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Socio-Economic Dynamics and Integrated Disease Management Practices of Mango Farmers in Chapainawabganj, Bangladesh

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ABSTRACT

The present study was conducted to investigate the socio-economic dynamics and assess the knowledge, perception and adoption of Integrated Disease Management (IDM) practices of mango farmers in Chapainawabganj. Using a descriptive survey research design, 73 marginal farmers were chosen by stratified random sampling spread across four upazilas. Data were collected through face-to-face interviews using a pre-structured questionnaire. The study revealed that most farmers were elderly (53% over 52 years), illiterate (63%), and smallholders (69.9% owned 0.21-1.0 hectares), with low annual incomes (70% earned less than 200,000 BDT/year). Despite having extensive farming experience, 89% farmers lacked the knowledge of IDM, as well as only 11% had received IDM training. Chemical methods dominated disease management practices (100% adoption), while biological, cultural practices were not used by them at all. About 75.5% farmers' attitudes toward IDM were neutral with moderate recognition of its benefits like disease prevention, income diversification and had limited understanding of its holistic application. The study highlights critical gaps in awareness, training, and adoption of sustainable practices, emphasizing the need for targeted extension programs to promote IDM. Policymakers and agricultural agencies must address socio-economic barriers to enhance environmentally friendly disease management in mango cultivation. These insights might help to shape plans for enhancing the sustainability of Bangladesh's mango industry and to minimize chemical dependency.

Keywords: Farmer training, IDM, Mango farmers, Smallholder farmers, Socio-economic

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1. INTRODUCTION

Mango (*Mangifera indica*), a member of the Anacardiaceae family, often hailed as the "king of fruits," is quite economically, culturally, and nutritionally important in tropical and subtropical areas all around. (Bini et al., 2024; Rajan, 2021). In Bangladesh, mango cultivation is a cornerstone of the agricultural economy, because it significantly supports both local consumption and export market. The country ranks as the 7th largest mango producer globally, with an annual countrywide production of approximately 1482937.04 metric tons in the 2022-23 fiscal year (BBS, 2023; Dhaka Tribune, 2021).

Chapainawabganj District often referred to as the "capital of mango" because of its prolific orchards and diverse varieties, stands out as the epicenter of production

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among Bangladesh's mango-growing regions (Bithe et al., 2021). The district alone cultivates over 270 mango varieties on 66133.47 acres of land, yielding around 117353.68 metric tons annually (BBS, 2023; Ghosh et al., 2023). About 85% of the local population is directly or indirectly involved with this sector, therefore highlighting its socio-economic relevance (Ghosh et al., 2023). However, despite its economic significance, mango farming presents many difficulties especially because of insect pests and plant diseases, which cause poor production and even crop failure.

From nursery to post-harvest storage, mango crops are very vulnerable to several diseases at all stages of development. Different plant parts including stems, branches, leaves, flowers, and fruits are affected by major diseases including powdery mildew, anthracnose, dieback, sooty mold, bacterial leaf spot, crown gall, gummosis, malformation, black tip, and internal necrosis (Khaskheli, 2020). Apart from lowering output, these diseases also threaten long-term viability of mango cultivation. Environmental factors such as temperature, humidity, and soil conditions may help bacteria, fungus, and viruses spread, therefore causing plant diseases that farmers in Bangladesh find difficult to control. Furthermore, insufficient disease management practices and lack of effective treatments aggravate the situation. Moreover, excessive use of chemical pesticides drives up cost of production and raises environmental issues including destruction of soil microbiota, and biodiversity loss (Tudi et al., 2021).

Post-harvest losses are another major concern, which can be attributed by inadequate storage conditions and lack of knowledge of disease control strategies (Tarekegn & Kelem, 2022). Farmers' educational levels, farm size, and resource availability among other socioeconomic elements have a major influence on their capacity to adopt efficient disease control techniques (Chen & Chen, 2022). Smallholder farmers, comprising the majority of mango cultivators, are especially susceptible due to financial limitations that hinder their investment in modern agricultural technologies (Kakraliya et al., 2020).

Among these difficulties, this paper aims to investigate the socioeconomic situation of mango producers in the four upazilas of Chapainawabganj district and the barriers they encounter in implementing sustainable farming techniques. Marginal farmers in these areas have less access to agricultural facilities than those in more accessible areas. Their remote locations often result in inadequate government support, and their proximity to riverbanks restricts opportunities for diversified crop cultivation. Although big scale farmers often depend more on chemical-based disease control techniques, small-scale farmers' use of Integrated Disease Management (IDM) stays questionable. This study intends to determine whether marginal farmers use IDM and to analyze its cost effectiveness in relation to traditional chemical-based strategies. This study aims to find the main obstacles to sustainable mango farming by means of knowledge of the socio-economic conditions of mango growers and their disease management practices, so enabling recommendations for better disease control in the area.

2. MATERIALS AND METHODS

2.1. Location of the Study

The research was carried out in the Chapainawabganj district, located in the northern part of Bangladesh which has an area of 1702.55 sq km. This region is located between 24°25' and 24°58' north latitudes and in between 88°01' and 88°30' east longitudes. It is bordered to the north, south, and west by the state of West Bengal, India, and to the east by the Rajshahi and Naogaon districts. The district consists of barind tract, diara, and char lands (Banglapedia, 2023). Moreover, within Chapainawabganj district, the study encompassed of four upazilas including, Chapainawabganj Sadar, Shibganj, Nachole, and Gomostapur, as illustrated in Fig. 1.

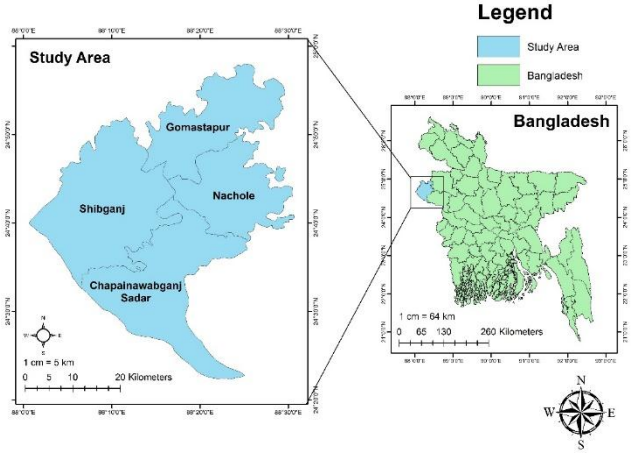

Fig. 1 Map of the study area.

2.2. Selection of Variables

Farmers age, family size, educational status, gender, marital status, land size, annual income of the respondents, farming experiences, knowledge about IDM, practicing method of IDM, training taken by farmers on IDM, attitude of farmers towards IDM were selected as variables for the study.

2.3. Measurement of the Attitude of the Respondents toward IDM

Farmers' attitudes toward use of IDM in mango production were measured using a Likert scale (Likert, 1932). This was measured using a 5-point scale, made up of 7 important IDM related statements on mango cultivation. Farmers were questioned about the statements in relation to five possible answers: strongly agree, agree, neutral, disagree, and strongly disagree, with a corresponding score of 5, 4, 3, 2, and 1 for positive statements; negative statements were scored in reverse. The scale score varied from 15 to 75, with 15 representing a highly unfavorable attitude and 75 denoting a highly favorable attitude. The total value of seven statements was equally divided into three categories: 'favorable attitude,' 'neutral attitude,' and 'unfavorable

attitude,' as no respondent selected 'strongly favorable attitude' or 'strongly unfavorable attitude.' Similar scale for measuring attitude was used by Alam et al. (2024) and Rana et al. (2020).

2.4 Data Collection Procedure

Primary data was collected involving random selection of marginal mango farmers through face-to-face interviews, using a pre-structured questionnaire. A total of 73 farmers were selected as sample of the study. The sampling was stratified across four upazilas, with almost equal sample form each upazila. Necessary precautions were taken into consideration to minimize bias and maintain the integrity of the responses.

2.5 Data Analysis

Data analysis was conducted utilizing Statistical Package for the Social Sciences (SPSS) version 26. Microsoft Excel was utilized for the creation of various graphs, charts, and tables. The study area map was generated using ArcGIS (Version 10.8). To comprehend the descriptive data, fundamental statistics such as frequency counts, percentages, and means were employed.

3. RESULTS AND DISCUSSION

3.1 Distribution of Socio-economic Characteristics of the Mango Farmers

The study population was evaluated using many demographic and socioeconomic data, such as age, farm size, educational status, gender, marital status, and land size, as shown in Table 1. The results give a detailed summary of respondents' personal attributes, including mean and standard error (SE) providing a clearer understanding of the distribution of these variables.

3.1.1 Age

The majority of respondents (53%) were over the age of 52. Middle-aged people (30 to 52 years old) made up 37.0% of the sample, while young people (under 29 years old) made up the lowest group (10%). The mean age of respondents was 46.26 years. This suggests that a sizable part of the farming population in the research region is elderly people, which may have an impact on their adoption of new agricultural techniques.

Table 1 Distribution of socio-demographic characteristics of the mango farmers (N=73)

Variables	Category	Frequency	Percentage (%)	Mean	SE (±)
Age	Young (up to 29 years)	7	9.6	46.26	0.93
	Middle (30 to 52)	27	37.0		
	Old (more than 52)	39	53.4		
Family Size	Small (1-5 Members)	36	49.3	5.22	0.26
	Medium (6-8 Members)	30	41.1		
	Large (>8 Members)	7	9.6		
Educational Status	Illiterate (0)	46	63.0	2.71	0.47
	Primary (1-5 years of schooling)	8	11.0		
	Secondary (6-10 years of schooling)	14	19.2		
	Higher Secondary (11-12 years of schooling)	2	2.7		
	Above Higher Secondary (>12 years of schooling)	3	4.1		
Gender	Male	61	83.6	-	-
	Female	12	16.4		
Marital Status	Married	6	8.2	-	-
	Unmarried	67	91.8		
Land Size	Marginal (0.02-0.2 ha)	1	1.4	2.34	0.07
	Small (0.21-1.0 ha)	51	69.9		
	Medium (1.01-3.0 ha)	16	21.9		
	Large (>3 ha)	5	6.8		

3.1.2 Family Size

In terms of family size, nearly half of the respondents (49.3%) had small families with 1-5 members. Medium-sized families (6-8 members) were reported by 41.1% of the respondents, while large families (>8 members) were the least common, representing only 9.6% of the sample. The

mean family size was 5.22 members. This suggests that, farmers belonging from small and medium-sized families dominate the agricultural landscape in the study area.

Table 2 Distribution of the personal attributes of the mango farmers (N=73)

Characteristics	Basis of Categorization	Frequency	Percentage (%)
Annual Income of the Respondents	Low income (<200000) Tk	51	69.9
	Medium income (20000-400000) Tk	15	20.5
	High income (>400000) Tk	7	9.6
Farming Experiences	Low Experience (<10 years)	13	17.8
	Medium Experience (11-20 years)	11	15.1
	High Experience (>20 years)	49	67.1
Knowledge about IDM	Low	65	89.0
	Medium	7	9.6
	High	1	1.4
Practicing Method of IDM	ChemicalMethod	73	100
	Physical Method	0	00
	Cultural Method	0	00
	Biological Method	0	00
	Host Resistance	0	00

3.1.3 Educational Status

The educational status of the respondents revealed that a substantial majority (63.0%) were illiterate. Those with primary education (1-5 years of schooling) accounted for 11.0%, while 19.2% had completed secondary education (6-10 years of schooling). Only a small proportion of respondents had higher secondary education (2.7%) or education beyond higher secondary (4.1%). The high illiteracy rate highlights the need for tailored training and extension services to improve farmers' understanding of modern agricultural practices.

3.1.4 Land Size

Land size distribution revealed that 69.9% of the respondents owned small plots (0.21-1.0 hectares), followed by 21.9% with medium-sized landholdings (1.01-3.0 hectares). Marginal landholders (0.02-0.2 hectares) and large landholders (>3 hectares) represented 1.4% and 6.8% of the sample, respectively. The mean land size was 2.34 hectares. The predominance of small landholdings underscores the challenges faced by farmers in achieving economies of scale and adopting resource-intensive practices. This highlights how small landholdings limit farmers' ability to expand production efficiently and invest in advanced agricultural practices. With restricted land, achieving economies of scale becomes difficult, making it harder to adopt costly technologies or inputs. As a result, small-scale farmers may struggle with lower productivity and profitability.

3.2 Description of the personal attributes based on income, farming experience, knowledge of IDM

The study further analyzed the respondents from Table 2 based on their annual income, farming experience, knowledge of IDM, and their preferred methods of disease management. The findings provide valuable insights into the economic such as the farmers' financial conditions, farming experience, and overall knowledge and experiential background which reflects the farmers awareness and current practices in managing crop diseases. Understanding these aspects helps identify gaps and areas for improvement in agricultural support and training programs of the farmers, as well as their awareness and practices related to IDM.

3.2.1 Annual Income of the Respondents

The majority of the respondents (69.9%) fell into the low-income category, earning less than 200,000 Taka annually. Medium-income earners (200,000-400,000 Taka) accounted for 20.5% of the sample, while only 9.6% of the respondents were in the high-income bracket, earning more than 400,000 Taka. This indicates that most farmers in the study area face economic constraints, which may limit their ability to invest in advanced agricultural practices or technologies. Limited land ownership means that most farmers operate on small plots, restricting their financial capacity to invest in modern agricultural technologies. Smaller landholdings often lead to lower productivity and income, making it difficult for farmers to adopt advanced farming methods. As a result, they primarily rely on traditional, low-cost practices to sustain their livelihoods.

3.2.2 Farming Experience

A significant proportion of the respondents (67.1%) had high farming experience, with more than 20 years in the field. Those with medium experience (11-20 years) represented 15.1% of the sample, while farmers with low experience (less than 10 years) accounted for 17.8%. The high level of experience among the respondents suggests that they possess traditional knowledge and skills, but this may also indicate resistance to adopting new practices without proper training and incentives.

3.2.3 Knowledge about IDM

The study revealed that the majority of the respondents (89.0%) had low knowledge about IDM. Only 9.6% had medium knowledge, and a mere 1.4% demonstrated high knowledge of IDM practices. This highlights a significant gap in awareness and understanding of sustainable disease management techniques among farmers in the study area.

3.3 Training Taken by Farmers on IDM

The Table 3 presents the distribution of farmers based on their participation in training programs related to IDM. Out of 73 respondents, only 8 farmers (11%) reported receiving IDM training, while the majority, 65 farmers (89%), had not undergone any formal training in this area. This indicates a significant gap in IDM training among farmers, which may impact their ability to effectively manage crop diseases. The low participation in IDM training indicates that most farmers, despite their extensive farming experience, have limited formal education and rely heavily on traditional practices. The lack of exposure to modern disease management techniques may hinder their ability to adopt sustainable farming methods. This highlights the urgent need for targeted extension services, awareness programs, and practical training initiatives to enhance their knowledge and improve disease control strategies.

Table 3 Farmers who have taken training on IDM

Categorization	Frequency	%	Mean
Yes	8	11	
No	65	89	0.11
Total	73	100	

3.4 Attitude of farmers towards IDM

The research primarily examined farmers' perceptions regarding the adoption and implementation of IDM practices. The respondents' mean attitude scores varied from 2.73 to 3.08, indicating a predominantly moderate viewpoint on IDM. Figure 2 illustrates the distribution of respondents according to their attitudes toward IDM. The data indicates that 75.5% of farmers maintained a neutral attitude, 16% demonstrated a favorable attitude, and merely 8.5% expressed an unfavorable attitude. This pattern indicates that although certain farmers acknowledge the advantages of IDM, many remain hesitant or ambivalent regarding its complete implementation.

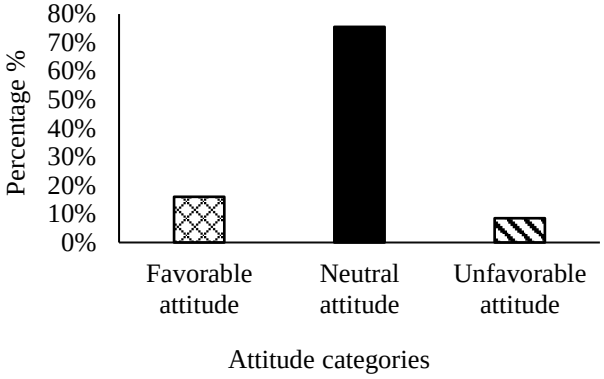

Fig. 2 Attitude of farmers towards IDM.

Moreover, a rank order was established by calculating mean scores for individual IDM related statements to explore specific perceptions in greater depth (Table 4). Farmers assigned the highest rating to the statement “IDM helps avoid creating conditions suitable for disease establishment and spread” with a mean score of 3.08. The subsequent statements were “IDM promotes sound structure and healthy plants” (3.07) and “IDM helps to increase income diversification” (3.04). In contrast, the assertion "IDM holds that eradication or wiping out the entire population is impossible" received the lowest mean score (2.73). The results suggest that although farmers recognize certain practical advantages of IDM, there may remain deficiencies in awareness or confidence concerning its full implementation. In a nutshell, IDM has moderate benefits but is not widely understood.

Table 4 Attitude attributes of farmers towards IDM

Statements	Mean score	Rank order
IDM helps to protect environment	3.01	4
IDM promotes sound structure and healthy plants	3.07	2
IDM helps to increase income diversification	3.04	3
IDM reduces the possibilities of introducing disease into the crop	2.86	6
IDM helps avoid creating conditions suitable for disease establishment and spread	3.08	1
IDM helps to regular monitoring of pathogen effect and their natural enemies and antagonist as well	2.99	5
IDM holds that eradication or wiping out the entire population is impossible	2.73	7

4. CONCLUSION

This study provides a comprehensive analysis of mango farmers in Chapainawabganj district, examining their demographic and socio-economic profiles along with their knowledge, adoption, and perceptions of Integrated Disease Management (IDM). The results indicate that the majority of participants were elderly, illiterate, and smallholder farmers with minimal annual incomes. Despite of extensive farming experience, the majority lacked knowledge of IDM, and only a small fraction had received formal training. Chemical methods were universally employed for disease management, whereas biological and cultural practices were not implemented. Farmers showed a neutral attitude toward IDM, with limited understanding of its holistic application. Moreover, the findings underscored the gaps in awareness, education, and adoption of sustainable practices. Finally, the study indicates that mango farmers in the area need interventions to encourage IDM adoption.

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