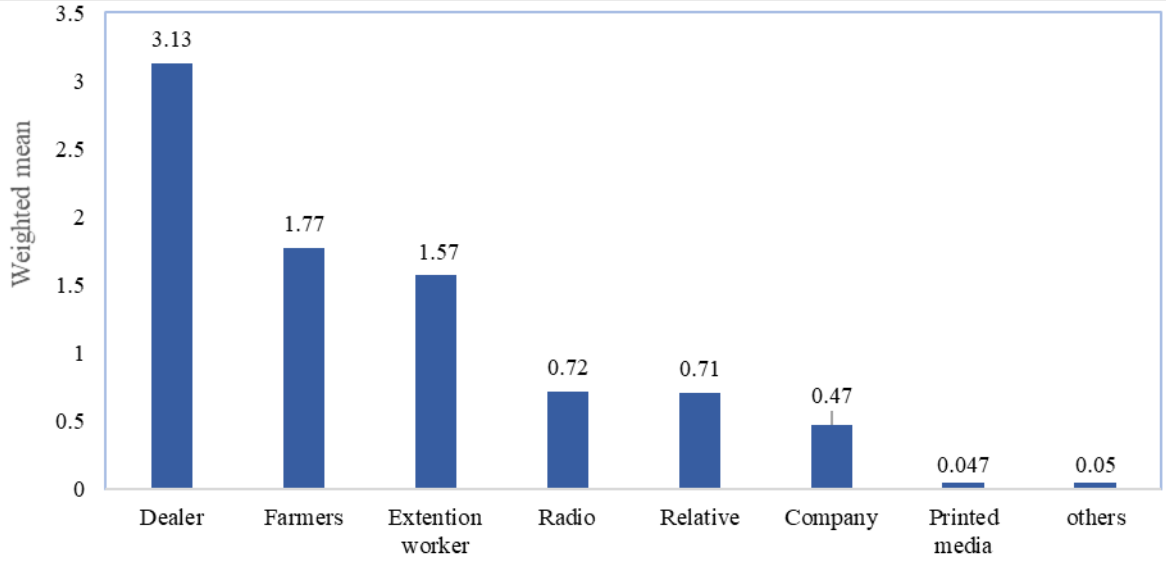


Fig. 2. Farmer's use of information source to determine agrochemical

3.3 Farmers' Preference of Information Sources

Figure 2 illustrates the weighted mean of farmers' preferences regarding various information sources. As depicted in Figure 3, the dealer and retailer stand out with the highest weighted mean equivalent of 3.082, followed by experienced farmers (WM = 1.771), government extension officers (WM = 1.62), and Radio and Television (WM = 0.692). In terms of weighted mean, the preference for YouTube and apps was the lowest. Similar to our findings, Rahman et al. (2016) also identified experienced farmers and input dealers as two highly preferred sources of agricultural information for farmers.

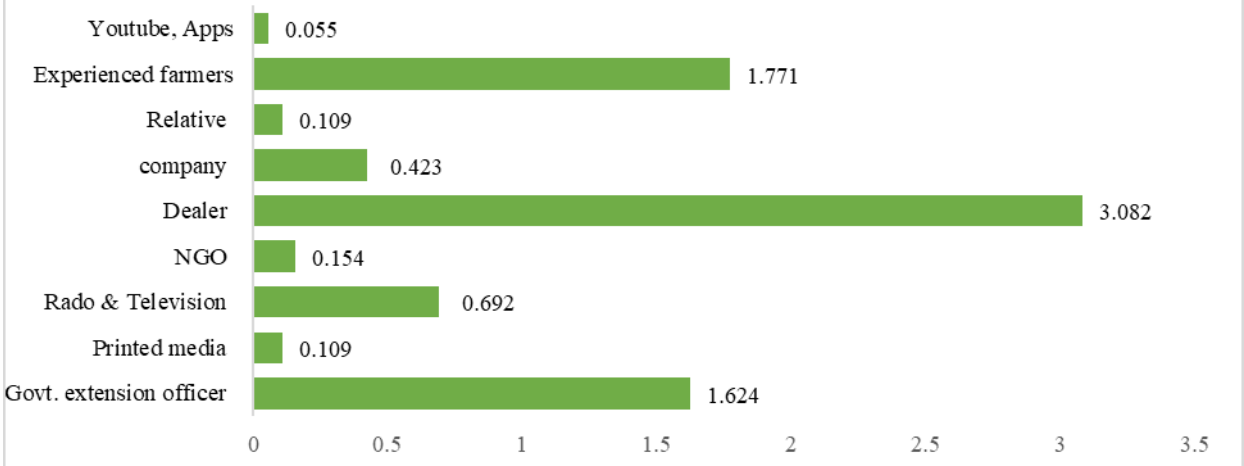


Fig. 3. Farmer's preference of different information sources

This study further investigates the reason for the preference for various information sources. Data presented in Table 4 shows that most farmers thought that agricultural extension officers were faithful (110) and experienced (117). However, very few farmers thought them readily available (3) and

accessible (2). In the case of television and radio, farmers in almost equal proportions thought them readily available (37), accessible (39) and inexpensive (34), while a major proportion of the farmers (59) thought them faithful. Most farmers thought dealers were readily available (252), and only 50 believed they were faithful. Most farmers consider advanced farmers to be experienced (200) and readily available (96), while only 38 consider them faithful.

Table 4. Farmer's cause of preference for various information sources

Sl.	Name of the source	Causes of preference				
		Readily available	Easily access	Inexpensive	Credibility	Experienced
1	Government Extension Agents	3	2	6	110	117
2	NGO workers	15	15	5	5	12
3	Radio, TV	37	39	34	59	2
4	Leaflet, Booklet, Magazine	4	5	2	22	3
5	Private company representatives	54	55	10	27	31
6	Experienced farmer	96	72	58	38	200
7	Dealers and Retailers	252	85	88	50	85
8	Relatives and peers	30	21	14	60	47

3.4 Determinants of farmers' use of formal information sources

The determinants of the farmer's use of formal information sources were measured using multiple regression analysis. Here, formal information sources include government extension agents, radio, television and print media. The data in the table show that, among the selected factors, farm area, awareness of the adverse effects of agrochemicals, training received, and farmers' location can significantly explain the use of formal sources ($F = 42.073$, $P < 0.001$), confirming the model's acceptability. The same table further shows that, compared to Gaibandha, the probability of using formal sources is 52.4% higher for farmers from Dinajpur district. Other variables that significantly influence farmers' use of formal sources include rice farm size ($\beta = 0.090$, $P < 0.05$), participation in training ($\beta = 0.357$, $P < 0.001$), and awareness of the adverse effects of agrochemicals ($\beta = 0.137$, $P < 0.01$). Supporting our findings, a study of vegetable farmers in Sri Lanka found that landholding size and training were significant factors influencing information-seeking behavior (Mahindarathne & Min, 2019).

Table 5. Determinants of farmers' use of formal information sources.

Predictor variable	**B**	**SE**	**β**	**t**	**P**	**VIF**
Constant	-2.228	0.880		-2.531	0.012	
REZ	0.001	0.001	0.090	2.239	0.026	1.037
AWAD	0.111	0.038	0.137	3.093	0.002	1.277
PTA	2.14	0.274	0.357	7.820	0.000	1.35
Dinajpur	3.13	0.311	0.524	10.05	0.000	1.763
Barisal	0.297	0.298	0.050	0.997	-0.319	1.614
Bagerhat	-0.318	0.313	-0.053	-1.015	0.311	1.785

Criterion variable: Farmer's use of formal sources R2=0.390; Adj.R2=0.381; p<0.000

3.5 Discussion

This study aimed to explore farmers' information-seeking behavior regarding the use of agrochemicals in four selected districts of Bangladesh, adopting a quantitative approach. The study results indicate that farmers primarily rely on input dealers and retailers for information related to agrochemicals. In rural Bangladesh, most farmers are less literate or have limited education. Most farmers (80%) are smallholders with a land area of less than 1 hectare, and they conduct their agricultural activities mainly using traditional methods. Eventually, their earnings from agriculture are also low. Due to low literacy and limited capacity, farmers primarily seek information from readily available sources, such as input dealers and experienced farmers, although many are not convinced of their reliability. Input retailers/dealers are often conveniently located in all areas and markets, offering information about various products (Piraino et al., 1998). Experienced farmers are people from the same social system as the farmers. Therefore, the farmers can share and exchange information freely with them whenever necessary. Experienced farmers are highly regarded as a source of information within their community as they often exchange valuable insights and practices (Babu et al., 2012). The government extension service, an essential player in agricultural knowledge dissemination, ranked third in terms of the use of information sources by farmers. Many farmers need more access to agricultural extension due to a lack of proximity. Proximity to the agriculture office is a significant factor influencing farmers' contact with the agricultural extension office (Uddin et al., 2021). Farmers have to travel a considerable distance to contact them, which is time-consuming and requires a significant amount of money. The extension service in Bangladesh is currently facing a severe staff shortage. For example, a government extension worker, such as a Sub-Assistant Agriculture Officer, is responsible for providing services to 2,200 farm families. This may reflect the difficulty of extension services in reaching remote areas or a preference for more personalized interactions (Wellman, 2001).

The findings on farmers' preferences for various information sources for receiving agricultural information show that input dealers and retailers are at the top of the list, followed by experienced farmers and public extension agents. The study findings further indicate that farmers' preference for dealers and retailers and advanced farmers are embedded in these media's availability and easy access. In a study in Nigeria, Bolarin et al. (2022) found that accessibility and availability are the two top reasons for determining information media use for agricultural purposes. However, a significant section of the farmers perceives public extension agents as more faithful and experienced. On the contrary, many farmers believe that input dealers and retailers should be more trustworthy and experienced. Input dealers and retailers often suggest unnecessary agrochemicals, such as growth promoters, pesticides, and fertilizers, to maximize profit. On the one hand, this increases production costs; on the other hand, it destroys the environment and the ecosystem necessary for sustainable agricultural production. The government extension service ranks third on the preference list, possibly due to limited availability and difficult access. Poor logistics support, inadequate use of information and communication technology, insufficient funds for actual extension work, distance from the locality, and political interference are significant factors that hinder the quality of the extension service (Mamun-ur-Rashid et al., 2018). Therefore, government extension services need to find ways to make their services available and accessible to farmers, so that they can receive a reliable, experienced information service.

Compared to the other locations, rice production in Dinajpur is higher. They also produce high-quality, commercially valuable rice. Therefore, the farmers are more likely to use formal information sources than those in the other study locations. When a farmer is aware of the adverse effects of agrochemicals, he/she usually become very conscious and rely on formal sources to use accurate doses and types of agrochemicals. Training opportunities for farmers can significantly contribute to the utilization of agricultural information (Shitaye et al., 2025). Trained farmers have a more robust network for sharing information than untrained farmers. Moreover, training can contribute to farmers' awareness-building in various aspects of agrochemical use (ILO, 1991).

This study makes a significant contribution to the literature in several ways. This research focuses on the use of agrochemicals in rice production, whereas other studies examine the use of information sources in general. This research examined diverse rice production ecosystems to explore the use of information sources for determining agrochemicals, thereby portraying a broader picture of the use of information sources. In addition to the use of information sources, this study also identifies the causes of preference. In addition to its obvious contribution, this study has several limitations. The geographical coverage of this study is limited; therefore, generalizing the findings requires caution. This study used cross-sectional data, which failed to capture seasonal variation in the use and preference of information sources for determining agrochemicals.

Policy implications from this research include increasing the availability and accessibility of public extension services, as well as ensuring the credibility and capacity of non-formal sources, such as input dealers and experienced farmers, in delivering quality information. It is also essential to undertake farmer training programs on the use of agrochemicals and necessary precautions to safeguard the environment.

4. Conclusion

This study investigates rice farmers' use of various information sources to determine agrochemicals in selected districts of Bangladesh. The study's findings reveal that farmers mostly rely on local agricultural input dealers and advanced farmers to determine agrochemical use. Farmers highly prefer informal sources, such as input dealers and advanced farmers, due to availability and accessibility. Many farmers also prefer government extension services due to their reliability and expertise. Training, farm size, and awareness of the adverse effects of agrochemicals can significantly shape farmers' use of formal extension sources, such as government extension services, radio, television, and print media. This study recommends enhancing the availability and accessibility of formal media, farmer training on the safe use of agrochemicals for crop production, and environmental protection.

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