DETERMINANTS OF NEW TECHNOLOGY ADOPTION IN MANGO FARMING: AN EVIDENCE FROM CHITTAGONG HILL TRACTS

SHARANON CHAKMA

DEPARTMENT OF DEVELOPMENT AND POVERTY STUDIES

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

SHER-E-BANGLA NAGAR, DHAKA -1207

JUNE, 2021

DETERMINANTS OF NEW TECHNOLOGY ADOPTION IN MANGO FARMING: AN EVIDENCE FROM CHITTAGONG HILL TRACTS

BY

SHARANON CHAKMA

REGISTRATION NO.: 14-05884

A Thesis
Submitted to the Faculty of Agribusiness Management Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

IN

DEVELOPMENT AND POVERTY STUDIES

SEMESTER: JANUARY-JUNE, 2021

Approved by:

Dr. Md. Mizanur Rahman Sarker	**Md. Abdul Latif**
Professor	**Professor**
Dept. of Agricultural Statistics	**Dept. of Agricultural Statistics**
Sher-e-Bangla Agricultural University	**Sher-e-Bangla Agricultural University**
Supervisor	**Co-supervisor**

Fatema Sarker
Chairman
Examination Committee
Department of Development and Poverty Studies
Sher-e-Bangla Agricultural University

Department of Agricultural Statistics

CERTIFICATE

This is to certify that the thesis entitled "**DETERMINANTS OF NEW TECHNOLOGY ADOPTION IN MANGO FARMING: AN EVIDENCE FROM CHITTAGONG HILL TRACTS**" submitted to the Department of Development and Poverty studies, Sher-e-Bangla Agricultural University, Dhaka-1207, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE (MS) in DEVELOPMENT AND POVERTY STUDIES**, embodies the result of a piece of bona fide research work carried out by **SHARANON CHAKMA**, Registration No. **14-05884** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

I further certify that any help or source of information, received during the course of this investigation has been duly acknowledged.

Dated:

Dhaka, Bangladesh

(Dr. Md. Mizanur Rahman Sarker)
Professor
Dept. of Agricultural Statistics
Sher-e-Bangla Agricultural University,
Dhaka 1207.
Supervisor

DEDICATED

TO

MY BELOVED PARENTS

ABSTRACT

Mango is one of the commercial horticultural crop grown in many South Asian countries. Right now, Bangladesh is the 7th largest mango producer in the world. The objectives of the study were: (i) to determine the social profile of tribal community farmers, (ii) to find the available adoption technology in tribal community; and (iii) to identify the determinants of new technology adoption by tribal mango farmers. The research surveyed 100 randomly chosen farmers in the Khagrachhari Sadar, Panchhari, Mohalchhari, and Dighinala upazilas of the Khagrachhari district during June to August 2021. Binary logistic regressing model was used to identify the determinants of new technology adoption. The dependent variable on adoption of new technology ((i)Fruit Bagging Technology; (ii) High Density Farming; and (iii) Contour Farming), whereas nine chosen characteristics of the respondents were considered as independent variables. These are: (i) Age, (ii) Secondary Occupation; (iii) Higher level of education; (iv) Training; (v) Experience; (vi) Social/Agricultural organization participation; (vii) Friends contact; (viii) Family contact; and (ix) Use of social media. Among selected characteristics of the respondents viz. highest education level of family, experience, friends contact, family contact and use of social media had significant positive contribution and characteristics like experience had significant negative contribution to their adoption of fruit bagging technology in mango farming. Among selected characteristics of the respondents viz. highest education level of family, training, friends contact, family contact and use of social media had significant positive contribution to their adoption of both high density farming and contour farming in mango farming. Thus, researchers and extension personnel should examine these critical elements in order to improve the mango farming who adopt new technology in Chittagong Hill Tracts.

ACKNOWLEDGEMENT

To begin, I would want to express my gratitude to Buddha, the most compassionate and kindhearted, the most kind and benevolent, who deserves all praise. All thanks is due to the almighty, omnipresent, and omniscient Buddha, who allowed me to continue my studies in Development and Poverty Studies and to successfully finish the research and writing of my thesis for the Master of Science in Development and Poverty Studies degree.

Now, I would like to express my inexpressible gratitude to my Supervisor, **Dr. Md. Mizanur Rahman Sarker**, Professor Department of Agricultural Statistics, Sher-e-Bangla Agricultural University, Dhaka-1207, for his ever-inspiring guidance, scholarly comments, and constructive suggestions throughout the research process and thesis preparation. Without his insightful intellectual counsel, precise constructive criticism, and assistance, this job would never have been completed. I would like to express my gratitude to my respected Co-supervisor, **Md. Abdul Latif,** Professor, Department of Agricultural Statistics, Sher-e-Bangla Agricultural University, Dhaka-1207, for his proper guidance, inspiring co-operation, and encouragement throughout the research process and thesis preparation.

I'd want to convey my appreciation to the 100 farmers who participated actively in this survey and, more significantly, helped me understand their efforts and actions linked to mango farming in general and to mango farming in particular. They contributed critical data that were used to develop several models for evaluating the effectiveness of agricultural operations.

I would want to convey my heartfelt gratitude to UAO and SAAO Khagrachhari District for their assistance throughout the data gathering procedure. I am at a loss for words to express my gratitude to my parents for their unwavering devotion and unflinching support, for their sacrifice and unflinching efforts to accomplish my ambition of obtaining a higher education. They served as a continual source of inspiration throughout the most trying periods of my study.

SHARANON CHAKMA

JUNE 2021

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

BARI	: Bangladesh Agricultural Research Institute
BADC	: Bangladesh Agricultural Development Corporation
BBS	: Bangladesh Bureau of Statistic
BDT	: Bangladeshi Taka
BER	: Bangladesh Economic Review
BINA	: Bangladesh Institute of Nuclear Agriculture
CHT	: Chittagong Hill Tracts
DAE	: Department of Agricultural Extension
et al.	: and others (at elli)
FAO	: Food and Agriculture Organization
H.S.C.	: Higher-secondary School Certificate
HYV	: High Yielding Variety
kg	: Kilogram
M.T.	: Metric Ton
NGO	: Non-Government Organization
T	: Ton
Mt	: Metric Ton
$	: Dollar
S.S.C.	: Secondary School Certificate
UNDP	: United Nations Development Programme
UHDMP	: Ultra High Density Mango Planting

CHAPTER 1
INTRODUCTION

1.1 Background

Most people prefer Mango (*Mangifera indica*) over any other fruit in Bangladesh, and it has been dubbed as the "King of Fruits" on numerous occasions (Ahmed, 1994). Mango, which belongs to the Anacardiaceae family, is a tropical to subtropical fruit that originated in the Indian subcontinent (Indo-Burma region) in prehistoric times. It is one of the important economically and aesthetically pleasing fruit. It has been grown for over 4,000 years (Candole, 1984). Mango is a commercial horticultural crop grown in many South-East Asian countries, including India, Pakistan, Philippines, Malaysia, Thailand, Burma, Sri Lanka, and Java. India, Pakistan, Mexico, Brazil, the Philippines, and Bangladesh are the world's leading mango producers. With a tropical fruit production of 25 million tons, mango ranks third among the world's tropical fruit grown (Anonymous, 2007). India is the largest producer, producing 15.5 million tons of mango (Bhuiyan, 2008), followed by Brazil, Pakistan, Mexico, Philippines, Indonesia, China, Bangladesh, Sudan, Sri Lanka, and Cuba. The current per capita mango production in various countries is approximately: 11.94 kg in India, 10.30 kg in the Philippines, 8.70 kg in Mexico, 8.20 kg in Tanzania, 6.70 kg in Pakistan, 4.70 kg in Zaire, 3.90 kg in Brazil, 3.0 kg in Indonesia, and 1.30 kg in Bangladesh (Rahman and Akter, 2019). In Bangladesh, mango is the most widely planted fruit and the third most abundantly produced. Various restraints, such as the use of excessive pesticides and fertilizers, the absence of fruit processing and preservation systems, and a lack of marketing facilities, have jeopardized mango production in these regions.

Mango trees are said to have originated in Malaysia or the Indo-Burmese area. Its cultivation quickly spread to adjacent nations, and by the 4^{th} or 5^{th} century, it had become a major fruit crop in South-East Asia. The mango is said to have been brought to Africa by Arabs on the East Coast, in Madagascar, and in Indian Ocean ports, from whence it moved inland. Before the colonial period, Africans were also instrumental in spreading the mango over intertropical Africa. The tree was often planted for its shade as well as its fruit yield. The mango was brought to Brazil by Portuguese navigators, from whence it spread over South America and subsequently to North America. It was brought to Australia only in the nineteenth century. From the 17^{th} through the 19^{th} centuries, several plantations were established in Europe, although they were mostly

unsuccessful. Mango was first reproduced through seeding, which resulted in tiny, very fibrous fruits with a distinct turpentine flavor. Graft propagation of monoembryonic variations was first perfected in the 19th century, giving birth to West Indian varieties like as Julie, Amelie, Divine, and others, which were transferred to West Africa. Commercial mangoes are often generated from the free or controlled hybridization of original polyembryonic or mono embryonic types, whose cross traits allow for the production of fruits that satisfy market demands. The Haden variety, derived from the Indian variety Mulgoba and created through the bud grafting method, was developed in the twentieth century after considerable study and selection efforts. Following that, a slew of new types appeared, all of which have now spread over the globe. Mango cultivation is preferred by the intertropical zone, although it has lately advanced in peripheral locations such as the Mediterranean, where Israel, Egypt, Morocco, and Spain are thriving. Because of its perishability, fresh mango has historically been relegated to local or regional trading. It wasn't until the development of air transport after World War-II that it started to be traded across wider distances. In the 1980s and 1990s, refrigerated sea shipping boosted mango exports to North America and Europe, two significant consumer markets. The delicious fruit mango is nutritionally superior amongst all fruits of the world. It is rich in several vitamins and minerals.

1.2 Overview on Chittagong Hill Tracts

In terms of demographic, cultural, and environmental diversity, the Chittagong Hill Tracts (CHT) is distinct from the rest of Bangladesh. Chittagong Hill Tracts (CHT) is one of Bangladesh's largest hilly regions, located in the country's south-east. The Chittagong Hill Tracts is located between latitudes 21'45' and 92'50' east. (Shelly, 1992). The Chittagong Hill Tracts cover approximately 13,295 square kilometers, or roughly one-tenth of Bangladesh's total land area. Chittagong Hill Tracts is a geographically isolated region of Bangladesh that includes the three hill districts of Rangamati, Khagrachhari, and Bandarban. To the north lies the Indian state of Tripura; to the east is Mizoram and Lushai a hill; to the west is Chittagong district; and to the south is Myanmar. The area (CHT) is made up of the seven main valleys formed by the rivers Feni, Karnafuli, Chengi, Myani, Kassalong, Sangu, and Matamuhuri, as well as their tributaries. The area, which is mostly hills, ravines, and cliffs covered in dense vegetation (trees, bushes, and creepers), stands in stark contrast to the rest of the country, which is mostly a plain of alluvial soil.

1.3 Overview on Tribal People in Bangladesh

According to the 2011 Census, Bangladesh has 1.58 million tribal people nationalities, most of whom live in clusters throughout the country. These tribal people are commonly referred to as "Adivasi," and the majority of them identify as Adivasi. In Bangladesh, there are approximately 50 distinct tribal nationalities. In the CHT area, nearly 92% people are Adivasis (tribal peoples). There is a significant lack of understanding about the needs of tribal people as a nationality and as a community among both government officials and non-governmental organizations. As a result, the major issues remain unidentified, unaddressed, and unaddressed. Finally, it has gone unnoticed by 'development' agencies led by representatives of the majority Bengali population. In this situation, it's not only a matter of a lack of knowledge; a fundamental shift in attitude is required. Tribal people have no discernible access to education or income-generating activities. They have a long history of farming, but the vast majority of them do not own their own land at the moment. Some of them work as internal migrant laborers and are frequently subjected to harassment and discrimination. Promoting education among ethnic minority peoples is critical, but so is providing a livelihood based on traditional skills such as agriculture. Primary school dropout rates are extremely high. Tribal people typically live within geographically distinct ancestral territories (or maintain attachments to them). They tend to keep separate social, economic, and political institutions within their borders. Rather than fully assimilating into a national society, they typically strive to maintain cultural, geographical, and institutional distinctions. They identify as ethnic minorities or minorities (Gregory, 2003).

1.4 New Technology in Mango Farming and its importance

To make farming more viable and increase productivity, farmers using modern technology in mango farming. Modern technology in mango farming may also help to reduce carbon emissions. Mango farming in Ultra High Density Mango Planting (UHDMP) method has gained popularity as the growers are getting additional income after the best uses of the method in Rajshahi region (BSS, 2021). Mango growers around the world are increasingly using pre-harvest fruit bagging as an efficient alternative to chemical pesticides. Following the successful application of this eco-friendly technology in several orchards over the last few years, more farmers have adopted it (Uddin and Rashid, 2019). Mango growers usually spray pesticides at least

15 to 25 times in their orchards in a season (Islam et al., 2017). Bagging technology has several beneficial effects on internal fruit quality reducing fruit disorders etc (Abdel et al., 2017). On an average 15.7% of the annual gross income was increased due to adoption of bagging technology whereas this technology contributed 25.13% increment in income from mango selling in Chittagong Hill Tracts (Uddin and Rashid, 2019).

1.5 Mango Productivity in the South Asia region

It is cultivated in India, Pakistan, Brazil, Mexico, the Philippines, Malaysia, Indonesia, Thailand, Burma, and Sri Lanka, among other places. Egypt, South – East Africa, Hawaii, and Northwest Australia have all embraced it. India is the world's greatest mango grower, producing 9.64 million tons of fruit over an area of 1.17 million hectares, accounting for around 66% of global mango output. (Jacobi et al., 2001).

1.6 Production of Mango in Bangladesh

Bangladesh become 7th largest mango producer in the world (DhakaTribune,2021). According to BBS 2020, the total mango production area in Bangladesh is 95,284 Hectares and total production of Mango is 11,09,947 Metric Tons (MT). Division wise total mango production area and total production are shown in Table 1.1.

Table 1.1: Division Wise Total Mango Production Area and Production

Division	Total Area (Hectare)	% of Total Area	Total Production (MT)	% of Total Countries Production
Dhaka	4,793	5.03	1,13,609	10.24
Chattogram	9,681	10.16	98,959	8.92
Rajshahi	42,646	44.76	6,16,766	55.57
Khulna	7,854	8.24	1,20,429	10.85
Mymensingh	10,975	11.52	22,775	2.05
Rangpur	6,708	7.04	1,49,259	13.45
Sylhet	212	0.22	35,567	3.20
Barishal	12,415	13.03	24,617	2.22
Total	95,284	100.00	11,09,947	100.00

Source: BBS 2021

1.7 Production of Mango in Chittagong Hill Tracts (CHT)

Massive budding of Amropali, a new variety of hybrid mango, is showing signs of a bumper production this year, to disbelieve of horticulturists in Chittagong Hill Tracts

(DailyStar, 2008). According to BBS 2021, Khagrachhari is the highest Mango producing district among Chittagong Hill Tracts (Table 1.2).

Table 1.2: Total Mango Production Area and total Production in CHT

District	Total Area (Hactare)	% of Total Area	Total Production (MT)	% of Total Production in CHT
Bandarban	1,162	26.91	3,787	20.53
Khagrachhari	1,567	36.29	8,893	48.20
Rangamati	1,589	36.80	5,769	31.27
Total	4,318	100.00	18,449	100.00

Source: BBS 2021

1.8 Scope of the Study

New technology's contribution to economic development can only be recognized when and if it is broadly disseminated and utilized. Understanding the elements that influence this decision is critical for both economists investigating growth drivers and the designers and manufacturers of such technology. The current research will aid in determining the factors that influence tribal community acceptance of new agricultural technology in mango growing. The current study will aid in the provision of information on the tribal community agricultural system, which will aid individual researchers who will conduct similar studies in the future and stimulate more complete and extensive research in this area. This research will assist policymakers in learning about many issues linked to the use of new technology in mango farming, recommending and providing benefits for farmers, and encouraging farmers to utilize new technology in mango farming.

1.9 Objectives of the study

In light of the aforementioned issues, the following particular goals were devised to provide the research with correct direction:

i. To determine the social profile of tribal community mango farmers;
ii. To find out the available new technology in mango farming; and
iii. To identify the determinants of new technology adoption by tribal mango farmers.

CHAPTER 2
REVIEW OF LITERATURE

In this chapter, an attempt has been made to review of pertinent literature keeping in view the problem entitled, "**Determinants of New Technology Adoption in Mango farming: An Evidence from Chittagong Hill Tracts**". Again, some of these studies may not entirely relevant to the present study, but their findings, methodology of analysis and suggestions have a great influence on the present study. Review of some research works relevant to the present studies, which have been conducted in the recent past, are discussed below:

Afsar and Sultana (2019) found that about 60% of the respondents showed high attitude towards fruit bagging as it increases shelf life, reduce pest incidence and overall ecofriendly.

Chetri et al. (2020) observed that the tribal farmers are socio-economically backward as compared to the non-tribal farmers in the study area. So as to eradicate the problems of tribal farmers, it is necessary for the policy makers to identify and quantify the socio-economic factors which are inhibiting their growth and development. The tribal farmers due to their lower living standard have not been able to keep pace with the modern society. Tribal farmers are not as advanced as the other farmers of Assam.

Islam (2007) found the knowledge on mixed cropping of the farmers had positive and significant relationship their extent of adoption of mixed cropping. This indicates that adoption of mixed cropping increases with the increase of knowledge on mixed cropping.

Islam (2015) signified that despite inhabiting in resource rich areas, the tribal people are in underprivileged position in all respects as reflected by their low socio-personal and economic status and poor employment opportunities. The prevailing scenario led to the repercussions like acute poverty, malnutrition, migration, substandard life quality, debt, unrest, nasalism, isolation from national mainstream, lack of awareness and exposure, traditional severity etc. The forests play a central role in the economic,

cultural and socio-political systems and the entire lives and livelihoods of a majority of the tribal people in the area. The forest-based livelihoods mainly revolve around collection, processing and utilization/ selling of various forest resources throughout the year as the natural heritage supports huge richness and diversity of forest resources in the area. Hence, the livelihood diversification using existing forest resources should be given topmost priority as important strategy of poverty reduction and socioeconomic upliftment of backward tribal people in the area.

Khan (2006) investigate the farmers adopted either one or more of six selected modern technology. It was also found that one respondent did not adopt all technology at the same time. One respondent was innovator for technology and may be laggards or late majority or early majority for other technology. Adoption of modern technology depends on availability of information.

Khan (2018) found the low organizational participation farmers adopted less rice production and with the increase of organizational participation of the farmers tend to increase their extent of adoption of technology. And with the increase in farm size of the farmers tends to increase their extent of adoption technology.

Lakshmi and Paul (2019) observed that majority of the sampled households lacked durable household assets. Around 37% of the land-owning sample did not have ownership rights. More than 60% fulfilled their credit needs from private money lenders. Therefore, there is a need to put more attention on educating the scheduled tribes, which can motivate them for their future life.

Rasul et al. (2004) found that the tribal farmers responded well whenever any opportunity arises for adoption of better land use. However, their efforts were largely constrained by poor institutional support, including lack of land title, poor extension services, inadequate credit and marketing facilities, and poor transportation and communication facilities. In some areas where such institutional support was available, farmers had abandoned extensive shifting cultivation and adopted occasionally suitable commercial land uses as agro forestry, horticulture and timber plantation.

Sarker et al. (2022) found that higher levels of education, more farming experience, subsistence farming, access to credit and smaller family size were all significant predictors to the adoption of climate-smart agriculture technology at Satkhira district in Bangladesh

Singh et al. (2010) investigated that majority of farmers had partial adoption of such practices as adoption of high yielding variety, selecting good nursery, intercultural practices, harvesting, packing and handling. However, majority of farmers did not adopt such practices as summer ploughing, application of manure and fertilizers (dose, time and method), intercrops, plant growth regulators, green manuring, insect pests and diseases, physiological disorders, and marketing procedures. Among the correlates of extent of adoption of mango production technology, religion, land size, education, farm power, socio-economic status, risk taking behavior, innovativeness, economic aspiration, scientific orientation and credit orientation were positively and significantly associated with fruit grower's extent of adoption of improved mango production technology at 0.01 level of probability. Regression analysis of extent of adoption of fruit growers on improved mango production technology revealed that level of knowledge of mango cultivation practices was found to be contributing positively and significantly in predicting the extent of adoption of mango fruit growers.

Uddin et al. (2018) investigated adoption of BARI mango varieties in selected sites of Chittagong district. The study revealed that the adoption of BARI mango varieties is an important for raising farm income in the region. But the rate of adoption was found to be low except BARI Aam-3. Unavailability of the saplings of BARI mango varieties and lack of its campaign were the major bottlenecks for wider adoption of BARI mango varieties in the region. The yield of BARI mango variety, training, extension contact, risk taking behavior and willingness to take loan influence farmers to adopt BARI mango varieties to a greater extent. In the case of individual production technologies, most of the farmers' respondent adopted partially or slightly might be due to unawareness or ignorance.

Uddin and Rashid (2019) found that the average market price received from bagged mango was 74% higher than non-bagged mango. The difference of average gross margin of bagged and non-bagged mango was recorded Tk.22790 per ton which implies

that bagged mango was more profitable than non-bagged mango. According to the survey report on an average 15.7% of the annual gross income was increased due to adoption of bagging technology whereas this technology contributed 25.13% increment in income from mango selling. About 96% of the respondents admitted that they were able to control fruit flies and 92% of them confirmed that they were able to produce safe and toxicity free fruits utilizing pre-harvest bagging technology.

The above mentioned opinions evidently show that no such studies were conducted on determinants of new technology adoption in mango farming in Chittagong Hill Tracts. The present study was undertaken to determine the determinants of new technology adoption in mango farming in Chittagong Hill Tracts and thereby to facilitate farmers and policy maker's decision making by providing information on new technology adoption in mango farming.

CHAPTER 3
METHODOLOGY

3.1. Introduction

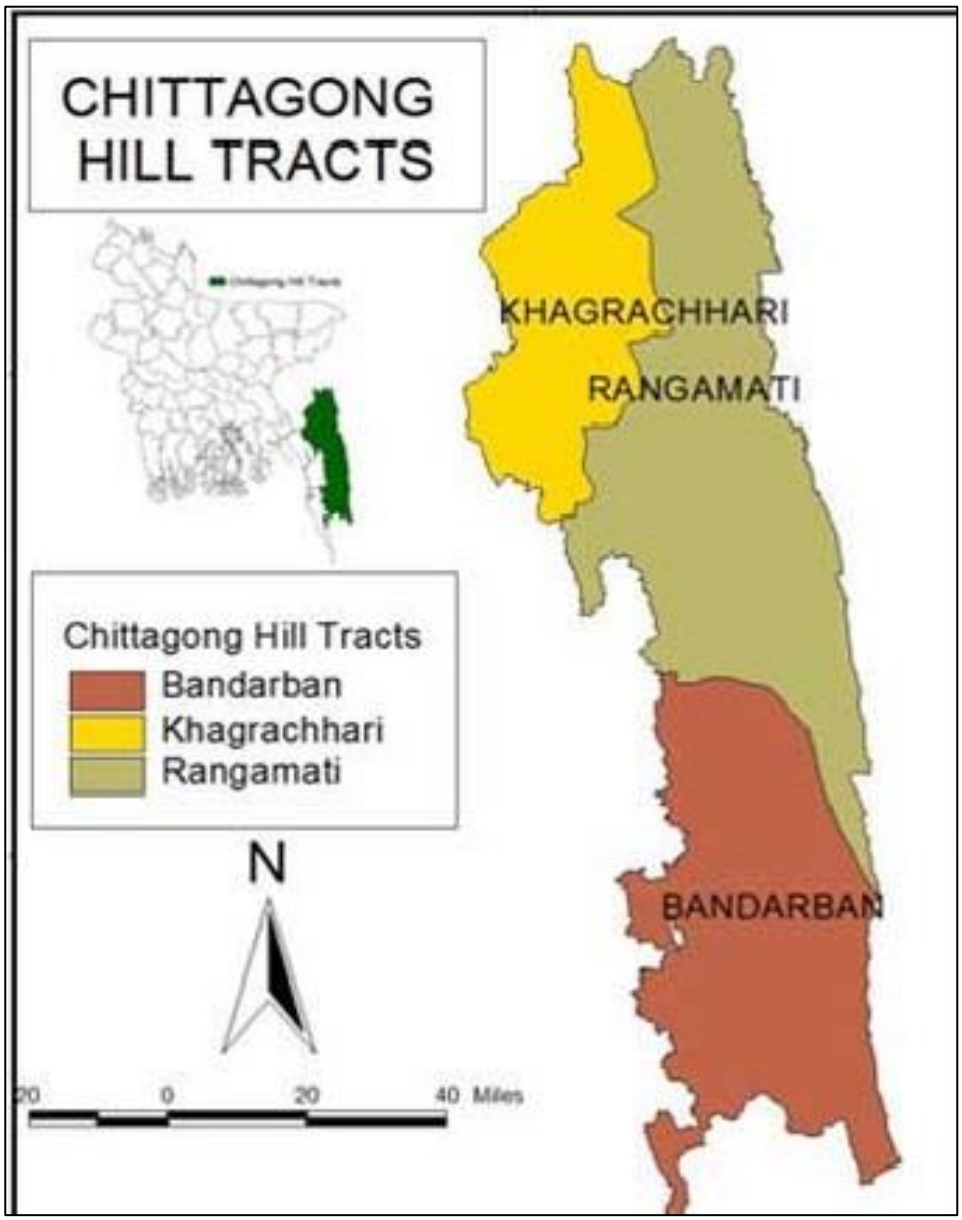
The quality of farm management research is determined by the study's approach. The use of proper technique is a must for excellent research. Any survey's design is largely defined by the study's nature, goals, and objectives. It is also contingent on the availability of the required resources, supplies, and time. Data for farm management research may be collected in a variety of ways. A farm business research normally entails gathering information from individual farmers; data collection for farm business analysis necessitates the analyst's judgment in selecting data collecting techniques within the constraints imposed by the work's resources (Dillon and Hardaker 1993). The "survey approach" was used in this research for two key reasons:

i. The survey allows for rapid study of a large number of instances; and
ii. The findings are more widely applicable.

The survey approach has a significant drawback in that the investigator must depend on the farmers' memories. To address this issue, researchers conducted several trips to the study region to gather data, and in the event of any omissions or contradictions, farmers were contacted again to get the "missing and/or accurate information." The following stages were used in the survey design for this investigation.

3.2. Selection of the Study Area

The selection of the study area is a crucial stage in any farm management research. The location chosen was appropriate for the study's specific goal as well as the possibility of farmer collaboration. Although mango is produced across Bangladesh, the Hill Locations of Khagrachhari, Rangamati, and Bandarban in the country's south east are the most significant districts where it is grown widely.



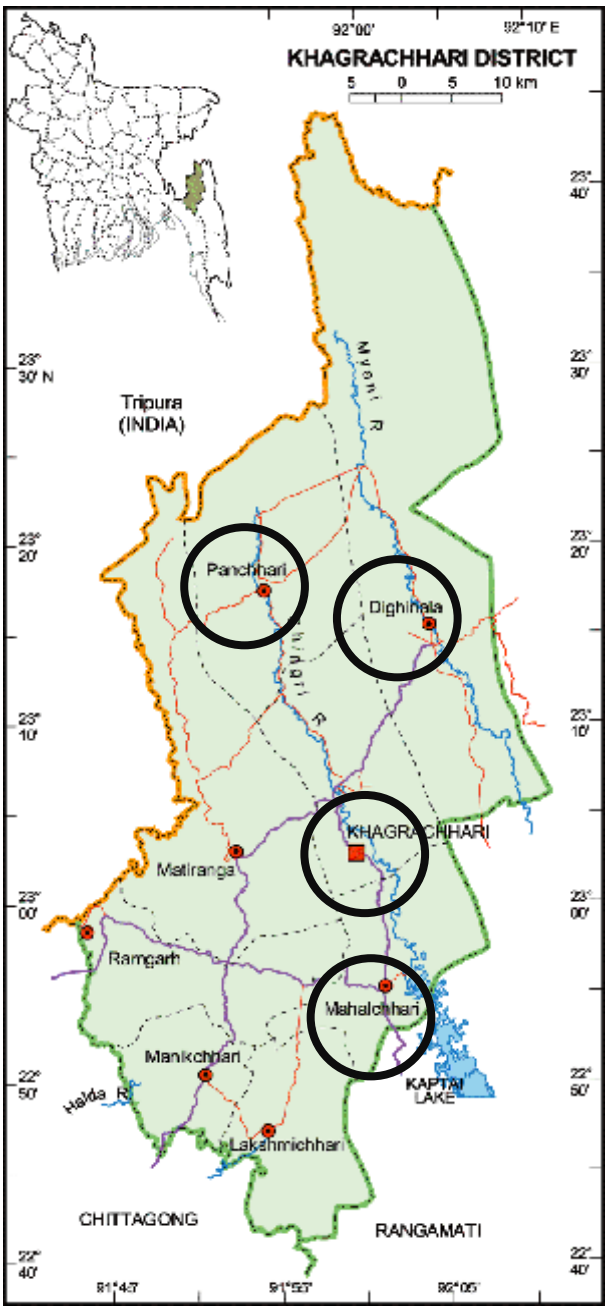
Source: www.google.com

Figure 3.1: Map of Chittagong Hill Tracts (CHT)

As a result of the larger concentration of mango production, four upazilas in Khagrachhari district, namely Khagrachhari Sadar, Panchhari, Mohalchhari, and Dighinala, were randomly chosen for the research. The districts of Bangladesh are divided into sub-districts called upazila (Sarker, 2010). The following were the primary factors in deciding on the research area:

a) The research region contained a big number of mango farmers;
b) These villages had certain similar physical features for growing mango, such as topography, soil, and climatic conditions;
c) In these communities, there was anticipated to be easy access; and

d) Adequate communication facilities, as well as a high level of cooperation from the respondents in order to acquire trustworthy data.



Source: www.google.com

Figure 3.2: Map of Khagrachhari District Showing Study Area (Upazilas)

3.3. Sampling Technique and Sample Size

When choosing samples for a research, two criteria must be taken into account. The sample size should be as big as possible to ensure that the statistical analysis has enough degrees of freedom. Field research administration, data processing and analysis, on the

other hand, should be manageable within the constraints imposed by physical, human, and financial resources (Mannan 2001). However, because to the variability of the technological and human environments, it is required to sample a large number of people before drawing any conclusions. As a result, sampling is used to pick a subset of the population that is representative of the whole population (Rahman 2000).

Due to time, money, and manpower constraints, it was not feasible to enroll all of the farmers in the research region. A total of 100 farmers were chosen at random. The current research used a purposive sampling and simple random sampling to save money and time while still achieving the main goals of the study.

3.4 Data Collection

Data collection is viewed as an important aspect of a survey since it has a substantial influence on the quality of the findings. Given its significance, the following precautions were taken throughout the development of the questionnaire as a data gathering tool:

3.4.1. Questionnaire Design

A questionnaire is a strong data collecting instrument that uses multi-dimensional questions to acquire information. A questionnaire without a defined objective and purpose would always ignore crucial topics and waste the time of enumerators and respondents by asking and responding to irrelevant questions. All of these issues were considered to the best of our ability in order to construct the survey questionnaire.

3.4.2. Pre-testing the Questionnaire

The questionnaire was pre-tested to determine the amount of time required to complete the interview, its reliability (i.e., if it caught the information sought), and its consistency (i.e., whether the information acquired was relevant to the survey's overall goal). The test also aimed to assess the logistics necessary for the survey's effective operation. Pre-testing was conducted in rural areas of Khagrachhari Sadar, Panchhari, Mohalchhari, and Dighinala within Khagrachhari District between the months of June and August, 2021 before to the survey to assure the optimal performance of the questionnaire in terms of data collecting, processing, and analyzing.

3.4.3. Finalization of the Questionnaire & Method of Data Collection

The questionnaire was adjusted and finalized based on the pre-test suggestions. After finalized of questionnaire field level data was started. With the permission, the

questionnaire was finally completed. Following the questionnaire, a face-to face interview was conducted on June to August, 2021.

3.4.4. Data Editing and Coding

The survey data analysis included data editing and coding, both of which were required for data processing. Prior to data processing, it should be finished. In the instance of this survey, coding was done concurrently with questionnaire construction so that the enumerator could mark the correct responses quickly and precisely. The process of verifying and cleansing data that had previously been obtained from the field was referred to as data editing.

3.5. Data Processing

Data processing included a number of procedures that were critical because they influenced survey findings based on the steps involved. The following actions were conducted during data processing:

- Data input;
- Appending and merging files;
- Data validation (additional computer checking, editing, and imputation);
- Final judgment on mistakes;
- Completion of data processing;
- Final documentations; and
- Storage of all files.

3.6. Processing and Tabulation of Data

The information gathered was manually modified and coded. After then, all of the data was compiled and thoroughly examined. Furthermore, data was entered into a computer and analyses were performed using the applications Microsoft Excel and STATA. It should be remembered that information was first gathered in local units. It was converted to regular international units after requisite checks.

3.7 Data Analysis

Determinants of new technology adoption in mango farming was determined using a binary logistic regression model, more often referred to as the logit model. The following is the model for this study:

$$\mathbf{Log\ [P/1-P] = \beta_0+\beta_1X_1+ \beta_2X_{2+} \beta_3X_{3+} \beta_4X_{4+} \beta_5X_{5+} \beta_6X_6+ \beta_7X_{7+} \beta_8X_{8+} \beta_9X_9+e}$$

Where,

P = Probability of Outcome (Fruit Bagging Technology/High Density Farming /Contour Farming)

X_1 = Age (Years)

X_2 = Secondary Occupation of Farmers (Yes/No)

X_3 = Highest Education Level of Family (Years)

X_4 = Training (Yes/No)

X_5 = Experience (Years)

X_6 = Social/Agricultural Organization Participation (Yes/No)

X_7 = Friends Contact (Yes/No)

X_8 = Family Contact (Yes/No)

X_9 = Use of Social Media (Yes/No)

β_0 = Intercept

β_1 to β_9 = Co-efficient of Age, Secondary Occupation, Highest Education Level of Family , Training, Experience, Social/Agricultural Organization Participation, Friends Contact, Family Contact and Use of Social Media;

e = Random Error.

STATA software was used to analysis the data. A probability of 10% (0.10) was utilized to reject the null hypothesis. Asterisks (***) indicate the significance of coefficient values at the 0.01 level, while two asterisks (**) indicate the significance of coefficient values at the 0.05 level and three asterisks (*) indicate the significance of coefficient values at the 0.10 level

3.8 Variables Used

A variable is any property that may take on varied or distinct values in subsequent individual occurrences (Ezekiel and Fox, 1959). A well-structured piece of study would often have at least two significant variables, referred to as dependent and independent variables.

3.8.1 Dependent Variable

The dependent variable is the variable that is assessed in an experiment or the variables that are altered during research. In this study the dependent variable is farmers'

adoption of: (i) Fruit Bagging Technology; (ii) High Density Farming; and (iii) Contour Farming in Mango production.

3.8.2 Independent Variables

The independent variables are those that the researcher modifies in order to examine the dependent variables or variables that may take on changing values and thereby affect the values of other variables. The researcher chosen 9 qualities of the respondent as independent variables in this study. The independent variables for this study are: (i) age; (ii) secondary occupation; (iii) highest education level of family; (iv) training; (v) experience; (vi) social/agricultural organization participation; (vii) friends contact; (viii) family contact; and (ix) use of social media.

3.8.3 Measurement of Dependent Variable

Adoption of fruit bagging technology/high density farming/contour farming by the farmers was the dependent variable for the study. The variable was measured on the basis of whether the farmers adopted or not adopted of fruit bagging technology/high density farming/contour farming in mango production.

The farmers who was an adopter of fruit bagging technology/high density farming/contour farming was given a score of 1 and the farmers who was a non-adopter of fruit bagging technology/high density farming/contour farming was given a score of 0. Thus, the range of adoption fruit bagging technology/high density farming/contour farming score was 0 to 1.

3.8.4 Measurement of Independent Variables

It was important to measure the independent variables in order to perform the research according to the goals. The independent variables were age, secondary occupation, highest education level of family, training, experience, social/agricultural organization participation, friends contact, family contact and use of social media. Procedures for measuring these variables are described below:

i) Age

Age of the farmers was measured in terms of actual years from his birth to the time of interview, which was found on the basis of the verbal response of the rural people (Rashid, 2014). A score of one (1) was assigned for each year of one's age.

Table 3.1: Short Description of Dependent and Independent Variables

Variable	Types	Measuring Technique
A. Dependent Variables		
Adoption of **(i) Fruit bagging technology** **(ii) High density farming** **(iii) Contour farming**	Binary	1 for adopter of fruit bagging technology/high density farming/contour farming and 0 for non-adopter of fruit bagging technology/high density farming/contour farming
B. Independent Variables		
(i) Age	Continuous	1 for 1 year
(ii) Secondary Occupation	Binary	1 for engage in secondary occupation and 0 for not engage in secondary occupation
(iii) Highest Education Level of Family	Continuous	1 for 1 year of schooling
(iv) Training	Binary	1 for participate in training and 0 for not participate in training
(v) Experience	Continuous	1 for 1 year of experience
(vi) Social/Agricultural Organization Participation	Binary	1 for participate in social/agricultural organization and 0 for not participate in social/agricultural organization
(vii) Friends Contact	Binary	1 for discussing with friends and 0 for not discussing with friends
(viii) Family Contact	Binary	1 for discussing with family members and 0 for not discussing with family members
(ix) Use of Social Media	Binary	1 for using social media and 0 for not using social media

ii) Secondary Occupation

Secondary Occupation was measured based on their response to engage in any secondary occupation. Those who was involved in any secondary occupation was given score 1 otherwise 0.

iii) Highest Education Level of Family

Highest education level of the family was defined as an individual respondent's ability to read and write, or the formal education obtained up to a given threshold in that family. If a responder lacked formal schooling, his or her score was zero (0). Each year of education was granted a score of one (1). If a responder passed the S.S.C test, he received a score of 10 for H.S.C. and so on.

iv) Training

Training was measured based on their response to participate any training programme. Those who was attended any training programme was given score 1 otherwise 0.

v) Experience

Experience of respondent was measured on the basis of the nature of their experience in Mango farming. A score of one (1) was assigned for each year of one's experience.

vi) Social/Agricultural Organization Participation

Social/Agricultural organization member was measured based on their response to member of any available social/agricultural organization in their area. Those who was member of any available social/agricultural organization was given score 1 otherwise 0.

vii) Friends Contact

Friends Contact was measured based on their response of communication and discussion with any friends. Those who was discussed with friends was given score 1 otherwise 0.

viii) Family Contact

Family Contact was measured based on their response of communication and discussion with any family members. Those who was discussed with family members was given score 1 otherwise 0.

ix) Use of Social Media

In this digital Bangladesh era, almost every person has access into the internet. Farmers also use internet. Through internet farmers use social media like facebook, youtube.

Use of social media was measured based on their involvement on social media those who use social media was given score 1 otherwise 0.

3.9 Null Hypothesis

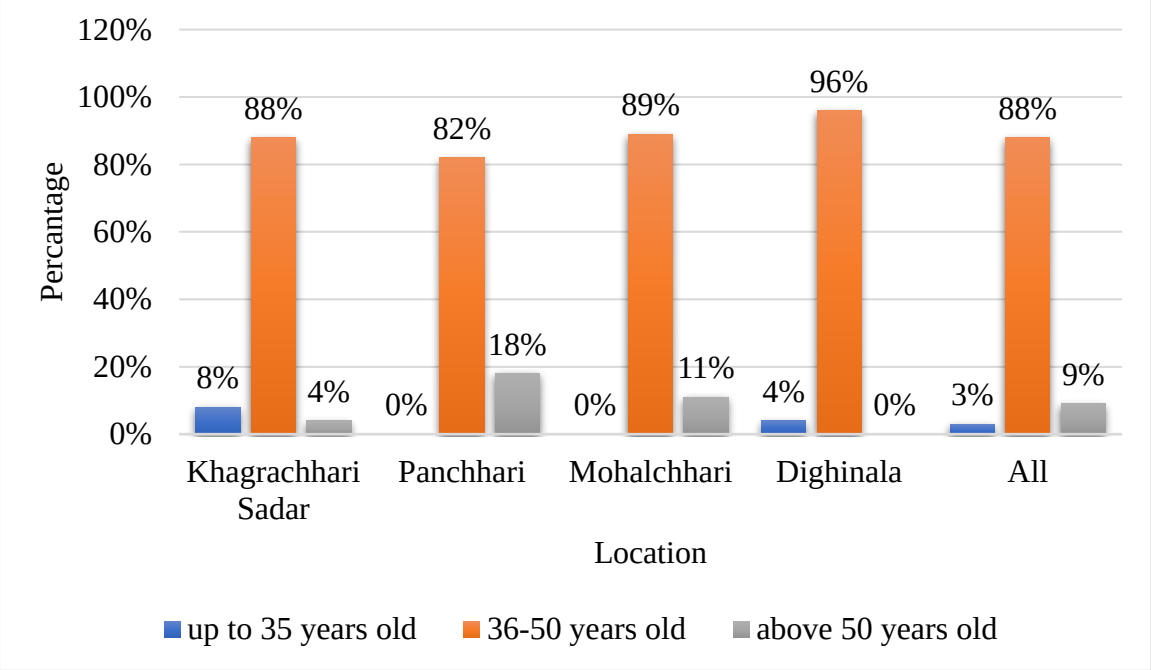
The current investigation tested the following null hypothesis. There is no statistically significant association between chosen farmer traits and satisfaction with agricultural progress in Bangladesh. The features in question are - age, secondary occupation, highest education level of family, training, experience, social/agricultural organization participation, friends contact, family contact and use of social media.

CHAPTER 4
SOCIAL PROFILE OF THE TRIBAL COMMUNITY MANGO FARMERS

This chapter examined the social profile of the respondents.

4.1 Age

In the study 25, 34, 18, and 23 samples were taken from four upazilas called Khagrachhari Sadar, Panchhari, Mohalchhari, and Dighinala, respectively, to reflect the whole population. In Khagrachhari Sadar Upazila, 8% of sample farmers were up to 35 years old, 88% were 36-50 years old, and 4% were above 50 years old. In Panchhari Upazila, 82% were 36-50 years old, 18% were above 50 years old and there were no farmers up to 35 years old . In Mohalchhari Upazila, 89% were 36-50 years old, 11% were above 50 years old and there were no farmers up to 35 years old.



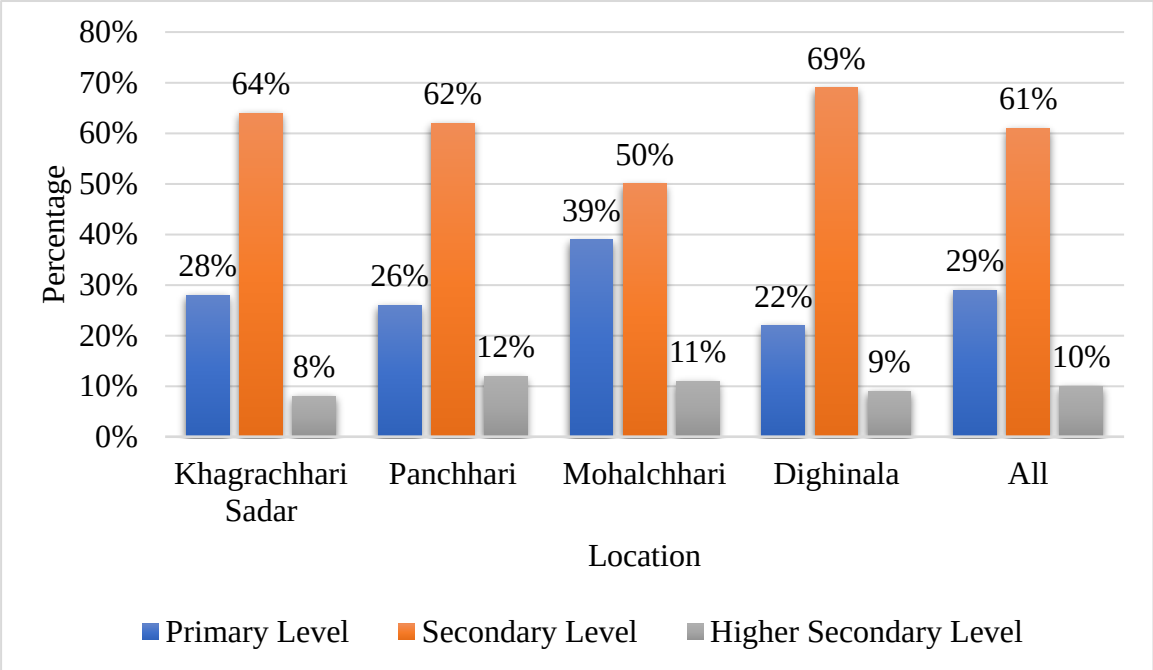
Source: Field Study, 2021

Figure 4.1: Age of the Respondent (Mango Growing Farmers)

In Dighinala Upazila, 4% of sample farmers were up to 35 years old, 96% were 40-49 years old, and there were no farmers above 50 years old (Figure 4.1). Overall, the majority of farmers (88%) age were between the ages of 36 and 50 in the study area.

4.3 Education Level of the Farmer

As per Figure 4.2, around 28% of farmers had a primary level of education, approximately 64% had a secondary level of education, and 8% had a higher secondary level of education in Khagrachhari Sadar Upazila. On the other hand, 26% of individuals had a primary level of education, 62% had a secondary level of education, and 12% had a higher secondary level of education in Panchhari Upazila. About 39% farmers had a primary level of education, 50% farmers had a secondary level of education and 11% farmers had a higher secondary level of education, in Mohalchhari Upazila. In contrast 22% of individuals had a primary level of education, 69% had a secondary level of education, and 9% had a higher secondary level of education in Dighinala Upazila. Finally, the majority of farmers (61%) had a secondary education in the study area.



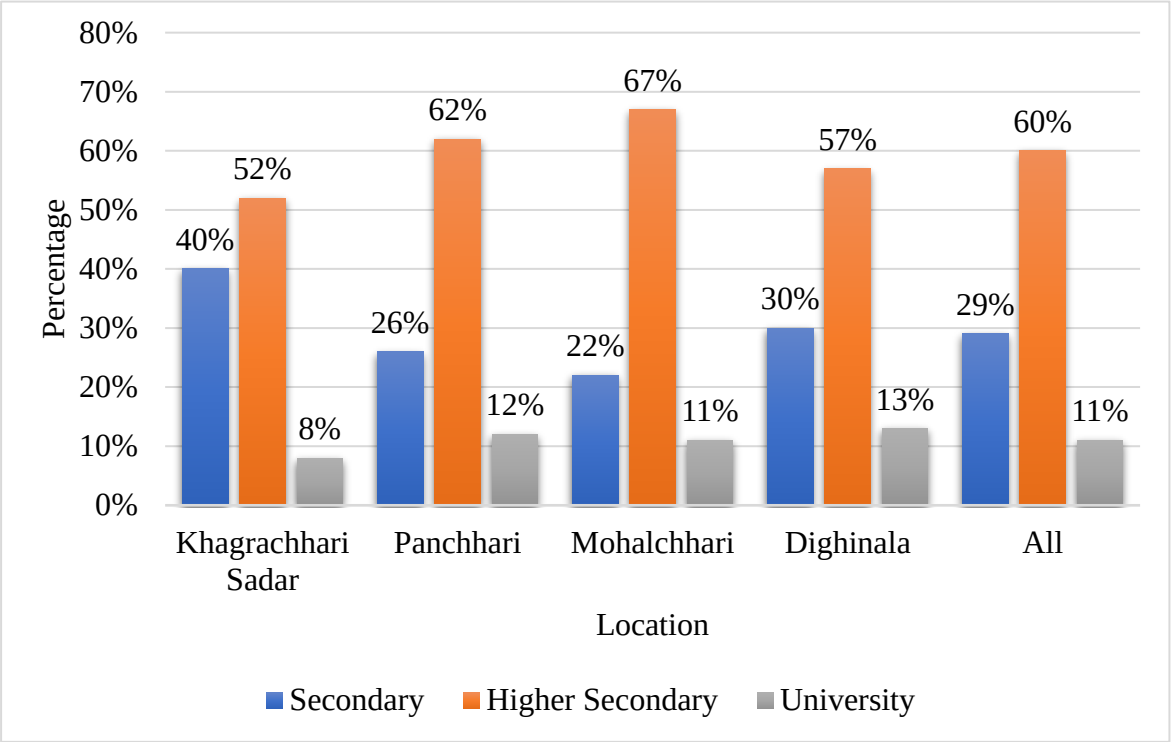
Source: Field Study, 2021

Figure 4.2: Education Level of the Farmer in the Study Area

4.4 Highest Education Level of the Family

Figure 4.3 showed that, in Khagrachhari Sadar Upazila, about 40% were found the family's highest education level had secondary level, about 52% were found the family's highest education level had higher secondary level and 8% people were found the family's highest education level to had university level. In Panchhari Upazila, about 26% were found the family's highest education level had secondary level, about 62% were found the family's highest education level had higher secondary level and 12%

people were found the family's highest education level had university level. In Mohalchhari Upazila, about 22% were found the family's highest education level had secondary level, about 67% were found the family's highest education level had higher secondary level and 11% people were found the family's highest education level had university level. In Dighinala Upazila, about 30% were found the family's highest education level had secondary level, about 57% were found the family's highest education level had higher secondary level and 13% were found the family's highest education level had university level. Overall, most of the family's highest education level (60%) was higher secondary level in the study area.



Source: Field Study, 2021

Figure 4.3: Highest Education Level of the Family in the Study Area

4.5 Composition of the Family Size

Family size is critical in terms of producing adequate nourishing grain for the ranch family. In this research, family was defined as the total number of persons living in a same kitchen and eating meals under the influence of a single family leader. The term "relatives" refers to the husband, children, unmarried little girl, father, mother, sister, and several other relatives who reside in the family permanently. According to Table 4.1, the average household size in Khagrachhari Sadar, Panchhari, Mohalchhari and Dighinala Upazila were 5.20, 6.16, 5.91, and 5.65, respectively. The average family

size in the study area was 5.65, while the average family size in the country is 4.06 (Table 4.1).

Table 4.1: Average Family Size and Distribution of Members According to Sex of the Sample Farmers in Study Area

Particulars	Male		Female		Total	
	Number	Percentage	Number	Percentage	Number	Percentage
Khagrachhari Sadar	3.05	58.65	2.15	41.35	5.20	100.00
Panchhari	3.31	53.73	2.85	46.27	6.16	100.00
Mohalchhari	3.23	54.65	2.68	45.35	5.91	100.00
Dighinala	3.33	62.71	1.98	37.29	5.31	100.00
All Farmer	3.23	57.17	2.42	42.83	5.65	100.00
National Average Family Size	4.06					

Source: Field survey, 2021

4.6 Agricultural Training

About 52% of responding farmers in Khagrachhari Sadar Upazila received instruction in mango farming, compared to around 56% in Panchhari Upazila, approximately 61% in Mohalchhari Upazila, and approximately 65% in Dighinala Upazila (Table 4.2). Overall 58% of the respondents received training where 42% were not. These training sessions heightened their awareness of proper plant handling, the use of resistant cultivars, the management of insecticides and pesticides, water management, and new technologies, etc. BINA, Khagrachhari, and DAE provided the majority of the instruction on mango farming.

Table 4.2: Agricultural Training of the respondent in the Study Area

Training Received	Khagrachhari Sadar		Panchhari		Mohalchhari		Dighinala		Overall	
	Number	%	Number	%	Number	%	Number	%	Number	%
Yes	13	52.00	19	55.88	11	61.11	15	65.22	58	58
No	12	48.00	15	44.12	7	38.89	8	34.78	42	42
Total	25	100	34	100	18	100	23	100	100	100

Source: Field survey, 2021

4.7 Social/Agricultural Organization Participation

In Mohalchhari Upazila, about 44% of mango farmers were found to be members of various social and/or agricultural organizations, but in Khagrachhari Sadar Upazila, 56% of mango farmers were found members of various social and/or agricultural organizations. In Panchhari upazila, 65% of mango farmers were participated in various Social and/or agricultural organizations and 48% of mango farmers were members of various social and/or agricultural organizations in Dighinala upazila (Table 4.3). Overall 55% of the respondents had membership of various social and/or agricultural organizations where 45% had not.

Table 4.3: Social/Agricultural Organization Participation of the respondent in the Study Area

Membership	Khagrachhari Sadar		Panchhari		Mohalchhari		Dighinala		Overall	
	Number	%	Number	%	Number	%	Number	%	Number	%
Yes	14	56.00	22	64.71	8	44.44	11	47.83	55	55
No	11	44.00	12	35.29	10	55.56	12	52.17	45	45
Total	25	100	34	100	18	100	23	100	100	100

Source: Field Study, 2021

CHAPTER 5

AVAILABLE NEW TECHNOLOGY IN MANGO FARMING

This chapter discussed about the new mango farming technologies available in the Chittagong Hill Tracts (CHT).

5.1 Fertilizer Application

Inconsistent flowering, low fruit set, and low fruit retention all contribute to low yields and poor quality fruits in mango production. Fertilizer is one of the most essential element affecting crop productivity. In the study area, about 100% of mango farmers reported using fertilizer in mango farming (Table 5.1).

5.2 Irrigation Facility

Mango is a drought-resistant tree, with a tap root that may extend more than 20 meters into the earth and access to ground water supplies, which enables mango plants to tolerate prolonged drought. Mango fruits cease vegetative development and immature leaves wilt first under extreme drought stress. Even after their full leaves fall, mango trees live for many days and new buds sprout immediately with the return of rain. About 100% of mango farmers reported having irrigation facilities for mango farming (Table 5.1).

5.3 Grafting

For the majority of fruit crops, including mango, vegetative propagation by grafting is advised. It entails the connection of scion and rootstock, with the rootstock developing into the root system and the scion developing the grafted tree's top fruiting portion. In the survey area, about 100% of mango farmers reported using grafting in mango farming (Table 5.1).

5.4 Pest and Disease Management

Pest control is critical to crop yield. Pests may be damaging to horticulture businesses by reducing crop yields, quality, and eventually marketability. About 100% of mango farmers reported using pest control in mango production (Table 5.1).

Table 5.1: Available New Technology in Mango Farming

Items	Number of Respondents	Percentage
Fertilizer Application	100	100
Irrigation Facility	100	100
Grafting	100	100
Pest/Disease Management	100	100
Weed Management	100	100
Fruit Bagging Technology	100	53
High Density Farming	100	54
Contour Farming	100	50

Source: Field Study, 2021

5.5 Weed Management

Weed Management is the process of reducing the weed population and its growth to a level that does not cause economic damage to the crop while maintaining a minimal environmental population. Weeds was controlled by using any applicable weed management approach and, if necessary, by combining two or more weed control methods. About 100% of mango farmers reported using weed management in mango farming (Table 5.1).

5.6 Fruit Bagging Technology

Bagging is a critical technical measure for producing high-quality external fruits by protecting them from blemishes, sunburn, and insects. However, bagging altered the microenvironment of the bagged fruit, affecting light intensity and photosynthetic capacity, and thus the accumulation of fruit inner substances. Sugar content reduced to a certain level as a result of bagging; the loss in content increased as light transmittance decreased. About 53% of mango farmers reported using fruit bagging technology in their operations (Table 5.1).

5.7 High Density Farming

High density farming methods teach farmers how to utilize their land more effectively, boosting yields without expanding planting area. More significantly, high-density

farming demonstrates that farmers with little land can still earn a livelihood from farming, contrary to the widespread idea that successful farming requires a lot of area. About 54% of mango farmers reported using high density farming in their operations (Table 5.1).

5.8 Contour Farming

Contour farming is a technique that involves tilling sloping ground along lines of continuous height in order to retain precipitation and minimize soil loss due to surface erosion. It has been done for millennia in regions of the globe with a high reliance on irrigated farming. About 50% of mango farmers reported using contour farming in their operations (Table 5.1).

CHAPTER 6

DETERMINANTS OF NEW TECHNOLOGY ADOPTION IN MANGO FARMING

This chapter explored the factors that influence new technology adoption in mango farming.

6.1 Fruit Bagging Technology Adoption in Mango Farming

The farmers adoption of fruit bagging technology in mango farming was found to vary between 0 and 1. Based on the number of times farmers in mango farming adopted fruit bagging technology, farmers were categorized into two categories: (i) fruit bagging technology adopters; and (ii) fruit bagging technology non-adopters. Table 6.1 shows the distribution of responders according to their usage of fruit bagging technology in mango farming.

Table 6.1: Distribution of Fruit Bagging Technology Adopters and Non-adopters

Category	Number of Respondents	Percentage
Fruit Bagging Technology Adopter	53	53.00
Fruit Bagging Technology Non-adopter	47	47.00
Total	100	100.00

Source: Field Study, 2021

Table 6.1 shows that, the highest proportion of the respondents were fruit bagging technology adopter compared to fruit bagging technology non-adopter regarding mango farming. About 53% respondents are fruit bagging technology adopter and 47% non-adopter in mango farming.

Binary logistic regression analysis was performed to find out the determinants of fruit bagging technology adoption in mango farming from the independent variables, as shown in Table 6.2.

Table 6.2: Binary Logistic Regression Coefficients of Contributing Determinants Related to the Adoption of Fruit Bagging Technology

Dependent Variable	Independent Variable	Para meter	Coefficient	P value	LR Chi^2	Pseudo R^2
Adoption of Fruit Bagging Technology in Mango Farming	Age ($X_{1)}$	β_1	0.129	0.451	108.88 (0.000)	0.79
	Secondary Occupation (X_2)	β_2	0.916	0.449		
	Highest Education Level of the family (X_3)	β_3	0.734*	0.096		
	Training (X_4)	β_4	0.647	0.605		
	Experience (X_5)	β_5	-0.506*	0.067		
	Social/Agricultural Organization Participation (X_6)	β_6	0.596	0.623		
	Friends Contact (X_7)	β_7	4.042**	0.017		
	Family Contact (X_8)	β_8	3.748**	0.027		
	Use of Social Media (X_9)	β_9	7.798***	0.000		

Source: Field Study, 2021

*** significant at P<0.01; ** significant at P<0.05; * significant at P<0.10

Table 6.2 shows that use of social media (significant at the 1% level of significance), friends contact and family contact (significant at the 5% level of significance) and highest education level of family and experience (significant at the 10% level of significance) were the important determinants regarding adopting fruit bagging technology in mango farming. The data in Table 6.2 test the final null hypothesis: There is no relationship between the selected characteristics (age, secondary occupation, training and social/agricultural organization participation) and the probability of adoption of fruit bagging technology by the farmers in mango farming. In order to assess, which determinants contribute to the adoption of fruit bagging technology by the farmers in Mango farming, binary logistic regression analysis was carried out. The

analysis suggests that the respective authority should consider the respondents' highest education level of the family, friends contact, family contact and use of social media for increasing the adoption of fruit bagging technology by the farmers in Mango farming.

The Pseudo R^2 was 0.79. It means the empirical model is 79% successful while predicting the respondents' adaptive responses against fruit bagging technology in mango farming. Besides, the LR Chi^2 (108.88) was highly significant at 1% level (Table 6.2), which indicates that, the model is valid.

6.2 High Density Farming Adoption in Mango Farming

The farmers' adoption of high density farming was found to vary between 0 and 1. Farmers were categorized into two groups based on their utilization of high density mango farming: (i) high density farming adopters; and (ii) high density farming non-adopters. The respondents distribution according to their utilization of high density farming in mango farming is shown in Table 6.3.

Table 6.3: Distribution of High Density Farming Adopters and Non-adopters

Category	Number of Respondents	Percentage
High Density Farming Adopter	54	54.00
High Density Farming Non-adopter	46	46.00
Total	100	100.00

Source: Field Study, 2021

Table 6.3 shows that, the highest proportion of the respondents were high density farming adopter compared to non-adopter regarding mango farming. (54% respondents are high density farming adopter and 46% respondents are high density farming non-adopter in mango farming.)

Binary logistic regression analysis was performed to find out the determinants of high density farming adoption in mango farming from the independent variables, as shown in Table 6.4.

Table 6.4: Binary Logistic Regression Coefficients of Contributing Determinants Related to the Adoption of High Density Farming

Dependent Variable	Independent Variable	Para Meter	Coefficient	P value	LR Chi^2	Pseudo R^2
Adoption of High Density Farming in Mango Farming	Age ($X_{1)}$	β_1	- 0.119	0.426	113.04 (0.000)	0.82
	Secondary Occupation (X_2)	β_2	0.999	0.519		
	Highest Education Level of the family (X_3)	β_3	1.314*	0.062		
	Training (X_4)	β_4	2.958**	0.018		
	Experience (X_5)	β_5	0.0417	0.831		
	Social/Agricultural Organization Participation (X_6)	β_6	- 1.869	0.136		
	Friends Contact (X_7)	β_7	5.664**	0.014		
	Family Contact (X_8)	β_8	5.395**	0.018		
	Use of Social Media (X_9)	β_9	3.664**	0.032		

Source: Field Study, 2021

*** significant at P<0.01; ** significant at P<0.05; * significant at P<0.10

Table 6.4 shows that training, friends contact, family contact and use of social media (significant at the 5% level of significance) and highest education level of family (significant at the 10% level of significance) were the important determinants regarding adopting high density mango farming. The data in Table 6.4 test the final null hypothesis: There is no relationship between the selected characteristics (age secondary occupation, experience and social/agricultural organization participation) and the probability of adoption of high density mango farming. In order to assess which determinants, contribute to the adoption of high density farming by the farmers in mango farming, binary logistic regression analysis was carried out. The analysis suggests that the respective authority should consider the highest education level of

family, training, friends contact, family contact and use of social media for increasing the adoption of high density mango farming.

The Pseudo R^2 was 0.82. It means the empirical model is 82% successful while predicting the respondents' adaptive responses against high density farming in mango farming. Besides, the LR Chi^2 (113.04) was highly significant at 1% level (Table 6.4). These findings indicate that, the model is valid.

4.3.3 Contour Farming Adoption in Mango Farming

The farmers' adoption of contour farming for mango production was found to vary between 0 and 1. The farmers were categorized into two groups based on their usage of contour farming: (i) contour farming adopters; and (ii) contour farming non-adopters. The distribution of respondents by their usage of contour farming in mango farming is shown in Table 4.9.

Table 6.5 : Distribution of Contour Farming Adopters and Non-adopters

Category	Number of Respondents	Percentage
Contour Farming Adopter	50	50.00
Contour Farming Non-adopter	50	50.00
Total	100	100.00

Source: Field Study, 2021

Table 6.5 shows that the proportion of the respondents were contour farming adopter and contour farming non-adopter regarding mango farming is equal, i.e. 50% respondents are contour farming adopter and 50% respondents are contour farming non adopter in mango farming.

Binary logistic regression analysis was performed to find out the determinants of contour farming adoption in mango farming from the independent variables, as shown in Table 6.6.

Table 6.6: Binary Logistic Regression Coefficients of Contributing Determinants Related to the Adoption of Contour Farming

Dependent Variable	Independent Variable	Para meter	Coefficient	P value	LR Chi^2	Pseudo R^2
Adoption of Contour Farming in Mango Farming	Age (X_1)	β_1	-0.118	0.405	108.91 (0.000)	0.79
	Secondary Occupation (X_2)	β_2	1.408	0.333		
	Highest Education Level of the family (X_3)	β_3	1.370**	0.036		
	Training (X_4)	β_4	2.459**	0.032		
	Experience (X_5)	β_5	-0.015	0.929		
	Social/Agricultural Organization Participation (X_6)	β_6	-1.259	0.244		
	Friends Contact (X_7)	β_7	5.446***	0.007		
	Family Contact (X_8)	β_8	5.524***	0.009		
	Use of Social Media (X_9)	β_9	4.189***	0.005		

Source: Field Study, 2021

*** significant at P<0.01; ** significant at P<0.05; * significant at P<0.10

Table 6.6 shows that friends contact, family contact and use of social media were the most important determinants (significant at the 1% level of significance), as well as highest education level of family, and training (significant at the 5% level of significance) are important determinants regarding adopting contour farming in mango farming. The data in table 6.6 test the final null hypothesis: There is no relationship between the selected characteristics (age, secondary occupation, experience and social/agricultural organization participation) and the probability of adoption of contour farming by the farmers in mango farming. In order to assess which determinants, contribute to the adoption of contour farming by the farmers in mango farming, binary logistic regression analysis was carried out. The analysis suggests that the respective

authority should consider the respondents highest education level of family, training, friends contact, family contact and use of social media for increasing the adoption of contour farming by the farmers in mango farming.

The Pseudo R^2 was 0.79. It means the empirical model is 79% successful while predicting the respondents' adaptive responses against contour farming in mango farming. Besides, the LR Chi^2 (108.91) was highly significant at 1% level (Table 6.6). These findings indicate, the model is valid..

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMODATIONS

This chapter presents the summery of findings, conclusions and recommendations of the study.

7.1 Summary of Findings

The objectives of the study are: to determine the social profile of tribal community mango farmers; to find the available new technology in mango farming; and to identify the determinants of new technology adoption by tribal mango farmers.

Data were collected from 100 randomly selected respondents of four selected upazila: (i) Khagrachhari sadar; (ii) Panchhari; (iii) Mohalchhari; and (iv) Dighinala under Khgrachhari district. Data were collected by using an interview schedule from the farmers during period June to August, 2021. Primary data were collected from the farmers. For the purpose of consistency and completeness, the obtained data were examined and validated. Prior to entering the data into the computer, it was edited and coded. All acquired data were thoroughly summarized and analyzed to weed out any probable inaccuracies. The data were entered onto a computer and analyzed using the appropriate software: Microsoft Excel and STATA.

The majority of the farmers (88%) age were between the ages of 36 and 50 in the study area. Maximum of the farmers (61%) had a secondary education in the study area. Most of the family's highest education level (60%) was higher secondary level in the study area. The average family size in the study area was 5.65, compare to national average 4.06. Most of the respondents (58%) were received training where 42% were not received training in the study area. Most of the respondents (55%) had membership of various social/agricultural organization where 42% had not membership of various social/agricultural organization in the study area

Farmers adopted many technologies in their mango field. All of the farmers in the study area adopted fertilizer application, irrigation facility, grafting, pest/disease management and weed management in their mango field. Almost half of the respondent's farmers adopted fruit bagging technology, high density farming and contour farming in their mango field.

The farmers' use of fruit bagging technology in mango farming was found to vary between 0 and 1. The highest proportion 53% of the respondents were fruit bagging technology adopter and 47% were non adopter regarding mango farming. Highest education level of family, friends contact, family contact and use of social media had positive significant towards the adoption of fruit bagging technology in the area. And experience had negative significant towards the adoption of fruit bagging technology in mango farming. Determinants like age, secondary occupation, training and social/agricultural organization participation had no impact in the adoption of fruit bagging technology in mango farming.

The farmers adoption of high density farming was found to vary between 0 and 1. The highest proportion 54% of the respondents were high density farming adopter and 46% of the respondents were non adopter regarding mango farming. Highest Education Level of Family, training, friends contact, family contact and use of social media had positive significant towards the adoption of high density mango farming. Determinants like age, secondary occupation, experience and social/agricultural organization participation had no impact in the adoption of high density farming in mango farming.

The farmers' adoption of contour farming in mango production was found to vary between 0 and 1. Contour farming adopter and non-adopter regarding mango farming were equals to 50%. Highest education level of family, training, friends contact, family contact and use of social media had positive significant towards the adoption of contour farming in mango farming. Determinants like age, secondary occupation, experience and social/agricultural organization participation had no impact towards the adoption of contour farming in mango farming.

7.2 Conclusions

Findings of the present study and the logical interpretation of other relevant facts, prompted the researcher to draw the following conclusions:

- Technology like fertilizer application, irrigation facility, grafting, pest/disease management, weed management, fruit bagging technology, high density farming and contour farming technologies are available in the study area.

- In the adoption of fruit bagging technology in mango farming determinants like highest education level of family, friends contact, family contact and use of social media were significant and has positive impact on adoption of fruit

bagging technology. Determinants like experience also significant but has negative impact on adoption of fruit bagging technology.

- In the adoption of both high density farming and contour farming in mango farming determinants like highest education level of family, training, friends contact, family contact and use of social media were significant and has positive impact on adoption of both high density farming and contour faming.

7.3 Recommendations

On the basis of observation and conclusions drawn from the findings of the study following recommendations are made:

- Education of the farmers had significant positive contribution with their adoption of new technology in mango farming. Therefore, it may be recommended that, adult education should be provided to the farmers so that they could increase their educational level which might be helpful to increase their adoption of new technology
- Related officials should organize more training about new technology in route level. So, that every farmer can get information about new technology.
- This research was conducted only in Khagrachhari district. To justify the findings of current study, it is important to make scope for more research in other CHT regions.
- In this study, the investigations explore only 9 selected variables to find out the determinants of new technology adoption in mango farming. Other factors may have influenced adoption of new technology in mango farming.

7.4 Limitation of the Study

The goal of this study was to discover more about a better knowledge of the current status of mango production, adoption capacities, and grower difficulties, as well as to investigate their link with certain specific features. Given the researcher's limited time, money, and other resources, as well as the need to make the study useful and manageable, the researcher had to impose the following limitations:

a) The study was confined to four upazilas named Panchhari, Khagrachhari Sadar, Mohalchhari, Dighinala under Khagrachhari district South-Eastern region of Bangladesh;

b) The study was confined mainly to status of mango production and technology adoption confronted by the farmers;
c) Out of many characteristics of mango farmers only nine characteristics were selected for investigation in this study;
d) For information about the study, the researcher was depended on the data furnished by the selected respondents during data collection; and
e) The respondents for data collection were kept limited within the heads of farm families.

REFERENCES

Abdel, G., Nehad, M. A., Gioushy, S. F. EL. and Baiea, M. H. M. (2017). Impact of different bagging types on preventing sunburn injury and quality improvement of keitt mango fruits. *Middle East Journal of Agriculture Research*. 6(2): 484-494.

Afsar, M. and Sultana, N. (2019). Effects of different bagging materials on mango production: assessment of profitability and fruit quality quality, Journal of Agricultural and Rural Research, 4(1): 1-11.

Ahmed A. K. M. A. (1994). Production Technology of Mango, Horticultural Research Centre, BARI, Joydebpur, Gazipur-1701, Bangladesh. pp.122.

Anonymous, (2007). Handbook of Agriculture, New Delhi. pp. 301.

BBS, (2012). Population and Housing Census 2011, Socio-Economic and Demographic Report, National Series, Volume-4, Statistics and Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. December 2012.

BBS, (2021). Statistical Yearbook of Bangladesh-2020, 40th Edition, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. May 2021.

BSS, (2021). High density mango farming method gains popularity in Rajshahi. Bangladesh Sangbad Sangstha, June 28, 2021.

Bhuiyan, M. A. J. (2008). Mango (*Mangifera indica)* in: Fruit Production Manual. Horticultural Research Development Project (FAO/UNDP/ASDB Project: BGD/87/025). pp. 1-286.

Candole, D. (1984). Orgin of Cultivated Plants. Vegal Paul Trench and Co., London. pp. 1-67.

Chetri, H., Sharma, R., Devi, D., Bordoloi, J., Pegu, B., and Kashyap, D. (2020). A Comparative Study on Socio-Economic Status and Expenditure Pattern of Tribal Farmers. International Journal of Engineering Research and Technology. 13(7): 1623-1628.

Dhaka Tribune (2021), Bangladesh become 7th largest mango producer in the world, The Dhaka Tribune, July 18, 2021.

Dillon, J. L., and Hardaker, J. B. (1993), Farm Management Research for Small Farmer Development, Food and Agricultural Organization, Rome. 6: 313.

Ezekiel, M., and Fox, K. A. (1959). Methods of correlation and regression analysis: Linear and curvilinear (3rd ed.).

Gregory, R. J. (2003). Tribes and Ethnic Minority: Origin, use, and future of the concept. *Studies of tribes and ethnic minority*s. 1(1): 1-5.

Jacobi, K. K., MacRae, E. A., and Hetherington, S. E. (2001). Postharvest heat disinfestation treatments of mango fruit. *Sci. Hortic*. 89(3): 171-193

.

Khan, A.I. (2006). Adoption of Modern Agricultural Technologies and Classification of The Adopters at Ramrail Union in Brahman Baria District. M.S. Thesis in Ag. Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University.

Khan (2018). Adoption of Selected Hybrid Rice Production Technologies by the Farmers of Joypurhat District in Bangladesh, M. S. Thesis in Ag. Extension and Information System, Faculty of Agriculture, Sher-e-Bangla Agricultural University.

Lakshmi, V. V., and Paul, M. M. (2019). Socio-Economic Condition of Tribal Community in Telangana and Andhra Pradesh - A Review. *Acta Scientfic Agriculture*. 3(8):104-109.

Islam, M. Z. (2007). Production potential of maize oriented intercropping as influenced by NPK level and row arrangement, PhD Thesis, Dept. Agron., Bangladesh Agril. Univ., Mymensingh, Bangladesh.

Islam, M. A., Rap, R., Qulp, S. M. S., and Tramboo, M. S. (2015). Socio-Economic and Demographic Descriptions of Tribal People Subsisting in Forest Resources of Jharkhand, India. *Asian Journal of Bio Science*. 10(1): 75-82.

Islam, M., Shamsuzzoha, M., Rahman, M., Haque, M., and Alom, R. (2017). Influence of pre-harvest bagging on fruit quality of mango (Mangifera indica L.) cv. Mollika. *Journal of Bioscience and Agriculture Research*. 15(1): 1246-1254.

Mannan, S. A. (2001). An Analysis of Agro-Economic Potentials of Jute Production in Bangladesh, PhD Thesis, Bangladesh Agricultural University. Mymensingh.

Rahman, H., and Akter, A. (2019). Performance of Mango (*Mangifera indica* L.) Genotypes at Jamalpur Region of Bangladesh. *International Journal of Genetic Engineering and Recombination.* 5(1): 19–37.

Rahman, M. Z. (2000). Effect of Spacing on The Growth, Yield And Storability of Some Garlic Germplasm, M.S. Thesis in Horticulture thesis, Bangladesh Agricultural University, Mymensingh.

Rashid, S. M. M. (2014). Empowering farmers through e-Agriculture, M.S. Thesis, Department of Agricultural Extension and Information System, Sher-e-Bangla Agricultural University, Dhaka-1207.

Rasul, G., Thapa, G.B., and Zoebisch, M. A. (2004). Determinants of land-use changes in the Chittagong Hill Tracts of Bangladesh, *Applied Geography.* 24(3): 217-240.

Sarker, M. M. R. (2010). Determinants of Arsenicosis Patients' Perception and Social Implication of Arsenic Poisoning through Groundwater in Bangladesh. *International Journal of Environmental Research and Public Health.* 7(10): 3644-3656.

Sarker, M. M. R., Khan, M., Parvin, M. M., Jury, F. H., and Fagun, A. N. (2022). Determinants of Adoption of Climate-Smart Agriculture Technologies in Rice Production in Bangladesh. *American Journal of Environmental Protection*. 11(4): 97-102.

Shelly, M. R. (1992). The Chittagong Hill Tracts of Bangladesh: The Untold Story. Centre for Development Research, Bangladesh. Centre for Development Research, Bangladesh.

Singh, K. V., Singh, G. P. and Priyadarshi, A. (2010). Extent of adoption of improved practices of mango production by mango growers in Muzaffarnagar district of Uttar Pradesh. *Indian Res. J. Ext. Edu.* 10(3): 107-113.

The Daily Star (2008), Good yield of Amropali Mango in CHT expected if weather favours, The Daily Star, February 18, 2008.

Uddin, M. J., Begum, M. E. A., and Chowdhury, M. K. H. (2018). Adoption of BARI Mango Varieties in Selected Sites of Chittagong District. *Bangladesh J. Agril. Res*. 43(2): 235-252.

Uddin M. J., and Rashid, M. S. U. (2019). Socioeconomic Impact of Bagging Technology for value addition in Mango in the Chittagong Hill Tracts of *Bangladesh. International Journal of Sustainable Agricultural Research*. 6(4): 203-212.

APPENDIX A
Questionnaire of
Determinants of New Technology Adoption in Tribal Community in the Chittagong Hill Tracts: An Evidence from Mango Farming

Serial No:

1. Farmer Personal Information

Name: .....

Village:…..... Upazilla:

….....

Sex: …..... (M/F)

2. Socio-Economic Profile of the Farmer

i. Age: …..... years

ii. Main Occupation: …..... Secondary Occupation: ….....

(1= Agriculture, 2= Business, 3=Job, 4= Daily Labor, 5= Driver, 6= Others)

iii. Family size of the farmer

Sex (M/F)	Age	Education level (Years of schooling)	Occupation
Total Number:			

(Note: 1= Agriculture, 2= Business, 3=Job, 4= Daily Labor, 5= Driver, 6= Housewife, 7= Students, 8= Others)

iv. Who is the head of your family? …….

v. Do you receive any credit for Mango production? Yes/No

If yes, please mention the source of credit: …….

Mention the total amount of credit: …… Taka

Mention the duration of credit: ……. Years

vi. Total Land (Bigha):

Type	Total Area (Acre)
Own land	
Cultivable Land	
Leased in	
Leased Out	
Mortgage in	
Mortgage out	
Total Land	

vii. Sources of Family Income

a) Farming income (Taka)

Parameter	Amount (Taka)
Agricultural Production	
Livestock Production	
Fisheries	
Others	
Total	

b) Non-Farming Income (Taka)

Parameter	Amount (Taka)
Business	
Driver	
Daily Labor	
Job	
Teaching	
Others	
Total	

c) Total Income (Taka):

(Farming income + Non Farming Income) = ……..……. Taka

d) Total Mango Production = ……. Kg

e) Total Annual Income from Mango Production = …… Taka

3. Information on Mango production

i. Do you discuss about new technology with friends? …… (Yes/No)

ii. Do you use social media? ..... (Yes/No)

iii. Do you influenced by someone? ..... (Yes/No)
If yes, who? Friends/Family/Respected Person/Techer/Others

iv. How many years have you been involved in Mango production? ……. Years

v. Are you a member of any social/agricultural organization? ..... (Yes/No)
If yes, how many organizations? .....

vi. Does Extension officer visit your field? ..... (Yes/No)
If yes, how many times in a year? .....

vii. Did you attend any training regarding New technology for mango production provided by near Extension office or any NGO? …… (Yes/No)
If yes, can you name some? …….. ……

viii. Mention the names of Mango variety you produce in your field
……
…..……

4. Types of Technology you used in the Mango Field

Sl No	Type	Yes	No	Why did you choose this technology?
1				
2				
3				
4				
5				
6				

7				
8				
9				
10				

5. Problems Regarding Mango Production:

……
……
……
……
……
……
……
……

6. Recommendation/Suggestion by the farmers:

……
……
……
……
……
……
……
……

……
……
……
……

Date: ..... **Correspondent Sign: .....**