Influences of Socio-economic Factors on Lemon Pest Management Practices in Tangail District of Bangladesh

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Authors' contributions

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ABSTRACT

Aims: The main objective of the study was to explore the influences of socio-demographic factors of lemon cultivators on accepting pest management practices.
Study Design: A total of 120 lemon growers of the Tangail district were selected as samples following the proportionate random sampling technique. Primary data were collected from sampled respondents using a pre-designed and pre-tested questionnaire by face-to-face interview.
Results and Discussion: Findings indicate that majority of the respondents were middle-aged (69.2%), having a secondary level of education (47.5%), small farm size (73.3%), medium family size (57.5%), and medium use of information sources (74.2%). Farmers use chemical, mechanical,

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and cultural pest management practices, with the majority of respondents had a moderate degree of adoption. Education, annual family income, contact with the source of information, and organizational participation of the respondents showed positive significant relationships with their adoption of pest management practices. High input price, low market price of the product, disease, and pest attack was identified as the major problems faced by the lemon growers.

Conclusion: Adoption of pest management practices significantly influenced by socio-economic factors of lemon growers. Hence, agricultural extension agents should step forward to work with different groups of farmers for raising their knowledge of integrated pest control and improve expertise in lemon cultivation. Furthermore, the government should take the requisite steps to address issues such as high production costs, low commodity prices, and disease and pest infestation.

1. INTRODUCTION

Lemon is a common citrus fruit of the local people to a large area, which prolongs from Himalayan foot hills of northeast India to north-central China, the Philippines in east and Indonesia, Myanmar, Thailand, and New Caledonia in Southeast. Lemon belongs to the genus *Citrus* and family Rutaceae. Lemon is eaten alone as fresh fruit and also processed into juice, or added to dishes and beverages [1].

Lemon tends to generate periodic growth flushes and hence regulating cropping in tropical areas for enforcing them into intense bloom needs judicious management of water shortage stress according to soil type and growing season. For root growth of lemon plants, a soil temperature around 25°C seems to be optimum. High humidity favors the spread of many diseases and frost is highly injurious. Desiccation may occur during hot wind and drop of flowers and developing fruits may also occur [2]. Chelong & Sdoodee [3] found negative effect to fruit development and quality while evaluating FQ of 'Shogun' tangerine produced in Yala & Pattani, India, on higher mean temperatures, lower precipitation and low soil moisture. According to Patel and Patel [4] temperature helped psylla population while leaf miner favored mass of the weather factors but sunshine hours.

Lemon can be cultivated in both subtropical and tropical regions of the world, barring these restrictions. Citrus is the most widely grown fruit crop in the world, surpassing grape, apple, and banana in terms of yield [1]. In 1990s, global citrus production rose at a 4.5 percent annual pace, resulting in output of 98.35 million tons in 2001-02 and 100 million tons in 2003-04 [5]. Bangladesh's citrus fruit production rose from 23,513 tonnes in 1970 to 165,327 tonnes in 2019, increasing at a 5.06 percent annual rate [6].

The production of citrus fruits in Bangladesh is steadily growing year after year. Lemon can be grown successfully throughout the region, though the majority of production is concentrated in the districts of Sylhet, Chittagong, the Chittagong Hill Tracts, Rajshahi, and Maulavibazar [7]. Citrus fruit production has promise in Cox's Bazar's hilly and well-drained areas of Panchgarh, Thakurgaon, Tangail, and Gazipur, as well as some other parts of Mymensingh, Narshindi, Sherpur, and Netrokona districts. Among these, the Tangail district's climate is ideal for lemon growing. According to Manik [8], Delduar, Modhupur, and Mirzapur upazilas are well-known for growing high-quality lemon. These three areas account for the majority of overall lemon supply. By removing the challenges, cultivating good varieties, and implementing better management methods, it is possible to produce citrus fruit commercially, meet national demand, and earn foreign exchange.

Leaf miners (*Phyllocnistis citrella* St.), citrus thrips (*Scirtothrips dorsalis* Hood), scale insects (*Aonidiella citrina* Coq.), bark feeding caterpillar/trunk borer (*Indarbela quadrinotata* Walker), fruit fly (*Bactrocera dorsalis* Hendel), mites (*Panonychus citri*), etc. are all important insect pests of lemon. Mealy bug (*Pseudococcus filamentosus* Cockrell), nematode (*Pratylenchus sp.*) and other pests attack citrus, particularly mandarin oranges, especially in humid climates [9]. Lemon butterflies can be seen all year. In nurseries and young plantations, where seedlings and trees may be totally defoliated, their assault is more pronounced [10]. Citrus aphid is found throughout the year in East Pakistan now Bangladesh [11]. Citrus plant of north western belt suffers severely from

Phyllocnistis citrella pest [12]. The trunk borer, *Anoplophora versteegi*, Citrus psylla, *Diaphorina citri* and black aphids (*Toxoptera aurantii* and *T. citricidus*) are major pests of citrus. In North Eastern region *Phyllocnistis citrella* and Leaf miner is also equally important and damages at nursery and plants during each green flush. Other pests of economic importance include lemon butterfly, leaf mining beetles, tobacco caterpillars, leaf folder, looper, mealy bugs, scales, orange shoot borer, bark eating caterpillar, fruit sucking moths, and fruit flies, etc [13]. A total number of 250 species of mites and insects have been reported infesting different species of citrus in India [14]. Batool et al. [15] reported that citrus diseases have founded as probable denunciation to the production of citrus globally. The farmers need to take several management practices, including, cultural, mechanical, biological, and physical control methods for preventing these pests and insects' risks [16]. Because according to Tariq et al. [17] production and quality of citrus fruit become affected due to a lack of information about the control of diseases and plant protection measures. However, the adoption of improved agriculture practices depends on the socio-economic characteristics of the farming communities [18,19,20,21,22].

The climate of Bangladesh is ideal for growing different cultivars of lemon. Lemon is one of the potential components of homestead gardens in rural Bangladesh [23]. It can also be a profitable farming practice [23,24] in the face of climate change in Bangladesh [25,19] where field crops are sensitive to disaster-related shocks and stresses in different agro-ecological zones [26]. However, due to the lack of knowledge on lemon production, its prospects, economic value, nutritional value, proper facilities, problems faced in cultivation, and postharvest management, farmers are not getting the full potential benefits of its cultivation and not interested in commercial production of lemon. Hence, the study was conducted to fill some of the existing gaps and reduce the data limitation of lemon cultivation in Bangladesh. The specific objectives of the study were to (i) assess the adoption of different pest management practices, (ii) find out the relationships between selected characteristics of the respondents and their adoption of pest management practices; and (iii) identify the problems faced in lemon cultivation. The study is expected to help reduce the problems being confronted and facilitate the commercial cultivation of lemon in Bangladesh.

2. Methodology

Descriptive survey analysis is used in this study. The research was carried out in the Delduar Upazila (lower administrative unit) of Bangladesh's Tangail district (Fig. 1), where there was a high concentration of lemon cultivation and the researcher had easy access to it. The study's population consisted of all lemon growers in the chosen Upazila. The proportionate random sampling methodology was used to pick 120 lemon growers as survey respondents. Face-to-face interviews was conducted with the respondent's farmers to gather data using a pre-designed and pre-tested questionnaire.

Socioeconomic (independent) factors were assessed using standard approaches [18,22,27-29]. A farmer's age was calculated using his real-life age and expressed in years. Training was calculated by the number of years spent in training. The total number of members, including the farmer, his spouse, children, and other permanent dependents, who lived together as a family unit, was used to determine the size of the family. In this analysis, the total land area occupied by the farmer under the farm and homestead was used to determine farm size, which was expressed in hectares. Farming experience was determined by the length of a farmer's experience of agricultural practice, which was reflected in years. The cumulative annual revenue of a respondent from various sources was used to calculate his annual income. The term "sources of information" refers to the personal, collective, written or electronic media that respondents used to gather data. A four-point scale, i.e. not at all, seldom, sometimes, and regularly, was used to estimate the respondent's organizational presence, and sufficient weights were allocated to quantify the attribute [30].

Adoption of pest control techniques was assessed using a four-point Likert-type scale that took into account the nature of cultural, chemical, and mechanical practices. Regular practice received a score of 4, frequent practice a score of 3, occasional practice a score of 2, and rare practice a score of 1 [30]. A respondent's cumulative score was determined by combining his or her item scores. A ranking of the four pest control practices was created based on farmer use. In addition, respondents were asked to list the main problems they had faced when growing lemons and their comments were meticulously

collected and analyzed to create a ranking of perceived lemon-growing problems [31].

The Statistical Package for Social Sciences (SPSS) was used to perform the data analysis. Descriptive statistical measures such as frequency, mean, percentage, and standard deviation were used to describe and interpret the data, while Spearman's correlation was employed to explore the relationships between selected characteristics of the respondents and their acceptance of pest management practices.

3. RESULTS AND DISCUSSION

3.1 Socio-economic Characteristics of the Respondents

Table 1 shows that the respondent group with the highest proportion of middle-aged people (63.3 percent) was the most common. The total number of respondents in the young and middle-aged group was 69.1%, making up the vast majority of the respondents. Kabir et al. [32] published a report with almost identical results.

The highest proportion of respondents (46.7%) had completed secondary school. Table 1 also showed that nearly 90.8 percent of the respondents were trained at the primary, intermediate, or higher secondary level, indicating that schooling improves an individual's ability to observe, analyze, comprehend, make decisions, and adapt to new situations.

Since the population is growing and their farm size is shrinking, almost 96 percent of respondents had small to medium farms. However, Bangladesh's national average landholding is 0.81 ha [33], while the respondent's average farm size is 0.63 ha. This may be attributed to the fact that, as Bangladesh's population grows and their needs in different sectors increase, land use trends are changing qualitatively, with areas under net cropped land and forest land steadily shrinking. Furthermore, each year, 1.0 percent of cultivable land is lost due to urbanization, manufacturing, and infrastructure—pressures that are unlikely to abate [33]. Despite their limited landholdings, both respondents had small plots of land adjacent to their homes that could be used to cultivate vital crops for their survival [34,35].

The majority of the respondents (57.5 percent) had a medium-sized household. The current study's results are in line with Farhad's findings [36]. The average family size of the respondents in the sample area (5.67) was also higher than the national average of 4.44, according to the findings [33].

Data presented in Table 1 also exhibited that the majority of respondents (48.3%) had 8 to 19 years of farming experience, which falls within the medium farming experience category. According to Ghosh & Hasan [30], the majority of respondents had medium farming experience, led by high experience and low experience.

Table 1 also showed that the top 57.5 percent of respondents had an annual income of more than Tk. 200000, indicating that they had a high annual income, followed by a medium annual income. There were no people who had a low annual income among the respondents. Every one of the respondents (100%) came from a family with a medium to high annual salary. This may be because the respondents were getting more involved in many sources of revenue [36]. The respondents' average income (225000 Tk) was significantly higher than the country's average per capita income of 92800 Tk [33].

It is also shown in Table 1 that the medium source of knowledge group has the highest proportion of respondents (74.2%). However, the results showed that the vast majority of respondents (91.7%) had low to medium experience with the sources of information used. 62.5 percent of respondents said they were moderately involved with their organizations.

3.2 Adoption of Pest Management Practices

Since producers must deal with a variety of pest species at the same time, pest control becomes a complicated task. Farmers used a variety of control techniques to reduce the chance of these pests. According to the data in Table 2, 67.5 percent of respondents had a medium level of pest control practice adoption, 17.5 percent had a lower level of practice adoption, and 15.0 percent had a high level of practice adoption. It was discovered that nearly 82.5 percent of them used medium to high levels of management techniques, allowing them to benefit from high-yield lemon production.
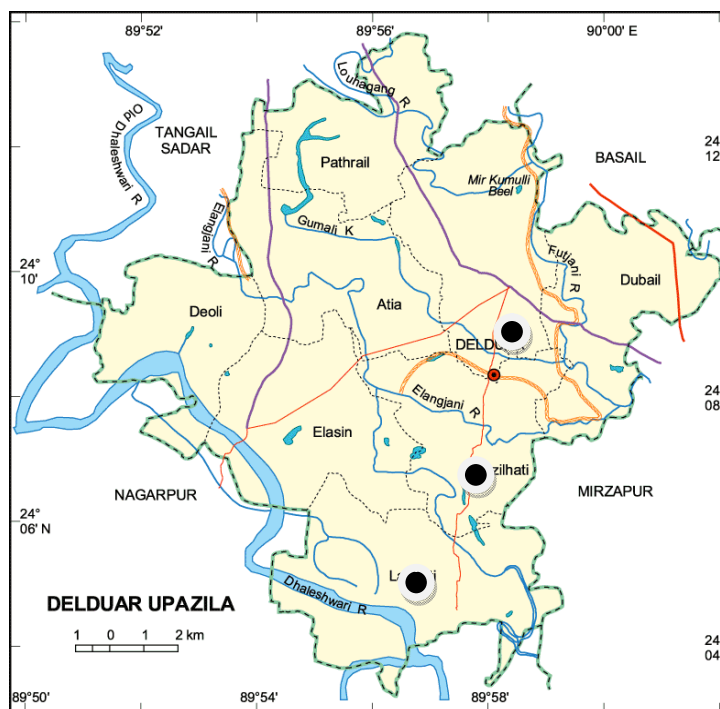
Fig. 1. Map showing Delduar upazila (⬤) indicating the study area

Table 1. Salient features of the socio-economic characteristics of the respondents

Variables	Categories	No.	%
Age (years)	Young age (up to 35 years)	07	5.8
	Middle age (36 to 50 years)	76	63.4
	Old age (above 45 years)	37	30.8
Educational level	Illiterate (0)	11	9.2
	Primary (up to 5)	37	30.8
	Secondary (6 to 10)	56	46.7
	Higher Secondary (up to 10)	16	13.3
Farm size	Small farm size (0.02-1.0 ha)	88	73.3
	Medium farm size (>1.01-3.03 ha)	27	22.5
	Large farm size (<3.03 ha)	05	4.2
Family size	Small (1-3 persons)	04	3.3
	Medium (4-5 persons)	69	57.5
	Large (> 6 persons)	47	39.2
Farming experience	Low experience (up to 7 year)	33	27.5
	Medium experience (8-19 year)	58	48.3
	High experience (Above 19 year)	29	24.2
Annual income	Low income (up to Tk 100000)	0	0
	Medium income (Tk 100001- Tk 200000)	51	42.5
	High income (above Tk 200000)	69	57.5
Contact with information sources	Low contact (up to 18)	21	17.5
	Medium contact (19-29)	89	74.2
	High contact (above 29)	10	8.3
Organization of participation	Low participation (up to 17)	22	18.3
	Medium participation (17-33)	75	62.5
	High participation(>33)	23	19.2

Table 2. Distribution of the respondent according to their adoption of pest management practices

Category	Respondent	
	Number	**Percent**
Low adoption (up to 05)	21	17.5
Medium adoption (06- 08)	81	67.5
High adoption (above 08)	18	15.0

Table 3. Relationship between selected characteristics of the respondents and their adoption of management practices

Selected characteristics of the respondent	Co-efficient of correlation
Age	-0.104 NS
Education	0.490 **
Family size	-0.098 NS
Farming experience	-0.116 NS
Annual family income	0.190*
Contact with the source of information	0.787**
Organizational participation	0.645**

*Significant at 0.05 level of probability, ** Significant at 0.01 level of probability, NS= Non significant

Table 4. Rank order of the problems faced by the respondents in lemon cultivation

Problems	Respondents		Rank
	Number	**Percent**	
High input price	107	89.16	1st
Low yield of the product	98	81.66	2nd
Disease and insect attack	70	58.33	3rd
Poor transportation system	39	32.50	4th
Lack of knowledge for improved lemon cultivation	38	31.60	5th
Failure in receiving an adequate amount of loan	24	20.00	6th
Lack of storage facility	18	15.00	7th
Lack of improved variety	10	8.30	8th
Premature fruit dropping	6	5.00	9th
Lack of contact with an extension agent	5	4.10	10th

3.3 Relationship Between Selected Characteristics of the Respondents and Their Pest Management Practices

Coefficients of correlation were computed to explore the relationships between the selected characteristics of the respondents and management practices (Table 3).

The relationship between education of the respondents and their adoption of pest management practices was found positively significant at a 0.01% level of probability ('r' value 0.490**) (Table 3). It meant that higher was the level of education of the respondents, higher was the use of pest management practices in lemon cultivation [18,21,22].

The computed value of 'r' was found 0.190* which was in between annual income of the respondents and their adoption of pest management practices and this was positively significant at 5% level of probability (Table 3). So, it can be concluded with a significant positive relationship between annual family income of the respondents and their adoption of pest management practices. This might be indicated that with the increased use of pest management practices by the respondents their annual family income would also be increased [18,21,22].

Contact with the source of information had a significant positive relationship with their adoption of pest management practices. That means if the source of information is higher, the adoption of pest management practices will also be higher. Similar findings were also observed by Goswami [18,21,22,35]. Organizational participation of the respondent also had a significant positive relationship with their

adoption of pest management practices. This means that respondents with highly organizational participation were more likely to have more adoption. Goswami [35] also found similar results in his study.

The respondents' age, family size, and farming experience had no substantial association with their adoption of management practices, implying that management practices adoption and the above characteristics of the respondents are independent of each other.

3.4 Problems of Lemon Cultivation

Respondents encountered a variety of issues during the cultivation of lemons in practice. A ranking of 10 problems related to lemon production was presented to explain the relative significance of various problems (Table 4). The respondent's most pressing issue was determined to be the high cost of input. It has an impact on the use of fertilizer for proper lemon fruit growth, as well as the use of insecticides and pesticides to protect plants from diseases and insect pests. They had been unable to grow lemons due to the high cost of seeds and seedlings, as well as the rising cost of fertilizer and pesticides. The majority of the respondents have small farms and have only a basic understanding of high-yielding varieties. Their annual profits will be boosted by a high yield. Low yields prevented them from growing lemons. As a result, low yield can be rated as the second most serious issue. In all types of crop production, diseases and insects are a common concern.

Since many insects and viruses were unfamiliar to the respondents, insect and disease attacks in lemon cultivation became a big issue. Farmers were unaware of the correct remedy for avoiding such insects and diseases. That is why a small insect became so dangerous, causing excessive damage and, as a result, a decline in yield. So, diseases and insect attacks can be classified as the third most serious issue. The majority of the manufacturing facilities were located far from the market. The route was not ideal for transporting goods from one location to another. In that location, there was no well-developed automobile. As a result, the farmer was unable to deliver his commodity to the city. That's why the farmer was unable to receive further compensation. As a result, the issue of poor transportation infrastructure could be ranked fourth. Just 23.5 percent of respondents had

extensive knowledge of lemon production. Respondents were unable to establish adequate preparation and use of new varieties and inputs due to a lack of expertise. This was the fifth most difficult challenge. Failure to receive a sufficient loan, a lack of storage facilities, a lack of improved variety, premature fruit fall, and a lack of contact with an extension agent were rated 6th, 7th, 8th, 9th, and 10th, respectively.

4. CONCLUSION

The case study in Bangladesh's Tangail district revealed significant individual differences among lemon cultivators in terms of socio-demographic characteristics, with the majority of respondents being middle-aged, having a secondary level of education, small farm size, medium family size, and medium interaction with information sources. Respondent farmers used chemical, mechanical, and cultural pest control techniques, with the majority of them seeing a modest degree of acceptance. The respondents' acceptance of pest management activities was positively related to their education, annual family income, engagement with the source of knowledge, and organizational involvement. The farmers' main problems in lemon cultivation were described as high input prices, low commodity market prices, disease, and pest attack.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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