

*Krishoker-Hut: A Novel Approach to Empower Rural
Agricultural Trade through Technology*

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A thesis submitted to the Department of Computer Science and Engineering
in partial fulfillment of the requirements for the degree of
B.Sc. in Computer Science

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Declaration

It is hereby declared that

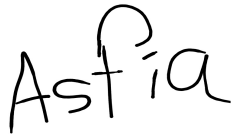
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2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
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Abstract

Agriculture is often considered as the key driver of economic growth in Bangladesh. However, many farmers residing in the rural areas barely even live hand-to-mouth. It is well established that farmers are ill paid given the contribution they make, due to several intermediaries that pass through along the trade between farmers and customers. Our research aims to deal with this major crisis, and it is feasible through establishing an e-commerce platform which will aid the farmers to directly trade with the general people. This solution is crafted as Krishoker-Hut, which is a Bengali expression that translates to ‘Farmer’s Marketplace’ in English. The interpretation of this title comes from the ambition of ensuring a decent position of farmers in the economy of Bangladesh, which they rightfully deserve. The application features a dashboard where farmers can list their items along with pricing, whereas customers can primarily request for items, negotiate the price and search for desired products. Apparently, the first logical step after identifying the problem is gathering opinions of both the parties involved and letting them get acquainted with the proposal. Extracting critical comprehension from our interviews with N=60 farmers residing in 4 different rural areas, we construct a pathway of the requirements farmers envision in the system. Furthermore, online interviews are conducted with N=37 general people to familiarize with their views and recommendations on the system. Based on the findings, we construct the system and make necessary modifications to match the needs of both farmers and general people. Some certain approaches are used to make the system convenient regardless of whoever uses it. In short, Krishoker-Hut e-commerce application endeavors to prevail as a simple and sustainable system which in turn makes sure to establish a more direct business approach between farmers and mass people.

Keywords: HCI; Agricultural trade; Agricultural economics; Technology in Agriculture; Direct trading; E-commerce platform;

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Chapter 1

Introduction

Almost 50% of the Bangladeshi population is either directly or indirectly involved in agriculture [39]. There are 16.5 million farmer families, according to a National Agricultural Census report [55]. According to FAO, 70% of the country land is dedicated for the purpose of farming [47]. Due to being a country filled with river, the soil fertility allows the effective growth of crops. However, the reality is that even though Bangladesh is the third-top rice producing country in the world, the farmers are unhappy [37]. Due to chain of finances that lead to the end users, that is, customers, the farmers barely get 10% of the profit that is actually made. Not to mention, they even sometimes undergo unfair pricing in the first place which reduces their actual profit to an even lower margin than it was supposed to be [29]. In other words, it is safe to say they make no profit at all. Months of hard work amounting to no fruit over and over again lead many farmers lives to come to a tragic end via suicide. Farming or agriculture contributes about 14.74% of the total GDP in Bangladesh [46], whilst providing employment to 41% of the labor force [34], so it seems really unfair to the farmers to lead such a miserable life where they bear such a contribution.

According to a report from Daily Jugantar, in the Haor area of Bangladesh, farmers sell paddy at the price of 17-19 Taka per kilogram to the intermediaries, whereas in the next season they must pay 50-53 Taka per kilogram to buy rice of the same paddy [33].



Figure 1.1: File Footage of a Farmer at Haor Area
[33]

This is where a technological solution formed through HCI comes to the rescue. HCI could be the link that connects farmers directly to the customers, thus in the process eliminating the inequality mentioned above. It is very difficult to get people to get interested in a new technique especially when they are already used to another, but once the grand benefits of the HCI comes into their view of understanding, the interest will automatically arise.

HCI or Human Computer Interaction is multidisciplinary focus of study which majors in the architecture of Computer Technology, especially the communication of the computers with human. It can also be defined as a field, related with the evaluation, design and execution of interactive computing systems incorporated with the study of major paradigms surrounding them [49]. HCI surfaced into the world for the first time in the 1980s along with the arrival of personal computing such as Apple Macintosh. Although it emerged in 1980, it owes a lot older to the disciplines. The fields present in the center of these would be the field of human factors which is both a science and a field of engineering. The main focus of study in this field would be the proficiency, barriers and performance of humans with the production of systems that are efficient, protected and pleasuring for those people who use them [54]. Those who studied the workings of HCI found it to be more and more interesting and eventually concluded that HCI was an essential tool to spread out the idea that the communication between humans and computers should be resembling that of human-to-human interactions. From 1980 to the current date, technologies have risen and expanded vastly both in quality and size such as the internet, gaming platforms, smartphones etc. It is quite evident that people have moved on from platforms like desktop in order to incorporate themselves into the smartphone world and HCI has accommodated all of these changes as well as encompassed more fields such as cognitive and computer science, etc.

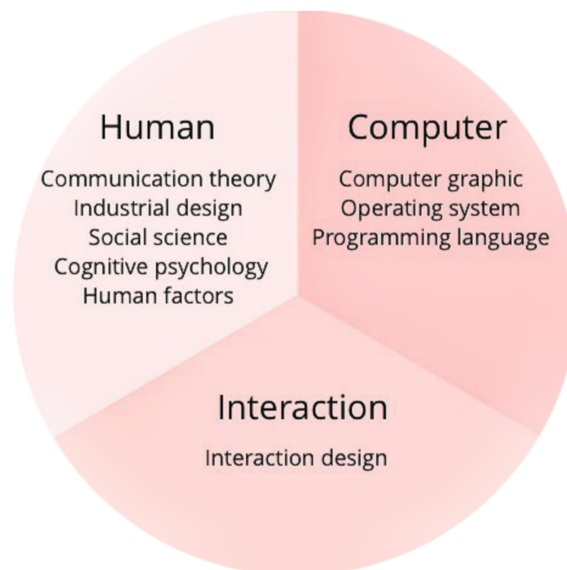


Figure 1.2: Basic Introduction of HCI

1.1 Research Problem

The qualities of the interface bridging the two sides have a direct impact on the productivity of human-computer interaction (HCI). With the passage of time, computers were no longer designed solely for professionals, and HCI's goal was to make every computer interaction simple and efficient for a wide variety of users of varied skill levels. Experts in human-computer interaction (HCI) research how people interact with computers and then develop technologies to help them do so more effectively. The goal is to reduce interaction cost (the amount of physical and mental effort required for a user to interact with technology) and increase interaction feasibility.

HCI has been applied in a variety of sectors for almost nearly half a century [27]. It has been employed in a variety of ways, especially in the agricultural industry. Farmers have become more comfortable using this technology in recent years. Along with technological growth, farmers are also slowly discovering the circumstances regarding HCI. Additionally, they are being acknowledged by several agricultural organizations which implements HCI.

A substantial part of the economy of Bangladesh depends on agriculture. The number of agricultural laborers is a little over 9 million. But still, there are about four million landless farmers and 6.8 million of them cultivate on other people's land [55]. According to Paylab, the minimum wage of a farmer in Bangladesh is just over 5000/= Taka per month, which is definitely not sufficient enough to bear family expenses even at rural areas [53].

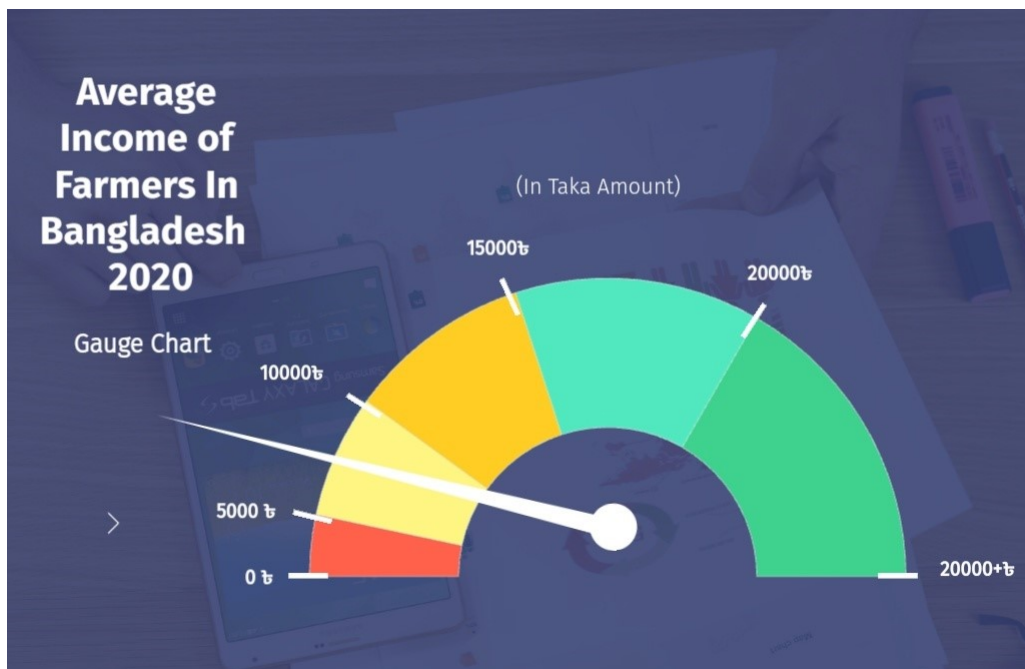


Figure 1.3: Average Income of Farmers in Bangladesh

Though these people play an important role in the agricultural field, things are not always fair for them. One which includes them not getting their fair share of prices. These farmers sell their grains to the wholesalers. These grains are supplied to the market place via multiple middlemen and eventually into the hands of the customers. Farmers are frequently duped in this trading system because they are naive and lack extensive knowledge of those self-seeking businessmen. As a consequence, they lose their share of profit as well as they get swindled. These swindling eventually leads to larger debt for them and for this, a large number of farmers fall into a great despair as they cannot provide enough for their family, their children get malnourished and get deprived of their basic rights.

Furthermore, a large portion of the agricultural supply chain is reliant on the importation of farmed commodities from neighboring nations. Frequently, the large availability of some commonly imported crops causes farmers to be treated unfairly since they do not receive a fair share of the profit for their imported farming products [17]. Then, it is also a big matter for the customers as they had to purchase items from the market at a much higher price than actual price. So, it's a kind of loss for them too. It causes problems for poor and medium classes.

Sometimes the price is so high that they have to starve. As a result, farmers have been forced to sell their products at a very cheap price because there are not enough merchandisers. When they are unable to locate a middleman to sell their goods, they just squander them due to a lack of storage facilities. As an outcome, both farmers and buyers face a major difficulty [32].

Farmers are losing interest in farming due to the losses they have been experiencing for a long time. They are traveling to the city in the hopes of finding another job that would allow them to feed their family. Sometimes they succeed, and but sometimes they fail and resort to a life of crime in order to make money.

Even so, dealing with the aforementioned issue will get more difficult in the following days. Furthermore, our country is heavily reliant on agriculture, but technological advancements may be ready to overcome some of these problems. As we all know, HCI can help us reduce interaction cost—the amount of physical and mental work required to use technology—and make interactions more human. As a result, implementing HCI in this sector can result in long-term reforms as well as alleviate the suffering of low-income people and farmers.

As for the customers, they would be buying the crops at the same price as usual and in fact they would have access to formalin free products and thus both parties would remain happy. Based on the discussion so far, our research question of in this paper are two-fold:

RQ1: *How can the underprivileged farmers be helped to sell their crops directly?*

Answer: To address this question, firstly through survey we need to identify whether the farmers in Bangladesh desire any changes from the existing system; where there are several intermediaries, to a more direct approach. Further, we may build a system in which the farmers may trade efficiently, ensuring the fair price. Following our response to this question, we turn our focus to the following research question:

RQ2: *Can we use technological solution to increase their profit?*

Answer: Here, our initiative is building such a technological solution that enables farmers to trade the crops via e-commerce. After a thorough comprehension, which we develop through a study with (N=97) possible farming relevant people, customers and farmers, we have established the acceptance of the technological solution. Then we will be creating an interface and implement it. In this case, we divide the population in two subsets of N=60 (relevant with farming or farmers) and N=37 (general people) to represent the opinion of both ends. We analyze the details and start to design and create the technological solution. Initially, it may take some time to get habituated to the proposed system as it would be a slightly different approach from the existing trade system.

1.2 Research Objective

HCI should be used in development and those must be driven by human needs [7]. This research aims to develop a trade system for farmers using HCI based E-Commerce application/system, in which both the sellers (e.g., Farmers) and customers or buyers can login. This would ensure direct trade between farmers and mass people. The objectives of this research are hereby described below:

1. To deeply understand HCI and the functionalities of it.
2. To gather knowledge on building an HCI based E-Commerce. application along with proper maintenance of the developed site.
3. To establish a direct relationship between farmers and customers.
4. To develop a model of an E-commerce application using HCI.
5. To evaluate the model and bring necessary changes.
6. To offer recommendations on improving the model.

1.3 Research Contribution

HCI can be deemed as a vast field and the introduction of it in the perspective of the socio-economic structure of agriculture can only prove beneficial. The contribution of our research work reaches out to the rural farmers along with the general consumers. Some of the offerings that this research serve are hereby provided:

1. *General Purpose:* Our team works along with the farmers and general people of Bangladesh to establish a system, which can reduce the gaps between this communities through ensuring direct trade between them.
2. *Gathering Information:* To understand the requirements of both the communities, we interview the farmers (N=60) by visiting 4 rural areas of Bangladesh. In the interviews, our prime focus is to fetch their opinion regarding our system

along with giving them a brief on the working of the system. Also, we reach out to the general people (N=37) regarding their requirements and opinion over the system.

3. *Building the System:* Analyzing the needs of both the communities and keeping their opinions in mind, the application is developed.
4. *Efficient Match Finding:* One of the key features and a futuristic prospect of the proposed system is to match the need of the end-users. For instance, if a user is looking for a certain product providing a certain price point, they can perform a request for it. The system then visualizes if the product is available at that certain price point or a nearby figure.

1.4 Background Studies

To begin with, the study of how computer technology affects human labor and how it provides an opportunity for cost reduction and other activities is known as Human-Computer Interaction [54], [30]. However, due to the complexity of computers many people find it difficult to have a proper interaction with it [48]. And the increase in computational challenge from the abundance and complexity of digital data has only made the difficulty worse [48]. But HCI has now come a long way from the early stages where even a simple task such as moving the cursor or erasing texts would require extensive training. It began in the 1980s as a study on how and why computers could be made more user-friendly. The research topic quickly grew to include practically every facet of information technology [48].

In earlier studies regarding HCI implemented with agriculture, we see how the adoption and development of e-commerce has been identified as a novel means of 18 influencing food systems and access to markets for smallholders. In the recent years, many smallholders in developing country such as China have begun transacting their agriproducts through e-commerce directly to the customers. There have been many other research papers on HCI which involves studying the agriculture to find a way to bring the agricultural transactions into the world of E-commerce through Human-Computer Interaction. A trend was going through the year 2000 to 2015 that agricultural e-commerce research gotten more and more attention from academic scholars [48]. In terms of gaining the early lead, the agribusiness of USA and China are the front runners for distributions across other countries. Many other countries followed their lead and as a result, the agricultural business research soared and attracting hundreds of IS researchers into this field. Not only IS researchers, but scholars researching Agricultural Supply Chains also entered into the research.

For the producers, going into the E-commerce business has shown already how much their effort can bear fruit if they adapt with the times and technology. Many instances around the world have shown how adapting themselves to e-commerce has expanded their profit margin. However, there are few difficulties which are needed to be overcome if one tends to actually implement the e-commerce business fully. One of the most common challenges include non-uniformity of products being transacted [5]. The fact that most agricultural e-commerce achievements have been in

packaged products like fertilizer, farm chemicals, animal health products, and machinery parts, or in exchangeable commodities, reflects the difficulties involved with this non-uniformity [5]. We know that different quality for crops or products have different end use, for example, varied wheat types have different processing characteristics. Because many of these characteristics are visible, grading standards can readily handle them [5]. But there was no solution for the traits that couldn't be observed. This is where HCI comes into play again where the involvement of the interaction between computer and human makes even the invisible traits visible by giving a small or detailed description of the product fully in order to allow the buyers to have a complete understanding of the product which includes even the invisible traits. However, implementing the AE doesn't often go as smoothly as it sounds. A survey was carried out during the test for AE where people from the city and people from were differently opinionated from their own views [48]. This is why it became necessary to make sure that these surveys would be carried out before any e-commerce system proposal is carried out. This way, the terms and conditions from both sides can be negotiated and accepted before the implementation begins.

Further studies show that E-commerce has the potential to help the rural economy and society flourish in areas such as economic growth, poverty reduction, and employment [48]. According to a certain report from Zhang and Jiang in 2015 on e-commerce and poverty alleviation, Alibaba's services helped 832 impoverished countries sell products worth a total of 12 billion RMB yuan in 2014. By late December 2014, it was anticipated that around 70 thousand homes or 280 thousand people were employed in the 212 Taobao Villages [30]. Furthermore, e-commerce can boost related businesses such as network infrastructure, road reconstruction, transportation, banking, education, technology, and online services [22][28]. It has been said that future researched could explore the possibilities even further and it may lead to many more positive impacts. For example, the beneficial impact of AE adoption on farmers' income can be explained by a number of factors, including sales growth, investment in production and operation, profitability, and an increase in absolute working hours [5]. When thoroughly understood, these promoting mechanisms based on rigorous assessments can provide valuable recommendations for the future development of Agricultural E-commerce.

1.5 Thesis Outline

The primary goal of our research is to apply and analyze HCI for the betterment of the farmers. Furthermore, we have surveyed both farmers and general people to get an overview and the features they require in the application we have developed. Here are the chapters discussed in this paper and a brief over them:

1. **Chapter 2:** The Related Works section compares, contrasts, synthesizes, and provides introspection about the available knowledge for a given topic or field. This part basically discusses briefly about published matter that technically relates to our proposed work.

2. **Chapter 3:** Methodology converses about the working pattern throughout the research work. This portion describes the actions taken to research a problem and our rationale for the specific processes and techniques used within the research to identify, collect and analyze information that helps the reader understand the problem [51].
3. **Chapter 4:** Experimental Evaluation is the section that is all about the findings of the research work which includes the field works along with the critical analysis of the findings.
4. **Chapter 5:** Design and Implementation of GUI part visualizes the prototype of the system proposed, which shows the current and future features of the system. It also visualizes the actual implementation of the system currently.
5. **Chapter 6:** Discussion section helps to understand the context of farmers, designing the required content, relates our work to currently existing works and shows the difference or unique features of our research.
6. **Chapter 7:** Limitation and future work is all about the difficulties we face throughout the research along with future optimizations to the system.
7. **Chapter 8:** Conclusion provides the ending to the paper with some far sighted advantages of the research work.

Chapter 2

Related Works

In this chapter, we are going to take a look at some works which relate to some similar kind of problem or proposed solution by the previous researches.

To begin with, Panneerselvam et al., [41] suggests a model of Smart Auction System for Agriculture-Based sector farmers using Blockchain Technology, where Clients can connect to the chain of network to display an item of their choice for auction. Other users can view the items and connect to the same chain of network to bid their items using user interface. All the information regarding the items is stored on the Blockchain. Thus, detailed records cannot be altered and the highest bidder has to make the purchase. Once the purchase is done, nobody can alter the data. As a result, information is safe and integrity is achieved as both seller and bidder are enabled with security.

Further, an e-commerce application is suggested to establish a farmer-to-consumer direct trading, reducing the number of intermediaries so that the farmers may involve themselves in direct business in India by V. Desai et al., [38]. In this study, they focused on the similar problem as we, which is – the direct approach of agricultural trade, reducing the number of intermediaries as possible, gaining the farmers more profit. In this system- buying, selling, bidding for bulk buyers, providing feedback, analyzing market are the main features. Angular, Node.js, MongoDB atlas is used to build the system.

In a similar approach of digital marketplace for farmers using an application by M. Bhende et al., [31] introduced a new trading method by which the farmers may sell his goods to each layer of the chain of market who can be the merchants, can be in market or can be a customer. Here, the proposed system may assist in the sale of crops at various ends where one becomes able to explore and analyze current market conditions using ‘KNN algorithm’ as nearest neighbor search for better decision making and ‘Haversine algorithm’ for latitude and longitude check using GPS system to crops dealing.

In another study by Thomas et al. [40], pivoting in food industry firms by acquiring e-commerce to deal with situations like COVID-19 is proposed for developing regions. In addition to that, co-pivoting of the delivery intermediaries is also mentioned. Business to Business, Farmers to Consumers dealings are prioritized as this

are helping to keep going the business despite the lockdown and helping the industry to survive and grow.

Vincent et al., [36] put forward a website and application, which will assist the user (farmers or relevant people) in locating the nearby farming equipment, necessary ingredients availability stores from where they may purchase this online. Thus, it may decrease manual labor by locating the appropriate retailer where users can acquire farming supplies online and have them delivered to the appropriate area. The method enables farmers to communicate directly with the market.

Farmers who are young, their intention toward using social media in order to marketing their agro-products is presented by P Vasumathi & C Joe Arun [42]. A conceptual model is proposed using UTAUT (Unified Theory of Acceptance and Use of Technology) framework by Venkatesh & Davis [3]. The model consists of social influence, facilitating condition, self-efficacy, sources of information, expectancy, effort expectancy, and performance.

Chakraborty et al., [45] present an idea of the implementation of mobile and web applications in order to agricultural trade. This study suggests a system through which farmers can upload their products details and consumers can request for purchase depending on the availability. After the transactions are made via mobile banking or credit card, the farmers will deliver the goods.

In another study, Salem Al-Oun et al., [18] explain that their goal is to identify and empirically assess the tactics used by small and medium-scale Badia entrepreneurs to respond to agro-business restructuring in ways that improve farm and household performance while also strengthening Badia economies' resilience. Here, a technology is proposed where the farmers can easily sell their products to the customers, exporters, private traders using supply chain.

Furthermore, Sharma et al., [52] proposes a modern production technology. According to the study, by using this technology, Agriculture is being transformed from sustainable to smart and scientific. This paper suggests, it is a less expensive organic technology that aids crop and farmer development. Through this system farmers can buy seeds, planting them, growing, harvesting/packaging then he can sell the products.

Likewise, the purpose of this study is to explain the potential of Nigeria's suburban agriculture, focusing on spatial tools for its creation and evaluation. Thomas U.Omali et al., [50], describes the geospatial techniques of agriculture around cities. The content of this study shows that this is possible with agricultural practices around the city. Maintaining a balance between Nigeria's livelihood and ecosystem. As well as contributing to food Security, employment opportunities, adaptation and mitigation to climate change, etc. Through this system farmers can monitor crop health, estimation of crop yields, predictive insights for assessment and management from natural disasters, early risk detection of pests to avoid losses.

In another study, Peter Lyle et al., [21] presents how HCI is beneficial for city farmers through a case study. This study identifies four areas that present key challenges and opportunities for HCI design that support social sustainability of the city farmer's market. This research presents the findings of a case study of the Northey Street City Farm in the city of Brisbane in Australia. A city farm is a term often used interchangeably with community garden, and is a form of urban agriculture that has a specific location and involves a productive farm or garden, run by the local community.

Similarly, another study is looking into productivity, income, employment, and adoption of technology in agriculture. It has revealed that adoption of precision farming has led to 80 per cent increase in yield in tomato and 34 per cent in brinjal. Maheswari K.R et al., [9] shares some new technologies such as GIS, GPS which are utilizing for analyzing variations in agricultural production.

Chapter 3

Methodology

In this section, we propose a series of steps which would be taken in order to lower the tragic losses of our farmers [8] and help them gain more profit, which not only will help them provide better for their families but also help in letting go of the mental pressure [6] they face all the time. In figure 1 below, we give a short overview of what our proposed idea for helping the farmers would look like. As for the steps within them, they are discussed below in the following segments.

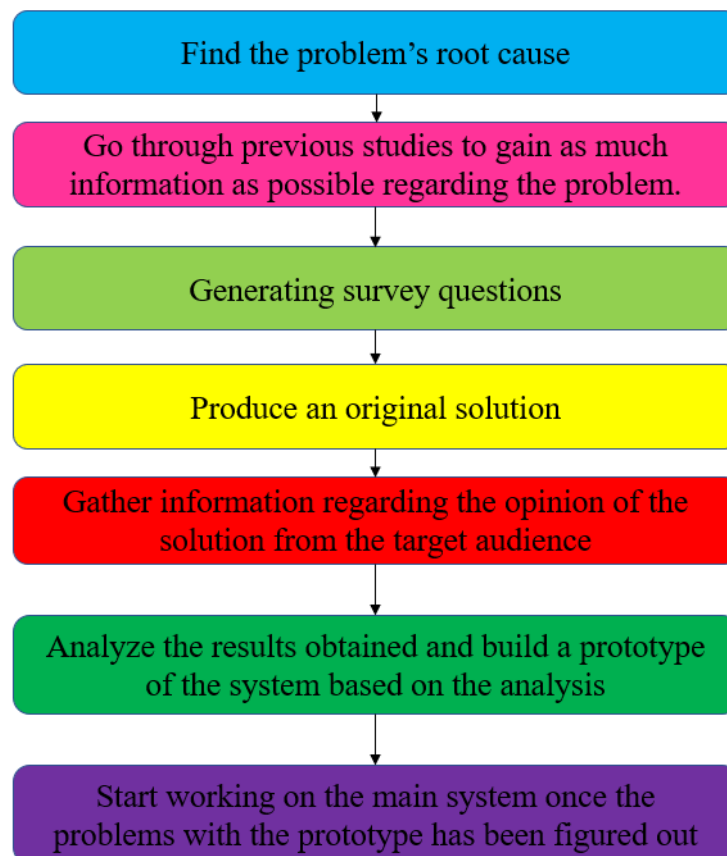


Figure 3.1: Methodology overview

3.1 Researching the problem

When facing a problem, its best to look for what others have already tried to use to deal with the same type of problems. Meaning, combing through the research papers of the past related to this is problem solving 101. We take various different papers, local or global and come to terms with the idea that is most likely to be efficient as well as a success. From there, we pick a solution which would be unique and has never been implemented before which would be the pin-pointed portion of the idea. In this case, it would be the HCI field which seems to have the highest chances to make a difference and from there we move forward into our game plan.

3.2 Survey Questionnaire Design

In order to perform survey, we must design standard survey questionnaire first, keeping the research problem, target audience, hypothetical solution in mind. There are two category target audience in our case who are the farmers and the consumers. For that, we create two different survey questionnaires.

While designing the questionnaires, we follow some standard guidelines such as - being clear and precise, avoiding leading questions, using natural and familiar language, asking one question at a time [26]. In addition, we phrase data requests as questions or imperative sentences alongside keeping the questions simple, not so complicated [12]. Furthermore, we use both closed-ended questions and open-ended questions to design our questionnaire [19]. For closed-ended questions, Likert scale is an efficient approach [16]. In brief, a Likert scale is a type of psychometric scale that is often used in surveys to find out how people feel about things. Besides, we follow the six-point suggestion of Roopa S and Rani MS [19] in order to question formulation and wording.

Firstly, we design a standard questionnaire for the farmers using the abovementioned approaches. However, the literacy rate of the farmers in Bangladesh is not that high. So, while interviewing, we decide to translate our questions into Bengali language which is easier for the respondents to understand. As a consequence, we design the same questionnaire in two languages- English and Bangla. Basically, we gather the data in Bangla and then translate it into English to perform various analysis. In the beginning of conducting survey, we decide to ask 9 general and demographic questions. Later, we move to the main questions of the questionnaire where we plan to ask 14 questions regarding the research problem and hypothetical solution. Among these questions, most of them are scaled questions where, there are 8 Likert scale questions, 1 quantitative question. Besides, there is 1 open ended question for gathering their overall feedback or suggestions. Overall, there are combinedly 23 questions are set to perform the survey to gather necessary information for our research from the major audience or respondent of our study. Further, we choose to perform this survey in-person interviews and write the responses in the survey paper.

Secondly, another questionnaire is designed for the tentative consumers which are the general people. In this case, we design 21 questions for the respondents. In

details, there are 9 general and demographic questions (for example- name, age, gender, etc.), and 12 major questions regarding the topic. Being specific, there are 11 closed-ended Likert scale questions and one open-ended question for their feedback. The Likert scale questions are set in a way where the answers can be chosen among ‘Strongly Agree’, ‘Agree’, ‘Neutral’, ‘Disagree’, and ‘Strongly Disagree’. However, there are no limitation for the open-ended question, the respondents can share their thoughts and suggestions. Furthermore, we plan to perform this survey via online platforms using google form as well as in-person interviews.

Lastly, after designing all the questions, we run a pilot survey which refers- a preliminary portion of research undertaken prior to a comprehensive survey to evaluate the efficacy of the research approach [19]. The purpose of pretesting is to determine if the questions are well-framed, the questions’ wording will get results. As well as, the questions are specific, in the finest order and are understood by all. After pretesting the questionnaires, we recheck the reliability and validity of the questions. Thus, we get the standard survey question and ready to proceed the survey using appropriate methods (Face-to-face interview, Telephonic interview, Internet questions) to reach the target respondents who are the farmers and the consumers.

3.3 Approaching the Farmers

In order to have a conversation with the farmers, the first part would be to generate questions which would be useful in getting valuable pieces information from them. This can be done by setting up a meeting with the team supervisors and team members and discuss which questions to ask, how to ask and what kind of answers should we be keeping into consideration. For example, Likert Scale questions, Simple Yes or No, Own opinions, etc. Once the questions have been readied, we can begin contacting the farmers. It would be great to have informal contacts as it would allow the interview to go smoothly. Regardless it is absolutely necessary to not cause any sort of disturbance or offense towards them as they have no idea what is going on. Also, it would be beneficial to carry out the interviews in the field while the farmers are working. This way not only will we be getting the answers, but we would be able to observe them while they work to gain further information. The questions themselves must be in Bengali in order for them to better understand it. Finally it would be best if the conversation began formally and ends with informality. This way, it would ensure a mutual comfort zone for both interviewer and participant and as a result, the farmer may even direct the interviewer to other farmers once the conversation is over [1].

Regarding participation in the interview, it is not required to be mandatory as it is not necessary that everyone would be comfortable with having an interview in the middle of work or for any other reason. Also, should any audio or video record of the interview is to take place, it should be done only when the permission is granted by the farmer. That includes even if situations arrive where the farmers decide midway that they change their mind regarding the recording or they simply don’t want to be recorded answering a certain question or two. Although, we said its best to carry the interview in the field, but that does not mean that the farmers cannot simply

say “Why don’t we do this at our house” or “Can I talk to you outside the Masjid”, etc., there is no reason to refuse either. Also, one of the most important tasks will be to ensure that the farmer’s identity and all personal information is kept secret.

Our target with the survey questions is to gather enough information and find the common pattern between all the farmers’ answers. Once the answers are gained, they would be translated to English and the answers would be filtered before any sort of analysis can be carried out on them. The table below displays the demographic characteristics of the farmers for a sample scenario.

Age (Years)	Gender	Mobile Usage	Family members
11 – 20 = 10 21 – 30 = 10 31 – 40 = 10 41 – 50 = 10 51 – 60 = 10 61 – 70 = 10 Above 70 = 5	Male = 61 Female = 37	Only uses Analogue: 30 Only uses Smartphone: 30 Uses both: 30 Uses None: 8	Minimum Numbers: 3 Maximum Numbers: 8 Mode: 4

Table 3.1: A sample scenario of demographic characteristics of the participants in the survey

3.4 Talking to the Consumers

Talking to the consumers would not be too difficult as most of the consumers would be coming from family and friends. With almost all of them, we can have informal communication, parents, friends, relatives, etc. The same snowball sampling method can be applied here as well [1]. As for the question answers, each person can fill out the survey papers themselves in any time they choose to and, in the end can even distribute it anyone else know who wouldn’t mind filling a survey paper. For people who we can easily reach physically, we can take their interviews face to face while for those who we can’t reach, we would send them the survey papers online through social media or email.

Just like for the farmer’s survey, none of the people in the general section are duty bound to answer the questions if they choose not to and the same rights are given for the recordings and anonymity. But unlike the farmers, they are given the choice to answer in Bengali or English, which ever language they should choose.

As for the questions that are being asked to the consumers are obviously going to be different from the farmers, but there will be some similarities obviously, for example, their opinion on the current food supply chain and whether the current system should change or not. Likert Scaled questions are applied here as well in order to not take too much.

3.5 Further Steps

The end result of taking the answers from both sides would be the generation of various bar graph and charts with many different types of analysis that not only recognizes the patterns but also finds relationships between the answers, if there are any. These results we gain are what we shall be using in order to develop our required system. Of course, building the system immediately won't ever be possible without a lot a problem. So, the first order of business after all this would be to make a prototype system which would contain as much detail as possible to not only allow the group members to understand the project but also anyone who listens to the idea to know exactly what the system would be doing and how it would be doing it.

Chapter 4

Experimental Evaluation

Findings and analysis of responses collected from the interviews are an important aspect of a research work, as it helps the researchers to learn about the condition and demands of the people subjected. We conduct surveys in 4 rural areas as well as over phone calls and the internet to establish connection with both farmers and general people. In this case, farmers are the sellers and general people are the end-users of our system. The findings from the surveys, along with their critical analysis are the topics of discussion on this chapter.

4.1 Findings From the Interviews

This section focuses on the findings from the interviews in general, which is required for the further in-depth analysis of the next subsection.

4.1.1 Outcome from Interviews with Farmers

Among all the farmers or people indirectly related with farming we interview, 33.3% of the population (20 out of 60) are aged between 51 and 60, 25% (15 out of 60) are aged between 41-50, 18.3% (11 out of 60) are aged within 31-40, 13.3% (8 out of 60) are aged between 61-70, 3.3% (2 out of 60) are aged above 70 and the rest of the people were below 30. This findings showcase the participation of primarily middle-aged to old people in our interviews as more than one-third of the people are aged above 50.

Among the participants, 95% (57 out of 60) were male and 5% (3 out of 60) are female- who were indirectly involved with farming. Moreover, 76.7% (46 out of 60) people are directly involved with farming whereas only 23.3% (14 out of 60) of the participants are not directly associated with farming (i.e. business related to farming, helping out farmers, guiding farmers).

Our findings also reveal that 61.7% (37 out of 60) among the total population claim that they, along with their family members, used mobile phones, which signifies the increase of popularity of technological devices in the farming community. However, only 8.3% (5 out of 60) could provide email addresses along with phone numbers. One of the participants expressed:

“Let it be educated people or farmers, who don’t use mobile phones nowadays?”

We get the majority of respondents from Narayanganj, followed by Kishoreganj, Dhaka (Savar) and Narsingdi. The following bar chart illustrates the number of participants from each of the places. The first location that is chosen to conduct the

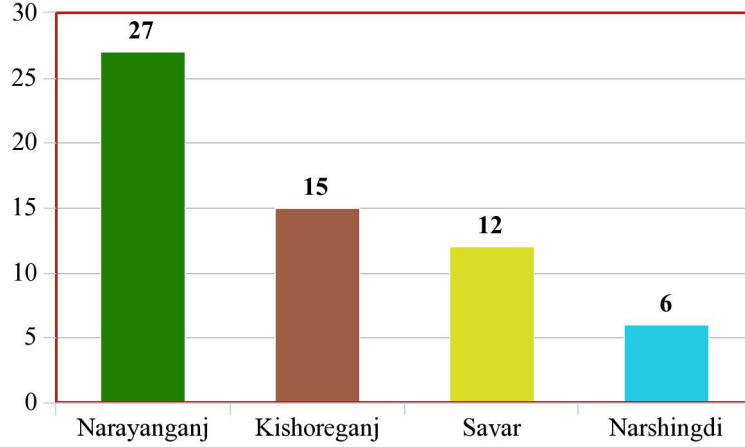


Figure 4.1: Area-wise Participation in Interviews

survey work was Narayanganj, where we reach out to 27 farmers. Majority of the people here are directly or indirectly involved with farming, so it is not a difficult task to reach out the farmers. They are very friendly towards us and serve us with all the answers and data we require. On the other hand, our team has given the level best to be as comfortable with them as possible, as it may be a new experience to some of the farmers. To sum up their courtesy, one quotation from a certain participant would be enough.

“Consider this place as your home, you folks can ask whatever you need”

The following pictures show some moments during the interview in Narayanganj.



Figure 4.2: Fieldwork at Narayanganj

After Narayanganj, three of our team members visit Savar, Kaundia and perform surveys there. Just like Narayanganj, people here are extremely friendly. They were asked the questions in a very friendly and insightful manner, along with explanations and the working process of our system. Here is a frame from Savar:



Figure 4.3: Fieldwork at Savar

The next place we visit, and the last place visited in-person is Kishoreganj, where 15 people take part in our interviews. They explained the proposed system thoroughly along with being asked the questions in the questionnaire. Following is a still picture from that interview.



Figure 4.4: Fieldwork at Kishoreganj

Bangladesh, being a developing country, it is safe to assume that farmers in this country live from hand to mouth. The responses we gather from the participants also head to the same direction.

Most of the farmers earn scarcely, which is affecting their livelihood; in some cases depriving them from essential or basic needs. It is clearly evident as a participant from Narayanganj asserted:

“I cultivate tomatoes and potatoes in the lands of its owner, from there the earning I get barely lets my family eat a single meal each day.”

68.3% (41 out of 60) of the farmers strongly agree to the fact that currently farmers are not earning enough to satisfy the needs of their family, which is certainly a matter of concern. On the contrary, some farmers have economically developed themselves and raised their financial condition. A participant from Savar expresses with delight:

“I have been cultivating sugarcane for 5-6 years and harvest them during autumn. I am more than happy with the earnings I have.”

Our findings also navigate thoroughly in the profits farmers get, and their thinking of how much they actually deserve. 36.7% (22 out of 60) of the farmers state that they earn less than half of what they should be earning. However, 20% (12 out of 60) farmers express that they earn upto 80% of the fair price, which provides a glimmer of hope.

Also, worth mentioning, 71.7% (43 out of 60) people demanded change in the existing system of crop-selling, which consists of several intermediaries- depriving the farmers of their deserved profit. Less than 4% (2 out of 60) among the farmers are content with the current system.

As mentioned previously, most of the people who have participated in the interviews have access to either smart or analog phones. Furthermore, 85% (51 out of 60) people imply that farmers from their respective places at least use an analog

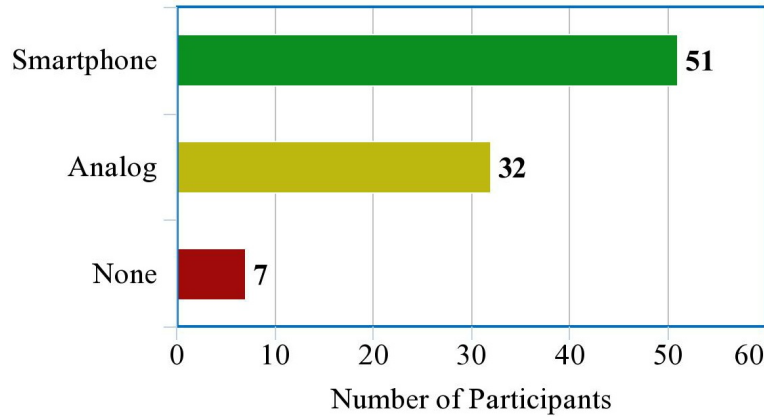


Figure 4.5: Smartphone Usage Among Participants

phone, whereas 53.3% (32 out of 60) people believe that the farmers have access to smartphones.

73.3% of the people (44 out of 60) strongly agree that usage of technology and technological solutions in the selling of crops or farming products will bring positive changes. On the other hand, 68.4% of people confirm that they are familiar or aware about E-commerce and selling products through it. One of them state:

“My son-in-law sells clothes through an E-commerce platform.”

However, there are some participants who were skeptical about our proposed system, but most of it is due to their lack of awareness about E-commerce. 20% (12 out of 60) of the participants state that they are unaware of selling products through E-commerce. On the contrary, only 1% (1 out of 60) people think that implementation of E-commerce will not provide much benefits to the farmers due to the infrastructure and economic status of our country. From this data, we can say that even though some farmers may be unaware of E-commerce currently, most of them think that implementing E-commerce will highly benefit them.

4.1.2 Outcome from Interviews with General People

The end-users of our system are general or mass people, who can be considered as consumers. So, their opinion on the system is equally as important as the opinion of the farmers. A total of N=37 general people have taken part in our survey. 81.1% (30 out of 37) people are aged 21-30. The following chart depicts the age group of the people: Also, 54.1% (20 out of 37) participants are Male and 45.9% (17 out of

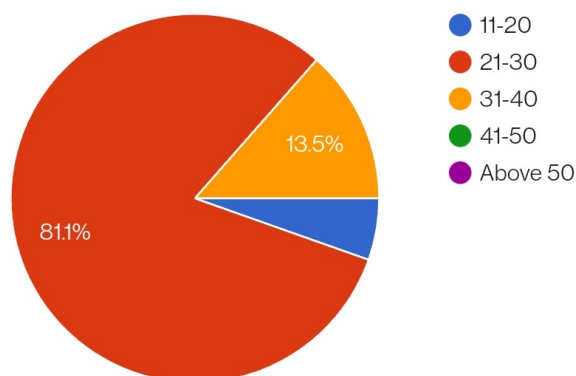


Figure 4.6: Age Group of Participants Among General People

37) were Female. 100% of the participants use at least a single technological device. The usage of devices among the participants is visualized below: We have conducted

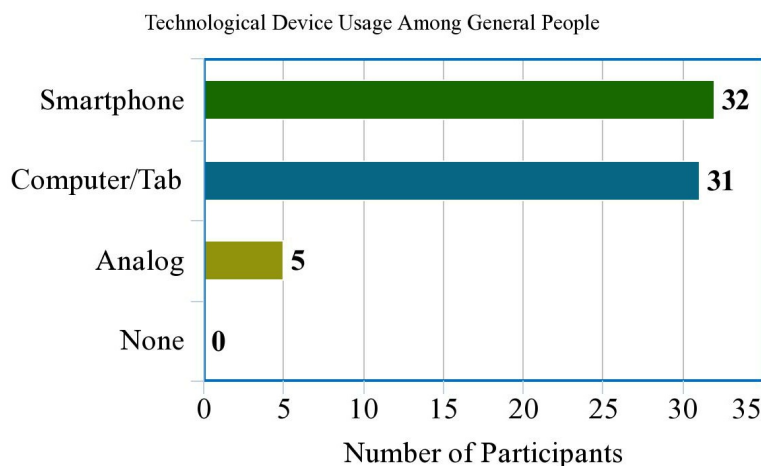


Figure 4.7: Technological Device Usage Among Participants

the interviews online, using a google form. The participants respond to the form accordingly and then our team has analyzed the data received.

We ask for the e-mails and phone numbers of the participants as demographic questions, which are optional of course; for the convenience of the participants. Then, they are enquired about the system we are proposing and their opinion on it.

It is no rocket science that most of the people who participate in the survey have at least the basic idea of E-commerce. Most of them accepted the system in a positive way. One of the participants stated:

“The system needs to be as simple as possible for the farmers to use it properly. If implemented properly, it would definitely benefit the farmers and the masses.”

Most of the people agree to the fact that consumers would love to buy directly from the farmers to uplift their condition. 81% of people reach an agreement with this. The following chart below shows the exact figure: Also, the mass people strongly

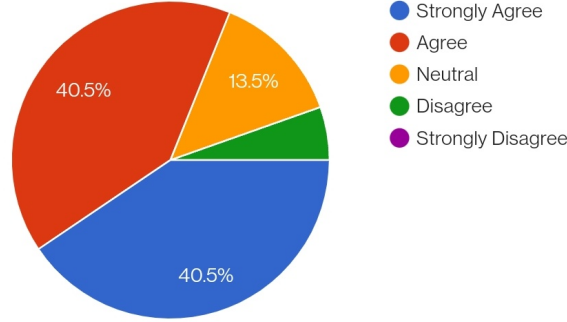


Figure 4.8: Agreement to Purchase Directly from Farmers

support the introduction of bargaining or negotiation in the system proposed. 73.6% (28 out of 37) stated that negotiation will highly benefit the consumers, whereas 70.2% (26 out of 37) believe that the same option would benefit the farmers as well.

On the contrary, there are some people who are not so sure about the system. Most of them are in doubt whether the system can be perfectly implemented in a country like Bangladesh or not. One of them state:

“I think agricultural products are something that should be assessed first before buying. In this case if we are involved in buying from e-commerce applications there is no doubt that people will get deceived. Let’s come to reality this is Bangladesh, here people will always try to deceive.”

To refute this statement, everything good depends on the intention of the person. Also, the system proposed in this paper is in a preliminary stage, from where there is a lot of room for improvement. We firmly believe that this system would turn out to be the future of crop-selling, since the world is turning more and more towards E-commerce. Even though it would take some time to adapt to this, it will prove beneficial for the majority as we have already learned in the findings.

“It might seem difficult at a glance, but the proposed application will definitely lessen the hassle for everyone, given that it is implemented properly. My uncle is a farmer and I know how hard it is for them. I really hope to see him prosper one day and if it is through this system, so be it.”

All in all, the findings both from the farmers and general people side suggest positivity regarding our proposed system except some exceptions.

4.2 Analysis

In this section, some quantitative and qualitative analysis are performed on the collected data from N=97 people, which are divided into 2 sub-sections- N=60→ Farmers or Farming Related People and N=37→ General People or Consumers.

An overview of the methods used for analysis:

Serial	Analysis Used
1	Line of best fit using Scattered Diagram
2	Chi-Squared Test
3	T- Test
4	Standard Deviation
5	Standard Error
6	Variance
7	Thematic Analysis

4.2.1 Quantitative Data Analysis

N=60 farmers or people related to farming are interviewed by us from Narayanganj (n=27), Kishoreganj (n=15), Savar (n=12) and Narshingdi (n=7).

Most of the farmers in our country are underprivileged, as they do not get the earning they deserve due to several intermediaries they pass through while selling crops. On top of that, our analysis of the data shows that a higher number of family members might also play a role in their poverty. The following scatter diagram shows the number of family members of the farmers who have participated in our survey.

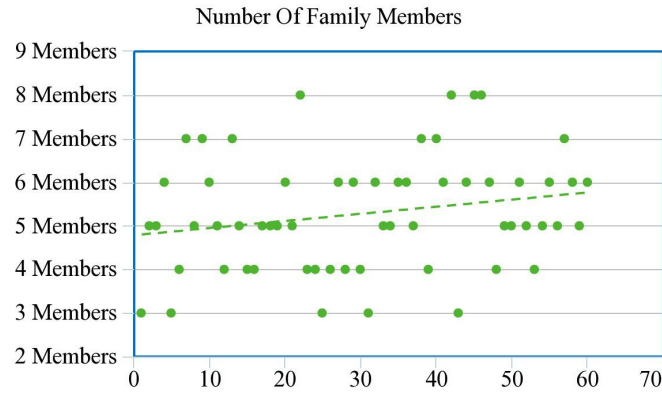


Figure 4.9: Number of Family Members among Farmers

From the scattered diagram, we can see that the farmers we interviewed had on an average of 5.28 family members, and the best fit line passes through it, reaching almost 6. Moreover, 41.67% (25 out of 60) of the farmers have 6 or more family members, which is definitely alarming from the perspective of such a populous country as Bangladesh. It is more than evident that they require sufficient earning to back up their family, and the implementation of our system can ensure to provide them that.

Furthermore, 26.7% (16 out of 60) of the farmers work on the land of a different owner other than themselves. Also, the same percentage of farmers work on both their own land and others. The following bar chart visualizes the workplace of the participants:

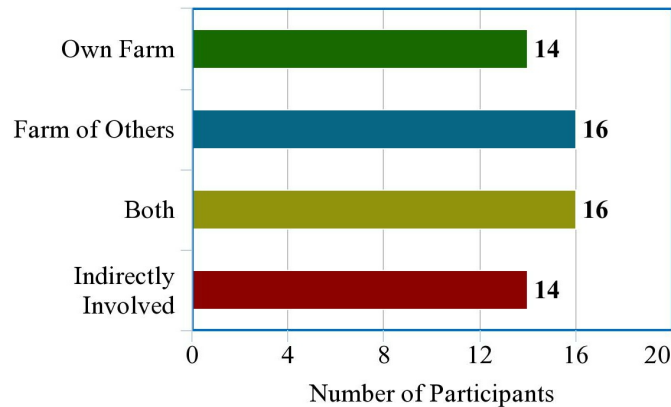


Figure 4.10: Workplace Ownership of Participants

78.4% (29 out of 37) of the general people strongly agree to the fact that farmers do not earn sufficient enough to properly bear the expenses of their family.

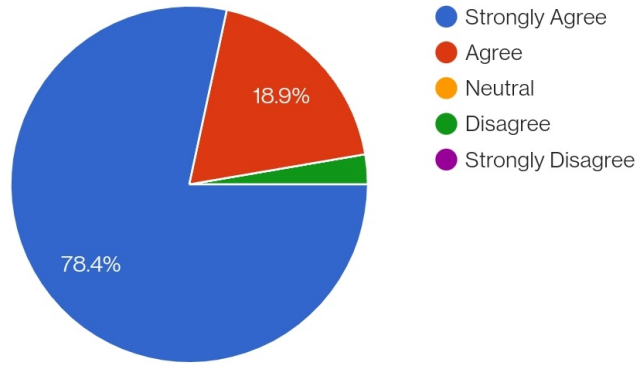


Figure 4.11: Opinion of General People on Farmer's Earning

It is evident enough that general people want to stand along with the farmers. The implementation of our proposal is also widely welcomed by the consumers. Most of the people have arrived at an agreement that direct trade between farmers and consumers will bring a positive change to the existing system. The following chart shows the exact figures:

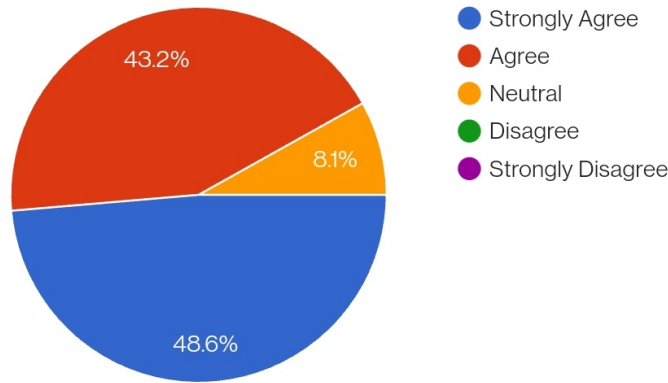


Figure 4.12: Opinion of General People Regarding Direct Trade with Farmers

The 2 districts that have provided us with the maximum number of responses are Narayanganj (27) and Kishoreganj (15) respectively. Now, we shall compare the feedback of farmers regarding sufficient earnings to bear their family expenses between these districts.

Process Name: T-Test

A T-Test is an inferential static used to determine if there is a note-worthy difference between the means of two groups. Formula(s) used:

$$\bar{X} = \frac{\sum X}{N}$$

$$s = \sqrt{\frac{(xi - \bar{x})^2}{(n - 1)}}$$

$$t = \frac{\bar{x1} - \bar{x2}}{\sqrt{(s^2(\frac{1}{n1^2} + \frac{1}{n2^2}))}}$$

After performing the calculations using survey dataset, we got: $t=0.794$ Significance: The closer the value of t is to 0, the more likely there is not a significant statistical difference.

On the contrary, if we analyze the value of t between Narayanganj (27) and Narshingdi (7), which is the district we managed to gather the least numbers of data from: We get, $t=1.4396$, which is comparatively higher than the value of t we previously obtained. This means, Narayanganj and Narshingdi has more statistical difference in terms of dataset than Narayanganj and Kishoreganj.

Upon the receiving of the data, among the list of analysis carried out, one of them is the Chi-Square Test. When performing this test, we take two columns of data and try to figure out whether the values in the columns are independent or whether dependent on another upon finishing the test. The data that is gathered directly from the columns is known as the observed data. Everything else can be calculated using the formulas in the following paragraphs.

OBSERVED DATA					
E-commerce Idea	Strongly Agree	Agree	Neutral	Disagree	Total
Full Idea	17	1	1	0	19
Some Idea	9	18	0	0	27
No Idea	1	6	6	1	14
Total	27	25	7	1	60

EXPECTED DATA					
E-commerce Idea	Strongly Agree	Agree	Neutral	Disagree	Total
Full Idea	8.55	7.916667	2.216667	0.316667	19
Some Idea	12.15	11.25	3.15	0.45	27
No Idea	6.3	5.833333	1.633333	0.233333	14
Total	27	25	7	1	60

CHI-SQUARED TEST - (Observed - Expected)^2/(Expected Data)					
E-commerce Idea	Strongly Agree	Agree	Neutral	Disagree	
Full Idea	8.351169591	6.042982	0.667794	0.316667	
Some Idea	0.816666667	4.05	3.15	0.45	
No Idea	4.458730159	0.004762	11.67415	2.519048	

X-Square Summation	42.50196921
Degree of Freedom	6
P-Value	1.46339E-07

Table 4.1: Idea regarding E-commerce VS Opinion on whether E-commerce would be a better idea in regard to Farming

In the above table for the CHI square, the data were taken from the column for the people who have/do not have an idea on E-commerce VS the people's opinion on whether it will have positive impacts on buying and selling crops via phone through E-commerce.

The Observed data basically contains data directly taken from the columns, that is, we search for the matches and find the common data. For example, the number of people who have full idea on E-commerce and also strongly agree that switching to E-commerce business will bring in a positive effect, the total number of people for both these conditions are 17 out of the 60 people. Similarly, the next value is for the number of people who have a full Idea regarding E-commerce while only agreeing to the benefits that direct business through E-Commerce would bring. As this continues, all the empty cells are filled with the values obtained and the total for both sides would amount up to the total number of people taking the survey which in this case is 60.

The table is about finding out the Expected Values of each and every cell in the Observed Data Table. The expected values are what we use to compare the original values to check whether the null hypothesis is true or not. The null hypothesis here says, the categorical variables in the columns have no link, that is, they are independent. In order to find the expected values of each cell, we multiply the column total and the row total associated with that particular cell and divide the whole thing with the overall total. In the first cell, we take the row total of 19 and multiply with the column total of 27 and divide the whole number with 60 which gives us 8.55 exactly. $[(19 * 27)/60]$. The rest of the values are calculated in the same way. Once finished, we reach the third table where the Chi-Square Value is calculated for each and every cell just like before. Here, the values taken in to calculate the Chi-Square values are the data from the Observed Table and the Expected Table. The formula for the Chi-Square value goes like this: (Assuming we take Observed Value as O.V and Expected Value as E.V) $[(O.V \text{ of the current cell} - E.V \text{ of the current cell})^2 / E.V \text{ of the current cell}]$. In the next step, all the Chi-Square values are summed up as given in the X2 summation. The Degree of freedom is basically the product of the number of $[\text{rows} - 1]$ times the number of $[\text{columns} - 1]$. Finally, the P-value is calculated using the Degrees of Freedom and the summation of the Chi-Square values which bring the value as 1.46339×10^{-7} . As the value is less than 0.05, which is a 5% risk for concluding that the values in the columns have a possibility of following the null hypothesis, this value of P indicates that there is a significant relation between the values, meaning that one column data is dependent on another. Few other columns have undergone this analysis.

Observed Data						
Opinion on Unfair Prices ->	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
<u>Opinion on System Change</u>						
Strongly Agree	35	8	0	0	0	43
Agree	4	3	1	3	1	12
Neutral	1	0	0	1	1	3
Disagree	0	1	0	0	1	2
Strongly Disagree	0	0	0	0	0	0
Total	40	12	1	4	3	60

Expected Data						
Opinion on Unfair Prices ->	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total
<u>Opinion on System Change</u>						
Strongly Agree	28.66667	8.6	0.71667	2.86667	2.15	43
Agree	8	2.4	0.2	0.8	0.6	12
Neutral	2	0.6	0.05	0.2	0.15	3
Disagree	1.333333	0.4	0.03333	0.13333	0.1	2
Strongly Disagree	0	0	0	0	0	0
Total	40	12	1	4	3	60

CHI SQUARED TEST					
Opinion on Unfair Prices ->	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
<u>Opinion on System Change</u>					
Strongly Agree	1.399225	0.042	0.71667	2.86667	2.15
Agree	2	0.15	3.2	6.05	0.26667
Neutral	0.5	0.6	0.05	3.2	4.81667
Disagree	1.333333	0.9	0.03333	0.13333	8.1
Strongly Disagree	0	0	0	0	0

X-Squared Summation	38.50775
Degree of Freedom (DF)	16
P-Value	0.00128

Table 4.2: Opinion on unfair prices VS Opinion on System Change from the Farmers' point of view

The above tables give the Chi-Square Analysis result for the data between the Farmer's opinion on the change in system, against the Farmer's opinion on Unfair Prices. As the previous calculations are carried out, this one is done in the same

way and with the P-value once again being less than 5%, it shows a significant relationship between the two columns which indicates high hints of association.

Observed Data					
Technology bring changes	Strongly Agree	Agree	Neutral	Disagree	Total
System should undergo changes					
Strongly Agree	40	3	0	0	43
Agree	4	8	0	0	12
Neutral	0	2	1	0	3
Disagree	0	2	0	0	2
Total	44	15	1	0	60

Expected Data					
Technology bring changes	Strongly Agree	Agree	Neutral	Disagree	Total
System should undergo changes					
Strongly Agree	31.53333	10.75	0.71667	0	43
Agree	8.8	3	0.2	0	12
Neutral	2.2	0.75	0.05	0	3
Disagree	1.466667	0.5	0.03333	0	2
Total	44	15	1	0	60

((Observed Data - Expect Data)^2)/Expected Data				
Technology brings changes	Strongly Agree	Agree	Neutral	Disagree
System should undergo changes				
Strongly Agree	2.273291	5.58721	0.71667	0
Agree	2.618182	8.33333	0.2	0
Neutral	2.2	2.08333	18.05	0
Disagree	1.466667	4.5	0.03333	0

X-Squared Summation	48.06202
Degree of Freedom (DF)	9
P-Value	2.49E-07

Table 4.3: Opinion on whether the System should change VS Opinion on whether technology would bring about changes from the Farmers' point of view

Another Chi-Square test carried out is based on between the Farmer's opinion of a change in the supply chain system against their opinion on whether technological advances can bring in more profit for them if utilized. Once again, using the same formulas, we end up with a P-Value of 2.4868×10^{-7} . Once more as the value is lower than 5%, there is very high significance for correlation between the two data columns.

Analog Phone	Smart Phone	Doesn't use
51	32	7

Based on the speculation of the respondents on mobile phone usage of the farmers residing in their respective areas, we determine the Standard Error (SE) from the particular field of dataset:

Formula(s) used:

$$SE = \frac{\sigma}{\sqrt{n}}$$

After performing the required calculations, Standard Error, SE= 12.74.

Lower value of SE derives that the dataset is more accurate. Since, the population used in the aforementioned dataset is not that huge, this might resonate in the higher value of standard error.

4.2.2 Qualitative Data Analysis

Thematic analysis is a method of analyzing and categorizing qualitative data. The approaches we have followed in order to complete this analysis are conducted in 6 steps. All 6 of these steps are included and minimized to form these 3 steps in the following:

Step 1: Familiarization and Coding

By conducting field surveys, we have interviewed almost 60 people and from them, we have gained necessary data on which we have carried out analysis in order to identify the pattern in the qualitative data that are important. While taking the interviews, we took necessary notes and went through the bundle of information in order to get familiar with it. For the qualitative data, we took one column which takes input from the farmers regarding their opinion on our idea of the e-commerce system which would be handled using phone apps. After that we must code the data, which is the process of marking areas of our text – generally phrases or sentences – and creating brief labels or "codes" to explain their contents. Here in this column, we have gathered the answers from our interview questions with the farmers.

Step 2: Themes

Themes are more general than codes. The majority of the time, many codes will be combined into a single theme. Previously, in the processes carried out in step 1, we have generated codes and based on certain similarities among the codes, we categorized them under specific themes. The table for the themes is displayed below:

Codes	Themes
Interested/positive feedback/ acknowledgement of e-commerce	Good Expectations
certainty with positive feedback	
indirectly expressing certainty	
certainty about bringing positive changes	
certainty alongside with the need of government	
expressing positivity of changing the system	
positive about using the advantage of technological progress	

Table 4.4: Theme: Good Expectations

Codes	Themes
Uncertainty	Hesitation
Demanding the help from the government	
Lack of idea about e-commerce	
Uncertainty without the help from government or any big company	

Table 4.5: Theme: Hesitation

Codes	Themes
Demanding simple user interface	It has to be profitable
Grateful if it brings profit	
Certainty about incoming profit using e-commerce	
It has to be profitable	

Table 4.6: Theme: It has to be profitable

Codes	Themes
Having idea about e-commerce and expressing frustration indirectly for not getting enough profit	Expressing frustration over low profit and impoverish livelihood
Struggling in life and expressing frustration over government	
Not getting enough profit compared to their hardwork	

Table 4.7: Theme: Expressing frustration over low profit and impoverish livelihood

Step 3: Result

Good Expectations:

Regarding Good expectations, the interviews revealed that many farmers seem to have a strong grasp on the idea of e-commerce and as a result, they positively acknowledged the idea of directly selling crops to the consumers. By the advancement of technological usage, these farmers also come to the understanding that some sort of change is definitely required in the environment of agriculture. One of the farmers from Narayanganj state:

“People Adapt as Time passes by”

From the interview, we got to know that nowadays most of the farmers and their family members, especially their children, are carrying smartphones. Some of these children buy products online while some family members have established online businesses. Here’s a relevant statement from a farmer of Kishoreganj.

“I myself now sometimes communicate with the customers through some groups on Facebook and sell them, it is beneficial to have a different app for this. In a way it is like I got the market in my hand.”

Hesitations:

Although lots of farmers support the idea of building an e-commerce system, there are some who are not completely convinced with the idea. Some of them are not sure about whether it will bring any change or not, as most of them don't have the idea of online businesses as they are not familiar with the concept of e-commerce system.

“I didn't think it would be possible, we didn't see it, but you see. You are the future of our country. I hope your initiative goes well.”

There are many who believe it is impossible to achieve without the assistance of the government or a large corporation. They think it will only be possible if they support us.

“The government's cooperation is needed to implement this project.”

At the same time, there are people who have shown interest in the building of an e-commerce system but they also think that without the help of the government this project won't bring in much profit.

“Good initiative but it will be difficult to implement it without the government or any big company.”

To Be Profitable:

With all the farmers we interviewed, almost all of them clearly mention that if the path leads to a greater profit, they would walk on it. This includes whether they know about e-commerce or not.

“If I get 1 taka more by selling through mobile, then that is profit”

The main idea of building this e-commerce system is to ensure that we can increase the profit the farmers can gain, which would be a lot more compared to what they gain now. Now, there are several occasions where they incur huge losses as well. Our system not only ensures that the farmer would gain greater profits, it is also here to reduce the losses that they suffer from, to a bare minimum.

Expressing frustration over low profit and impoverish livelihood:

Due to the miniscule number of profits and the loss that the farmers incur from time to time, most farmers are unable to provide even basic rights for their families. This abundance of effort ending with nothing but meaningless struggle has led too many farmers to go under depression and almost all of them are frustrated over the government as the government cannot fulfill their needs. A participant asserted:

“The household is struggling; the government does not give much assistance”

Many of the farmers have mentioned that, the materials which they require for the agricultural work, the prices of these tools have gone up while the selling price of the crops haven't increased at all compared to that. As a result, a lot of cost is taken into account when buying these materials. A farmer from Savar stated:

"The cost of labor, pesticides, fertilizers and accordingly the cost of crops becomes higher"

Themes	Sub-Theme	How many participants mentioned it
Good Expectations		36
Hesitations	Lack of Ideas	3
	Need Government Help	5
To be Profitable	Demanding Profit	6
	Certainty	7
Expressing frustration over low profit and impoverished livelihood		4

Table 4.8: Theme: Quantitative evaluation of the result

The major goal of our research is to assist underprivileged farmers by utilizing technical solutions that would enable them to increase their revenues. We intend to sell the crops directly through the internet. We have interviewed them and showed them the structure of our plan for establishing an e-commerce system. According to our analysis, approximately 37 of the farmers we have spoken with are delighted after hearing about our e-commerce system concept. 13 of them are unwilling to support our proposal because three of them have never heard of an e-commerce system and five believe that it cannot be established without government assistance. Almost 15 farmers directly state profit when asked about it. 4 of them desire profit regardless of whether they believe in e-commerce, and 7 of them are positive that if we can set up a system like this, it will be profitable. 4 farmers express their dissatisfaction with the lack of profit, stating that they cannot support their families on such a small sum of money. They are also disappointed with the government's lack of awareness of this problem.

Chapter 5

Design & Implementation of GUI

After gathering a sufficient amount of data and analyzing those, we intend to propose our system model. In this chapter, the proposed design and its implementation is described.

5.1 Design

According to our analysis we propose the system in this way where the farmers become able to sell their crops directly to the customers through a developed system. On the other hand, the consumers become able to purchase their desired crops via the proposed solution. Both parties can negotiate their terms through the system. In addition to the ‘buy-sell’ facility there is noteworthy provision in the system, which is – the farmers and consumers can request for any desired product setting the desired price range to buy/sell. The web server receives and processes the requests. Due to this, the farmers can let the consumers know about their supply as well as the consumers may set a demand for any particular goods. Whenever, the farmers product and price range matches with the customers required product and price, the system sends them a notification. Thus, they find their desired match and trade. The system model is presented in the Figure 6.1:

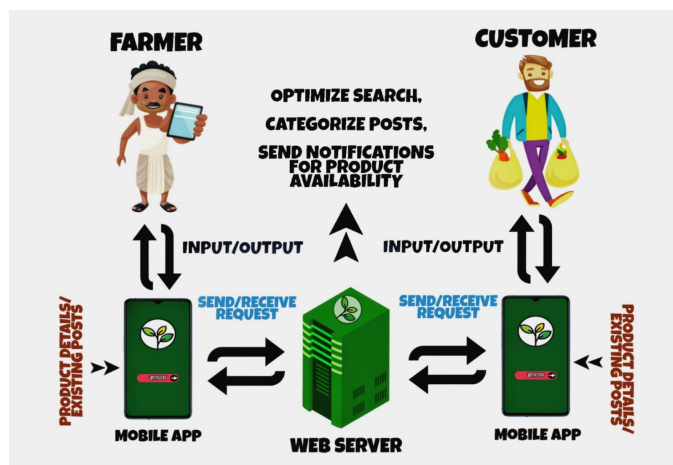


Figure 5.1: Proposed System Model

After the response from farmers/consumers end, the proposed system mainly does a few tasks. Firstly, it keeps the information in the general records which can be accessible by both ends. Along with that, it tries to match the product type and price range in the existing server (of a certain period) so that it finds if there is any match. Lastly, it sends the farmer/consumer a notification regarding their request whether there's a match found in the system or not. Thereby, the user may proceed to trade if there's a match or modify/update the request to find a match (if any match not found).

5.2 Implementation Phase

In this phase, we describe the prototype and the real-time application "Krishoker-Hut"

5.2.1 The Prototype

For the prototype we create, the first page is the welcome page which is followed up by the choice of whether the user is a farmer or a customer. Once clicked on the desired type, we are taken to the login and sign up page. For the signing up, the input that must be given are Username, Phone number, Gender, Email, Address and password. Once done, we can now Login to the app using the Username and Password.

Farmers

Suppose we have logged in as the Farmer. The first two things we would witness as we log in are the options in the middle of the page which are View Dashboard and View Customer Requests. Along with that there would also be the logout option, the notification bell button and of course the own profile.

Suppose we now press the View Dashboard button and upon pressing it, we would be forwarded to all the posts that all the farmers have posted and posting. Here is another option called Post. Upon pressing it, we would be shown a form of some sort where we would have to input in the product name, price per kg, product picture description of the product, which includes how it was cultivated and farmed and when it was harvest, and also another segment where the farmer can put in the bargained price for which they can sell the product. However, the last segment when posted will not be visible to any other customer or farmer. Now, going back to the dashboard, there is another icon which is the Search Icon. Using this, we can look at the kind of post we desire by multiple search options which include searching by Product, searching by Location, searching by price or a combination of any two or all three.

Next, let's go back to the home page of the farmers and this time press View Customer Requests. As the name suggests, we can view the requests that the customers have sent in order to buy the products. Once the page has been opened, we can view how many people wants to buy the product in the form of a list. In each of the requests, we can press See Request in order to view it in more details. Upon

viewing the details, we can choose whether to accept or choose depending on our situation.

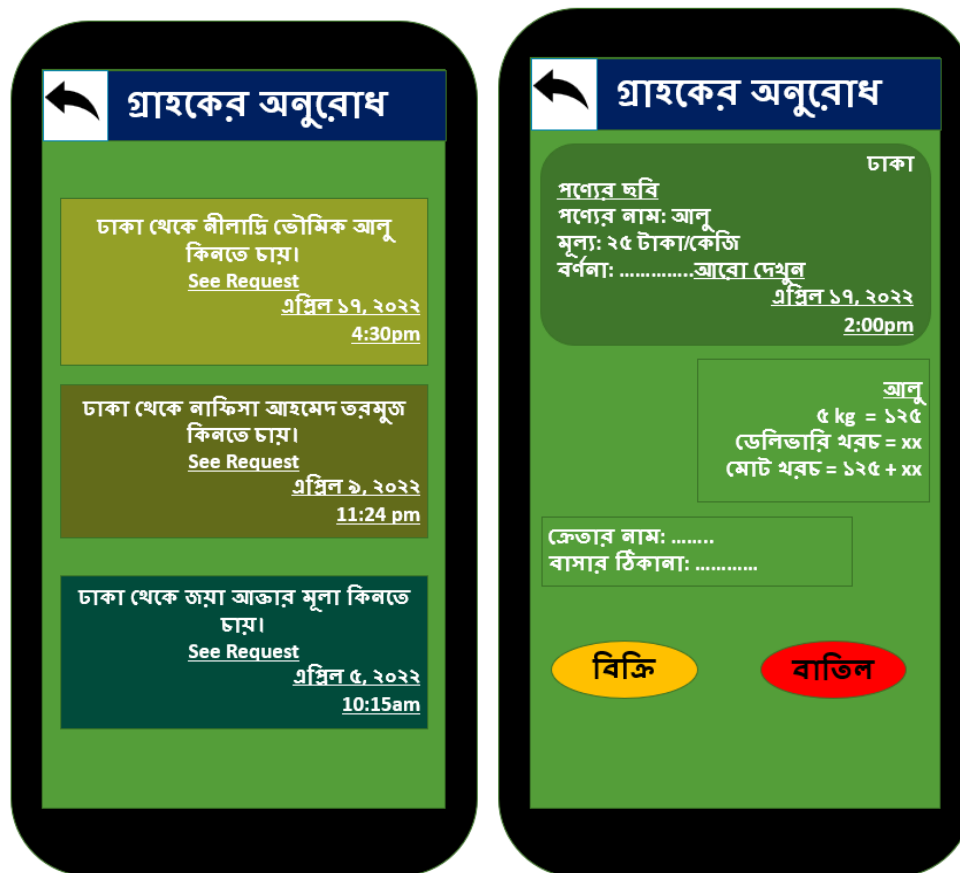


Figure 5.2: Accepting Requests from Customers from the dashboard

Now let's go back to the home page once again and this time, click on the bell icon. The notifications that come here are about customers who made requests to buy specific product at a certain price which was not given in the dashboard. If the product is something the Farmer is selling and the requested price is within the bargained range of the farmer's product, he could easily sell it. Of course, there might be situations where he may have to decline for certain reasons. For example: The product is no longer in stock, or the delivery deadline is too quick, etc.

Before viewing the requests, the farmer would be given the choice for which requests he would want to view. This includes viewing the requests locally or requests from far away.

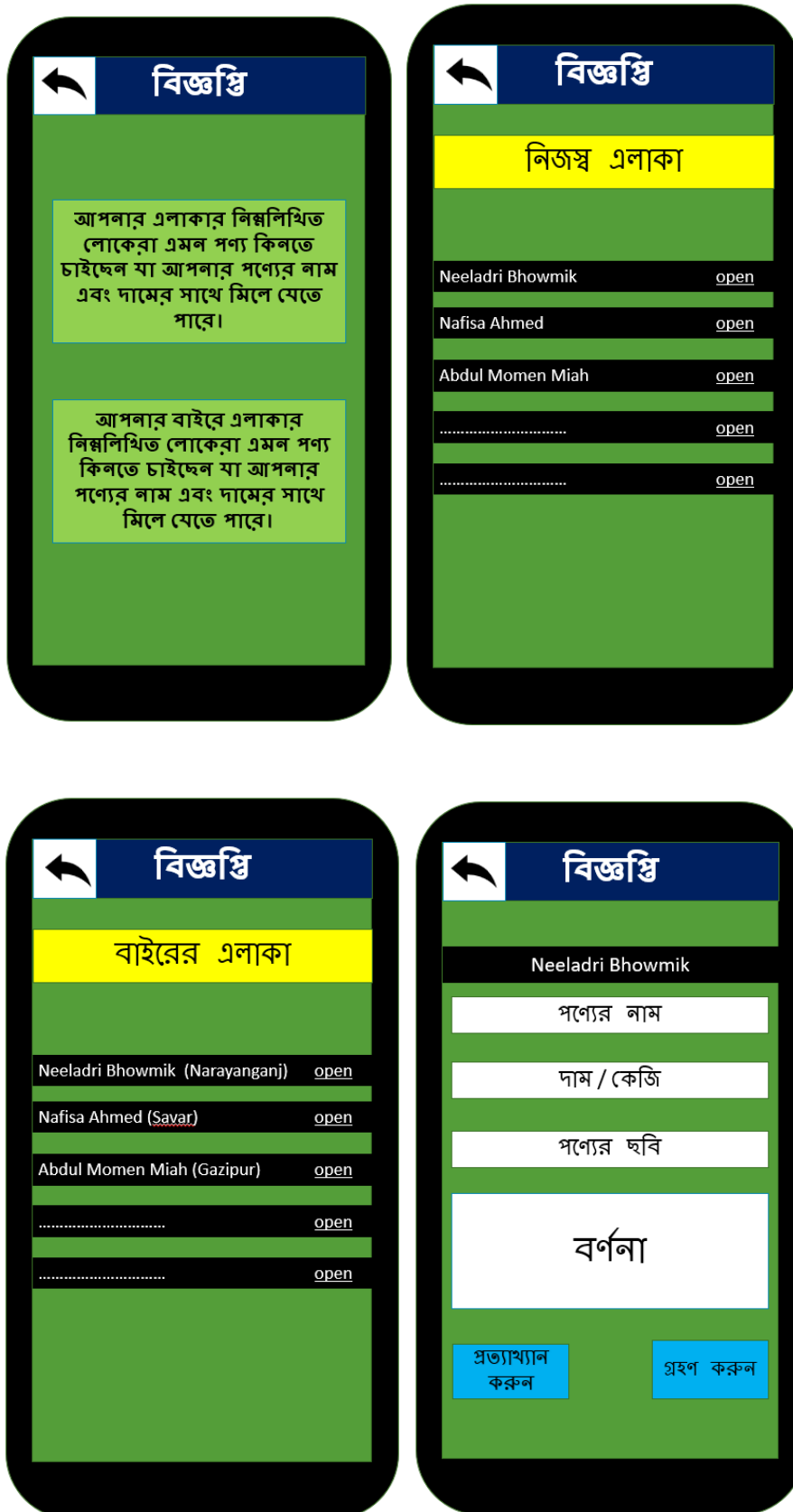
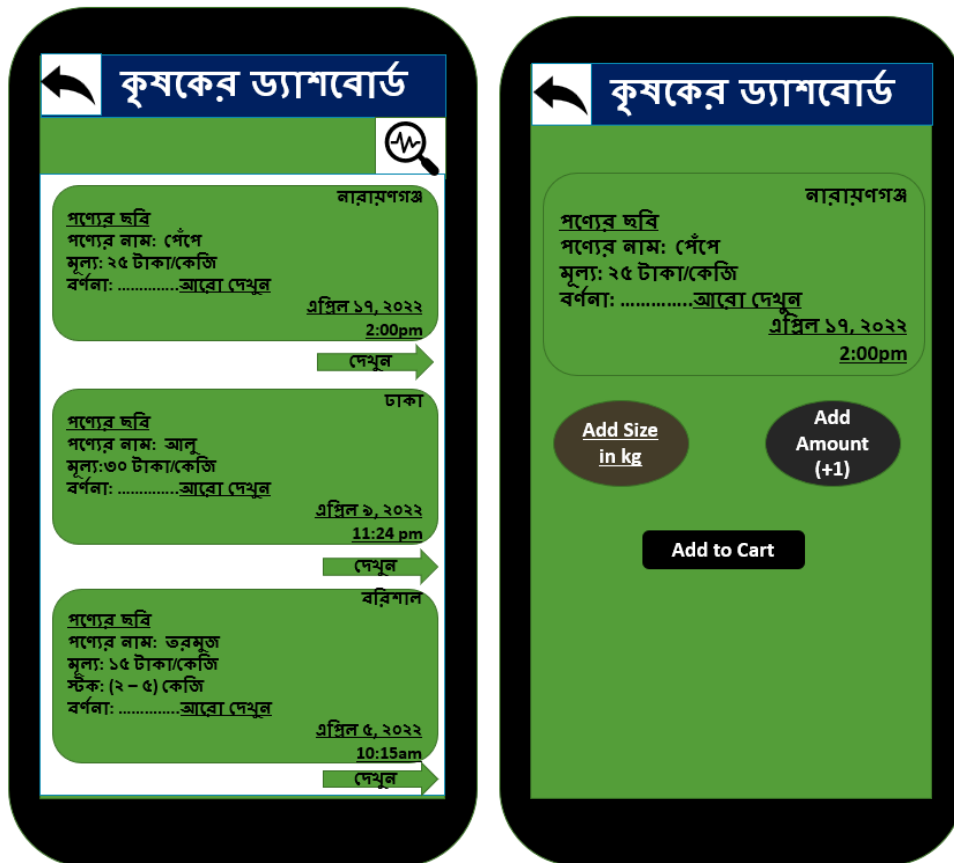


Figure 5.3: Accepting Personal Request from the Customers

Customers

Now, we would once again log in to the app, but this time as a customer. As usual, in the home page for the customers we would find the logout button, the bell button and the profile icon. In the main area, we will find the options for the Farmer Dashboard, Send Request and View Own Requests.

Inside the Farmer Dashboard, we can view all the post from the farmers in the nearby regions who are selling their crops online through this app. Like before in the Farmer dashboard, the customers can also search through the dashboard in the same way with the same conditions. Once we click the view button on, any of the posts we find interesting, we are taken to the next page where we have to choose the size and amount of whatever we are trying to buy and once we have decided, just click on the Add to cart button. We would be taken to the next page where the overall price has been calculated and laid out. Sending the send request button would send this as a request to the farmer from who we are buying. As the request gets accepted, we would get the thank you notice and we are done with our transaction and the final price would be paid upon delivery through Cash or using online transaction methods.



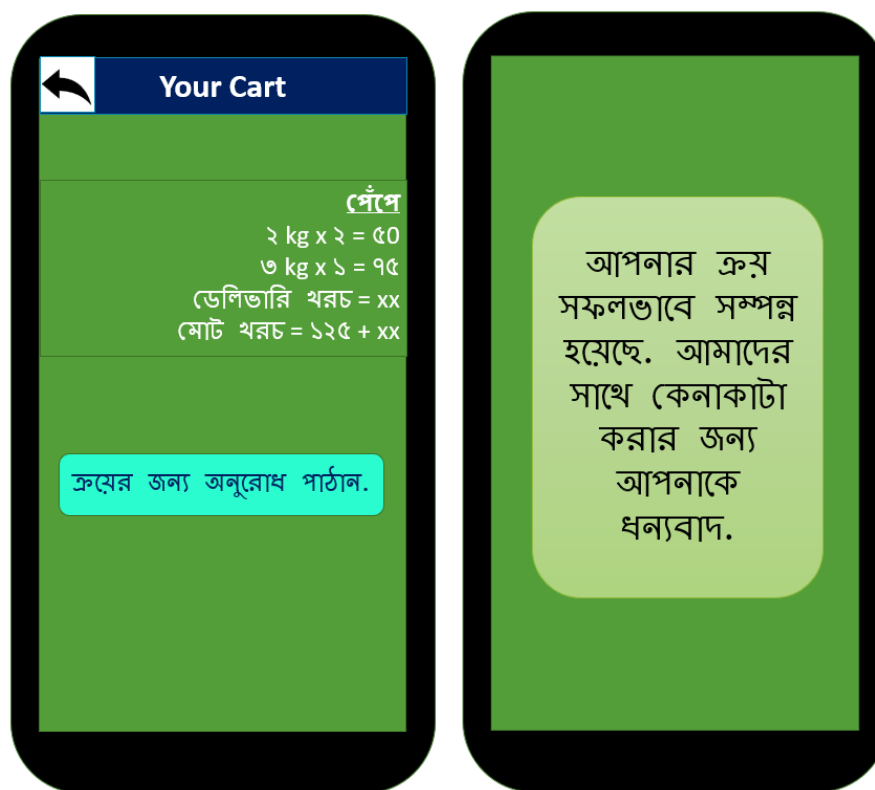


Figure 5.4: Customer purchasing products from the Dashboard

Now, let's go back to the home page where we look at the next section of the customer side. After Farmer's Dashboard, comes Send Request. It is kind of self-explanatory as all that happens here is that the customers do not find what they are looking for in the dashboard and as a result, they send a request form in which the requirements are the product name, the desired price per kg, the product picture and a small description which may consist of the number of the products and within how many days it should be delivered, etc. Once the request has been sent and accepted, the customer who sent it would get a notification which is the bell icon in the home page. Finally, the last item from the home page is the View Own Request. This is simply viewing the requests the customer himself or herself has sent to the farmers.

5.2.2 The Application 'Krishoker-Hut'

The app's architecture is basically Java programming with the platform being Android studio. When building the app, the type of user, the login and sign up is just as it has been described in the prototype design.

The app's creation is through the XAMPP Server and the database associated with it is the MySQL Database. With each and every request or post made, all of them are stored here in the database in order to keep track of all the information and if necessary, follow the trail to track a certain post.

When a customer cannot find what he/she is looking for in the dashboard, the person is allowed to make a request with the product he/she is looking for or the desired

place which was not available. But it becomes imperative that this request remains a secret, in other words, no other customer can get to see the requests made by other customers. However, this is something we are still working on.

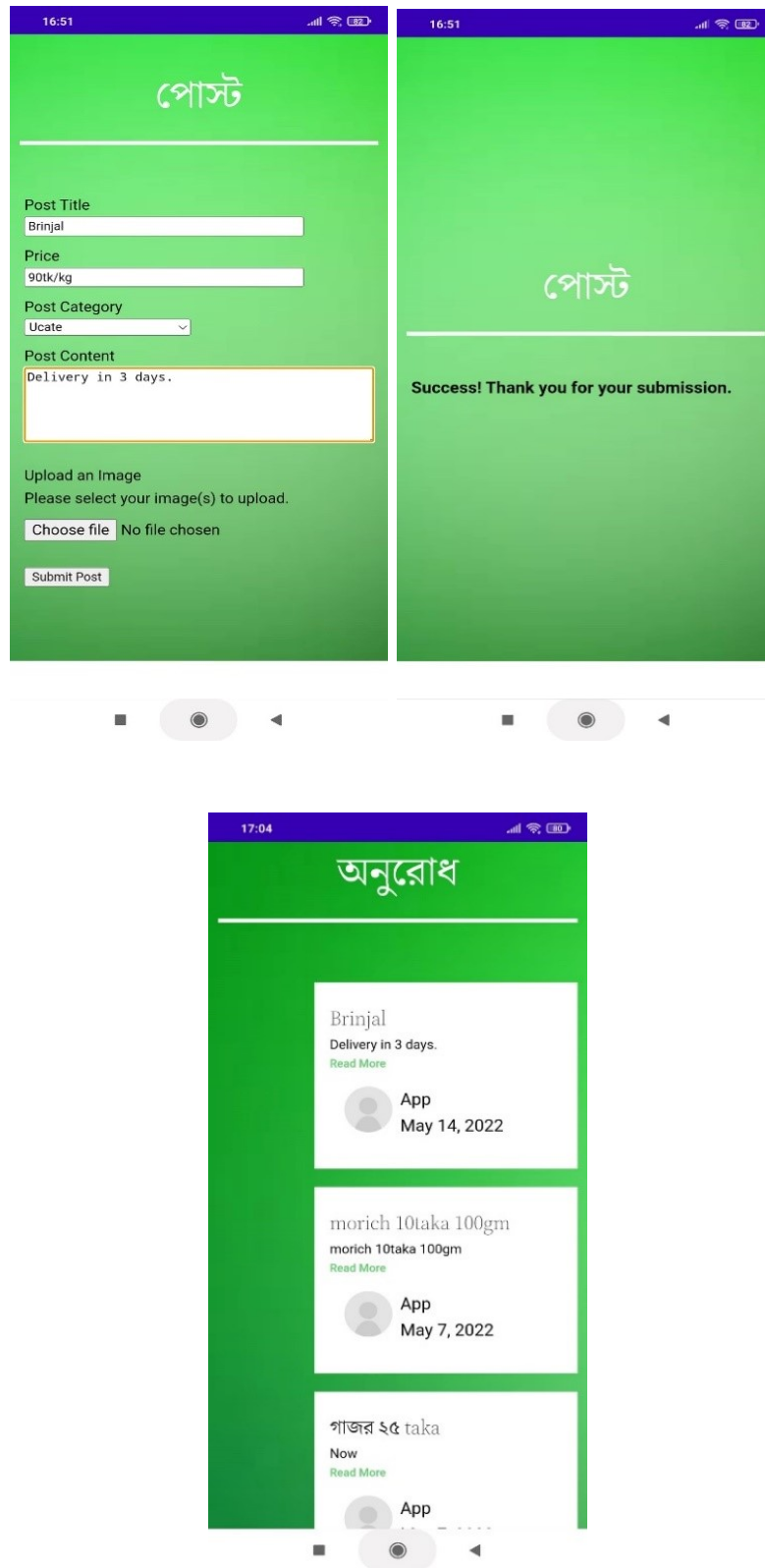
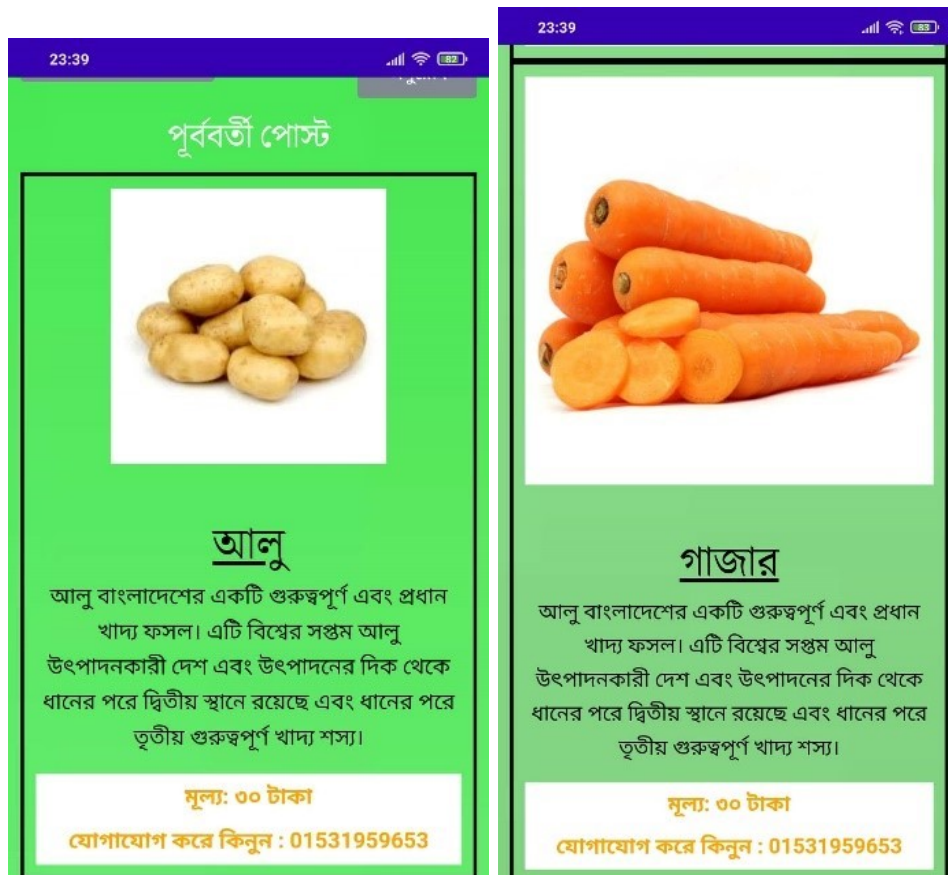


Figure 5.5: Implementation of the Prototype from the farmer's side

As for the purchasing taking place, we plan to implement Cash on Delivery Payment however, as it is still a work under progress, we chose to add the phone number of the farmers selling the crops so that with one phone call all the information exchange can take place.

When talking about from the Farmer's side of the login, when a farmer makes a post, that post needs to be checked and revised before it can be posted. In other words, each of the posts that have been created were first verified manually by the admin before being given the clear final verdict. For future goals, we have a vision of making this portion of the app automated, that is, there will be no need for the admin to give any sort of check on each and every post.



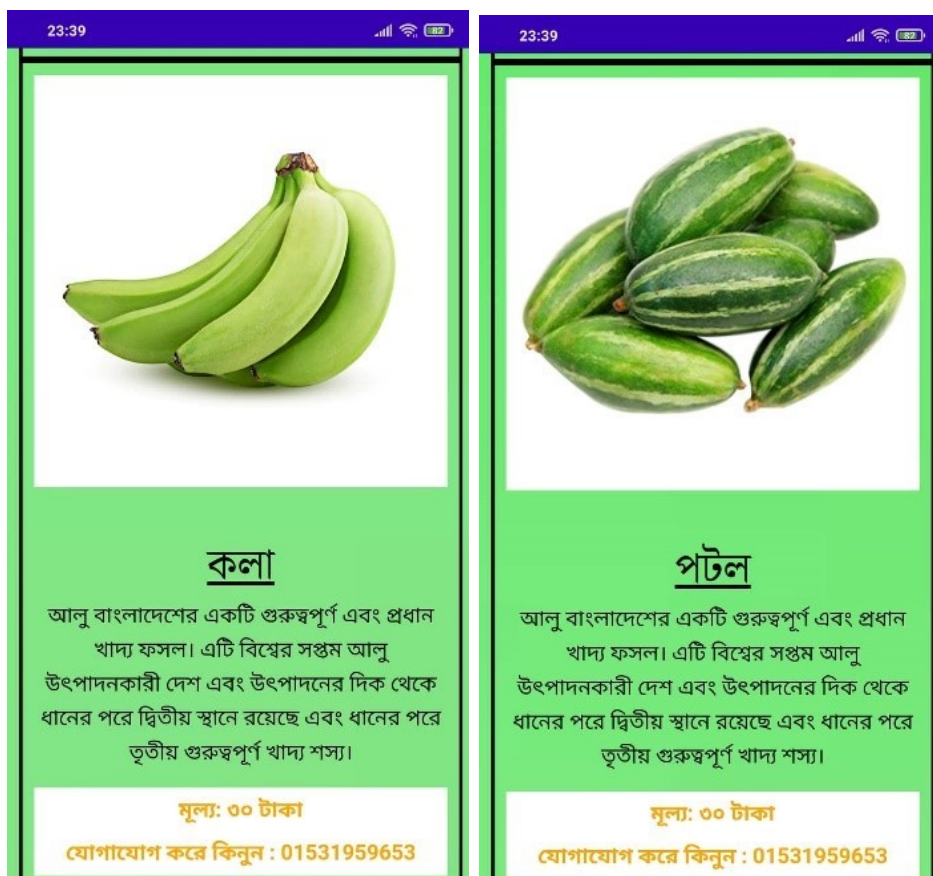


Figure 5.6: Looking at products from the dashboard from the Customer's point of view

The above images show the type of items being sold and that, in order to purchase them, the customer has to call at the number given below and purchase the product as mentioned above.

Also, when the customer sends a request when he/she cannot find the desired product or price in the dashboard, the request is visible to not only all other customers but for all the farmers too, even the ones who live in different divisions, so the request being pinged only to the farmers close by is something we are aiming to fix.

Chapter 6

Discussion

In the aforementioned sections, we attempted to provide some clear idea on the current condition of the farmers, the financial benefit they make using the traditional system of agricultural trade, farmers response toward a change in the system. Further, we tried to present the financial challenges of the farmers in respect to the research studies and surveys. Moreover, we discussed the important findings from our fieldwork, system model. Adjoining, we are on the verge to present our discussions on the impacts of our finding.

6.1 Understanding The Context of Underprivileged Farmers

As Bangladesh is a major agricultural country, most of the people living in the rural regions of the country earn their living through the profession of farming. They are mainly engaged in the task of cultivation of land and harvesting of crops. Although a very important and noble profession, it is not enough to earn a decent living, especially when you have a family to support [2]. Although the community of HCI has found different effective ways to solve this problem in other different countries [43], our solution is one where we have gathered Intel regarding the viewpoints of farmers in profit. Almost all the farmers shared their view that farming alone is not enough to provide the basic needs for their family. As a consequence, whenever they get a better deal than the previous one, they would want to jump on it.

The data we have collected via many interviews shows various relationships between the farmer's situation and desire, especially when it's concerning their current income and their interest in the profit that can be generated through e-commerce. [4] In the current situation that the farmers are living in, the amount of hard work they put in the fields, growing their crops, the amount earned in the end makes the hard work seem meaningless. Moreover, when they incur a loss instead of profit, the damages that takes place are brutal. The living expenses have to be decreased, insufficient food, arising sickness, mental distress, all of which eventually leads to worse things along the line, example: death [10], [14].

The system we propose would be erected with the sole purpose of making sure the farmers are earning their rightful amount of income. By using the Krishoker-Hut

application, they can directly trade with the customers and gain more profit than before which will help them to be financially stable and fulfil the basic needs which they are being deprived since a long time.

6.2 Designing Technology Appropriate to The Content

As we are creating a system for the farmers, simplicity is a key factor. It has to be easy to understand so that the farmers may feel comfortable while using it. [23] Mention worth, many farmers may not understand how to use the system so if the system is built in an uncomplicated method, then it'll be easy for them to get used to [15], [24]. As, Simple things are easy to adapt. One of the general people in the interview states:

“The application would only work if it is simplified enough for the farmers to understand and use it properly.”

The farmers, or at least someone from their household, need access to smartphones to be a part of our system. In the current era of industrialization, more and more people are getting under the radar of smartphones. Though there are several farmers who barely use it, we have witnessed smartphone usage among many farmers throughout our interviews.



Figure 6.1: A Farmer Using A Smartphone

Another significant matter of concern is the language. According to a study conducted by Sharmin et al. [20], 82% of the farmers did not cross high school education and 66.7% of people did not cross primary level education [35]. Keeping the low-literacy in the mind, we had to design the app in the Bengali language as well. To make it more user friendly, we tried to visualize most of the contents in the system. Because, if the designed technology is not simple and understandable then it may lose its credibility.

6.3 Comparison with Existing Works

The adoption and development of e-commerce has been identified as a novel means of 18 influencing food systems and access to markets for smallholders. Scopus study resulted in the identification of 41 journal articles and 23 conference papers. The results of the descriptive analysis demonstrate that the number of publications has been steadily increasing since 2000, demonstrating that Agricultural food e-commerce research has piqued the interest of scholars from various countries and disciplines. [30]

The following table compares our model titled ‘Krishoker-Hut’ to other existing literatures which is relevant to our field of study:

Paper Name/ Proposed Model	General Features	Common factors with ‘Krishoker Hut’	Contrasting factors with ‘Krishoker Hut’
Agricart (2020) [37]	Facilitate farmers to find shops to make purchases and manage agricultural activities	1) Benefits the farmers. 2) Both the models work on the basis of buy and sell.	1) This model is primarily focused on the betterment of farmers, whereas ‘Krishoker Hut’ helps both farmers and general people. 2) In the ‘Agricart’ model, the role of farmers is ‘buyer’ and the role of shop vendors is ‘seller’. On the contrary in our model, Farmers are the sellers whereas the general people are buyers.
Digital Market (2018) [31]	A web based application at government level which will help out the farmers find out nearest markets, stock details along with demand of a particular product.	1) Benefits the farmers. 2) Both the models feature a comment or complaint box for better convenience.	1) This model does not include the general people. 2) This model cannot be defined as an e-commerce one, since there is no commercial trade here. 3) As trade is absent in this model, it does not comprise of negotiation, which is one of the novelties of our model.

Understanding and designing for intermediated information tasks in India (2006) [6]	Focuses on intermediation with the goal of empowering and enabling technology access to beneficiaries.	1) Benefits the end users. 2) Aims for optimal utilization in terms of productivity.	1) Heavy loads are imposed in both front end and back ends to ensure dual user phenomenon, whereas our system keeps the front end simple for the convenience of farmers.
Krishi Bazaar (2021) [39]	A web based application to establish direct trade between farmers and consumers.	1) Selling and bidding system. 2) Benefits both farmers and consumers 3) Uses SQL to store data	1) 'Krishoker Hut' is implied on the basis of the responses collected from the farmers and end-users. So, it is more simplified and sophisticated than Krishi Bazaar.

Table 6.1: Comparison of 'Krishoker-Hut' with Existing Works

Chapter 7

Limitation and Future work

One of our main limitations is, our system can help those who have their own smartphones or are willing to use one in the near future. A portion of farmers do not use smartphones or aren't familiar with its usage despite having one. As a consequence, it'll be tough for us to help them bring in the system. However, a remarkable solution of that is- in most of their families, someone like children or siblings use smartphones. In this case, they (who use smartphones) can help them to be a part of this electronic trade system being family intermediaries or providing basic direction regarding using this simple app. Despite this limitation, the findings and proposed solution can be useful for the farmers to do smooth business adapting this new platform.

Transportation or delivery of the purchased items is a fundamental part of the proposed system. The estimated delivery time is updated by the delivery agency. The overall process is under optimization and both the parties (ie. Farmers and Consumers) along with the system management will bear the cost to ensure efficiency.

In future, we plan to do many additions to our system so that it becomes more useful for the agenda. From developing the system's interface to evolving the back-end work, security issues, etc. will be a running process. Besides, we will try to gain help from the Ministry of agriculture, and ICT ministry by a project like educating the farmers regarding information and technology which may help the farmers to be familiar with technological concepts [13]. One of the farmers asserts about it:

“Support from the Government is a must to ensure the launch of the system you people are suggesting.”

Apart from this, we'll try to seek funding from the government investment programs or agencies like Bangladesh Association of Software and Information Services (BASIS) for developing the system to a larger level, countrywide marketing and so on.

Lastly, as a student finding and designing this kind of solution for the underprivileged farmers brings us a positive energy to do something more efficient and larger which may ease their life in respect of farming and business. As a beginner level work, our system may have many bugs and security concerns but these will be sorted gradually in the future. In spite of having some limitations, the goal is clear and we firmly

believe that the solution will be useful and impactful for bringing a positive change for the people, who describes our country as an agricultural one.

Chapter 8

Conclusion

Even though farmers are the backbone of Bangladesh, it would not be a stretch to say that as a community they suffer the most. This is mainly due to the orthodox trading system existing in the country. In most of the cases they do not get the fair price due to several intermediaries. The crop production in our country is also affected frequently by flood, drought, and salinity [11]. The sufferings of the farmers know no bounds when all their hard toil and sufferings are priced as if their value is non-existent. Farmers are impoverished and famished, while others concrete their success on the struggles of the previously mentioned. As Bangladesh is growing and developing each day, our conscience is questioned whether or not we are taking any steps to improve the condition of the farmers.

Krishoker-Hut comes to the rescue in this case, to at least ensure that the farmers are not deprived of the fair price. The direct trade between general people and farmers restricts any kind of unfair means in the process. Also, the negotiation process ensures that it is a win-win situation for both the parties involved. Lowering the number of intermediaries definitely profits our economy as a whole. [25]

Worth mentioning, there are far sighted benefits of the proposed system. We have followed a very minimalistic approach to design the application, using Bengali (Native and most used language of the farmers in Bangladesh) so that it is accessible to the remote farmers. As a result, it would increase the usage of technology in farmers given that it is proved beneficial. Also, betterment of farmers would result in the betterment of our socio-economic status as a developing country, facilitating further opportunities.

Let's head back to the report regarding the farmers of the Haor area published on the Daily Jugantar [33]. Does that farmer really deserve to suffer this kind of loss after all the effort he puts in? It is the duty of the educated minds in Bangladesh to ensure that he gets fair price and puts up a smile on his face.

The focus of our paper is to structure such an e-commerce application that deducts the quantity of intermediaries existing in the market, thus creating more of a direct transaction between farmers and general people. To conclude with a positive note, empowerment of farmers is one of the crying needs of Bangladesh right now– and Krishoker-Hut is nothing but a leap towards that cherished goal.

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APPENDIX A DETAILS OF SURVEY QUESTIONNAIRE AND ITS PREPARATION

There are two sections to our survey questionnaire. One of them is for farmers, while the other is for the general people. Each portion is divided into two parts. We collect demographic data in the first phase, which includes information such as name, gender, age, and profession. After that, we move on to the second phase, where we ask the main questions about our research paper. We decided to ask 14 major questions to farmers and 12 major questions to the general people that are connected to our research subject.

We try to design our survey questionnaire in a way that our conversations with farmers flow like a story so that they can share their opinion easily with us. We ask them about the challenges they are currently facing, which may include less profit or low income, unable to provide basic needs for family, etc and try to provide possible solutions for those problems.

As for general people it is natural to assume that their opinion may differ from the opinion of the farmers. For their survey questionnaire we provide question with the option 'Other'. This is to ensure so that we can gather more information regarding any other problems they may want to address.

Survey Questionnaire For Farmers

We initially conduct the survey in Bangla [44] for the convenience of the farmers. However, for the purpose of this research, the survey questionnaire is translated for better understanding.

Form Id:

1. Your name (optional) _____
2. Your age
 - (a) 11-20
 - (b) 21-30
 - (c) 31-40
 - (d) 41-50
 - (e) 51-60
 - (f) 61-70
 - (g) Above 70
3. Your gender
 - (a) Female
 - (b) Male
 - (c) Other
 - (d) Don't want to disclose
4. Your contact number/ mobile number (optional) _____
5. Your email address (if any) _____
6. District you live in _____
7. Your Profession _____
8. Email address of any other family members (if any) _____
9. How many members of your family, including you? _____
10. How are you involved in the agricultural profession?
 - (a) Directly involved
 - (b) Indirectly involved
 - (c) Not involved
11. If you are farming, who owns the land?
 - (a) Your own
 - (b) Someone else's

- (c) Both my own and other's land
 - (d) Not directly involved in farming.
12. At present, farmers are not able to earn enough to run their families - to what extent do you agree with the quote?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
13. Farmers in Bangladesh are not getting a fair price for their produce - what is your opinion on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
14. If you think that farmers are not getting fair price, what percentage do you think they are getting fair price?
- (a) Below 50%
 - (b) 51-60%
 - (c) 61-70%
 - (d) 71-80%
 - (e) Above 80%
15. To what extent do you agree with the phrase "there is a need for systematic changes in the buying and selling of agricultural products at the present time"?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
16. "The application of technology in the purchase and sale of agricultural products can bring benefits" – how accurate is the comment?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral

- (d) Strongly disagree
 - (e) Disagree
17. Who do you or your family use a smartphone?
- (a) Myself
 - (b) Myself and other family members
 - (c) Other family members
 - (d) No one uses it
18. What kind of phones do other farmers in your area or his family members usually use?
- (a) Analog
 - (b) Smartphone
 - (c) No one uses it
19. How much do you know about the sale and purchase of products through e-commerce or mobile phones?
- (a) Well aware
 - (b) Somewhat aware
 - (c) Neutral
 - (d) unaware
 - (e) Not aware at all
20. Using e-commerce or mobile phones to sell products directly to buyers will have a positive impact on farmers – How accurate is the phrase for you?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
21. "In the case of buying and selling of agricultural products by e-commerce or mobile phones, negotiation will ensure proper profit for the farmers" – to what extent do you agree with the saying?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
22. "Agricultural products through e-commerce or mobile phones will ensure fair returns for farmers. "–to what extent do you agree with the saying?

- (a) Strongly agree
- (b) Agree
- (c) Neutral
- (d) Strongly disagree
- (e) Disagree

23. Express your overall opinion on the purchase and sale of agricultural products using e-commerce platforms or mobile phones dedicated to farmers: _____

Survey Questionnaire For General People

Form Id:

1. Your name (optional) _____
2. Your age
 - (a) 11-20
 - (b) 21-30
 - (c) 31-40
 - (d) 41-50
 - (e) 51-60
 - (f) 61-70
 - (g) Above 70
3. Your gender
 - (a) Female
 - (b) Male
 - (c) Other
 - (d) Don't want to disclose
4. Your email address (if any) _____
5. Your occupation
 - (a) Student
 - (b) Businessman
 - (c) Doctor/Nurse/Pharmacist/Health Professor
 - (d) Teacher
 - (e) Engineer
 - (f) IT Professional
 - (g) Defense
 - (h) Government Officer

- (i) Private Officer/ Employee
 - (j) Private Employee (Not Officer)
 - (k) Unemployed
 - (l) Retired
 - (m) Housewife
 - (n) Other _____
6. What technological devices do you use?
- (a) Feature phone
 - (b) Smartphone
 - (c) Laptop/Desktop/Tab
 - (d) None
 - (e) Other _____
7. How much time do you spend on your device on average?
- (a) Not Applicable
 - (b) 1-3 Hours
 - (c) 4-6 Hours
 - (d) Above 6 Hours
8. Your contact number/ mobile number (optional) _____
9. Do you have access to Internet?
- (a) Yes
 - (b) No
10. How much time do you spend using Internet on average?
- (a) Not Applicable
 - (b) 1-3 Hours
 - (c) 4-6 Hours
 - (d) Above 6 Hours
11. "Farmers of Bangladesh do not have sufficient earning"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree

12. "Farmers can earn more if they can sell their crops directly to the customers via e-commerce" - How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
13. "Customers will show interest on buying agricultural products directly from the farmers via e-commerce/mobiles phones" - How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
14. "Ordinary customers would love to buy directly from the farmers to uplift them financially" - How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
15. "A decade ago, many of our farmers did not use mobile phones but now most of them use Feature/Smart Phones" - How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
16. "In the upcoming years, the farmers/their children will use Smartphones/Internet" - How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree

17. "Farmers will be able to conduct direct business through internet, used by themselves or through their children or any intermediary people"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
18. "Direct trade between farmers and customer will bring a positive change to our existing system"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
19. "Bargaining/Negotiation in the e-commerce platform would highly benefit the consumers"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
20. "Bargaining/Negotiation in the e-commerce platform would highly benefit the farmers"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
21. "Negotiation would bring more enthusiasm to this platform and attract new users"- How far do you agree on this?
- (a) Strongly agree
 - (b) Agree
 - (c) Neutral
 - (d) Strongly disagree
 - (e) Disagree
22. Any additional thought or suggestions regarding this online trade of agricultural products will be highly appreciated _____