The Use of a Mobile-Based Decision Support System in Agriculture: An Interpretive Case Study in Southwest and Central Bangladesh

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Abstract

The purpose of this research is to investigate the factors influencing the adoption of a new mobile-based decision support system among farmers in rural Bangladesh. A Decision Support System (DSS) is an area of the Information System (IS) discipline that focuses “on supporting and improving managerial decision-making” (Arnott and Pervan 658). This study is an interpretive case study exploring the adoption of a mobile-based DSS for accessing agricultural information in a rural context. Research questions are: 1) How do the end-users (farmers and extension officers) define the system to be useful in their work? 2) Is it easy for farmers to use the mobile application for farming? Conversely, are the applications creating complexity in their normal duties? 3) What are the factors playing an important role in using the decision support system? 4) How essential are the facilities provided by the agency in using the decision support system. Alongside the analysis of recent documents, the data collection process includes interviews and focus group discussions with farmers and extension workers, and participant observation. The outcome of this research will be a qualitative assessment of a decision support system in the context of rural Bangladesh. This study can help to determine the future variables that can help future researchers to consider for quantitative study. Also, the case study helps to draw a richer picture of the use of a mobile-based DSS in a rural environment.
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Acronyms

DSS – Decision Support System
SAAO - Sub-Assistant Agriculture Officer
AICC – Agriculture Information and Communication Center
UAO – Upazilla (Sub-District) Agriculture Officer
AIS – Agriculture Information Services
Chapter 1

Introduction

There are about 15 million farm households in Bangladesh (Bangladesh Bureau of Statistics, 2009). This population contributes approximately 17 percent to the national economy (World Bank, 2015). However, the rapid population growth along with limited land-base is leading to the shrinking of farm land. This shrinking of farmland is causing the reduction of the agricultural contribution to overall GDP (World Bank, 2015). Farmers of Bangladesh traditionally received greater support through extension services from various sectors, particularly from the public sector (Agricultural Services Innovation and Reform Project, 2003).

The recent government initiation of an Access to Information (A2I) program takes a large step to implement e-Agriculture. E-Agriculture is a globally emerging field of Information, Communication and Technology (ICT). Governments and other sectors use it to overcome key hindrances to the growth of the agriculture industry. These hindrances include the mismanagement of agriculture inputs such as seeds and fertilizer management, inaccessibility to rural finance, ineffective and inadequate extension services, lack of awareness about agro-processing, and insufficient preparedness for natural calamities (A2I Programme, Prime
Minister's Office, Government of Bangladesh, 2008). As a part of this initiative, mPower Social Enterprises Ltd is implementing a Decision Support System in the Khulna and Barisal districts of Bangladesh.

A Decision Support System (DSS) is a computer technology solution that can be used to support decision-making and to solve problems (Shim, et al., 2002). DSS falls within the area of the Information Systems (IS) discipline “that is focused on supporting and improving managerial decision-making and also making better choices” (Arnott & Pervan, 2008, p. 657). Essentially, DSS is about developing and deploying IT-based systems to support decision processes (Arnott & Pervan, 2008).

Decision making in agriculture includes selecting better farming options to improve crop productivity. According to research by A.J. Churi and colleagues (2013), timely distribution of seasonal information is crucial for improved crop yield. A Decision Support System can allow agricultural experts to participate in sharing climate information and proper agricultural knowledge with farmers (Churi et al., 2013). Also, farmers can immediately get expert opinions about fertilizers and crop disease remedies.

Decision Support Systems can help to reduce financial uncertainty in developing countries like Bangladesh. Because of climate change and frequent natural disasters like cyclones and floods, farmers of this region suffer from lost productivity every year. The use of
DSS in agriculture may set higher productivity and help farmers to get relevant knowledge easier and faster.

However, it is important to consider user participation in the process of system design. An interpretive case study of participants’ views would help in understanding the key social factors of Decision Support System. It can illuminate areas of contemporary practice in ways that any other methods examining DSS research cannot (Arnott & Pervan, 2008). This case study will help to reflect users’ opinions on the system design. Dale et al. (2009) argued that users should be able to influence the process, and this would help to develop sophisticated systems beneficial to them. The degree of user influence in the design process is an important component, as little or no influence from users can lead to a poor system (Lynch & Gregor, 2004).

As this study aims primarily to investigate the factors influencing the adoption of the new mobile-based decision support system in Bangladesh, it helps to create an opportunity to implement users’ suggestions and opinions in system design. The qualitative approach to this study ensures in-depth participation in recording user’s experiences with the system. The underlying purpose of doing so is to allow a better understanding of how to provide essential services to the farmers’ community.

This research examines the following issues:

• Exploring earlier theories and models on technology adoption,
• Selecting a conceptual research model for learning about farmers’ behaviors,
• Investigating factors relevant to rural Bangladesh, and
• Observing findings and hence identifying the factors with associated variables that are relevant to rural people in developing regions.

This study recognizes the farmers’ and extension agents’ adaptability and acceptance of mobile-based decision support that can be a valuable resource for further IS and DSS researchers.

Community Organization and Research Site

The case study was conducted with the help of mPower Social Enterprises Ltd., which is implementing an Agricultural Extension Support Activity (AESA) in the Khulna and Barisal districts of Bangladesh. mPower Social also developed seven mobile applications, which are working as mobile-based support systems where farmers and agriculture extension agents can inquire about the solutions of their farming problems and ensure proper management. The reason for choosing this site for research is that it is in the initial phase of the early development process, and it will be benefit from learning about user opinions for future system development.

The overall project, which is called the “USAID Agricultural Extension Support Activity” project, is working in 20 districts in the central and southwest areas of Bangladesh (Barisal, Dhaka, and Khulna divisions). The project is working on capacity-building and supporting the creation of a farmer demand-driven agricultural extension system, synergized by
the use of information communication technology (ICT) (DAM, 2014). mPower Social Enterprises Ltd., in consortium with CARE Bangladesh and Dhaka Ahsania Mission, is implementing this project (DAM, 2014). mPower Social Enterprises Ltd. provides technical guidance in making a support system for farmers as well as providing training to the users.

Map: The Project Area (Green Box)
For learning about the project I have visited the following project locations:

<table>
<thead>
<tr>
<th>Sl.#</th>
<th>Region &amp; District</th>
<th>Sub-District</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Faridpur</td>
<td>Faridpur Sadar</td>
<td>Focus Group</td>
</tr>
<tr>
<td>02</td>
<td>Jessore</td>
<td>Chowgacha Upazila, Jessore Sadar, Keshabpur,</td>
<td>Training Observation, User’s Interview, Focus Group, User’s Interview</td>
</tr>
<tr>
<td>03</td>
<td>Shatkhira</td>
<td>Varashimla</td>
<td>User’s Interview, Observation</td>
</tr>
<tr>
<td>04</td>
<td>Norail</td>
<td>Norail Sadar, Kalia</td>
<td>Training Observation</td>
</tr>
</tbody>
</table>

The support system developed by mPower consists of seven mobile applications. These applications support farmers and extension agents with crop disease prevention, fertilizer/pesticide recommendations, and crop/plant selection. Extension agents also receive services for gathering and managing data from farmers on a regular basis. This project is in its initial phase and has a limited number of existing users (n=92) for one year at the time of this study.

Appendix A provides the approval letter from mPower Social Enterprises Ltd. to conduct this study.
Chapter 2

Literature Review

The following section discusses the existing research literature and methods of learning about the technology acceptance model approach for examining the behavior of technology users.

A. DSS in Agriculture

Smallholder farmers can transform into medium-scale agricultural production operations by availing themselves of a Decision Support System (Churi et al., 2013). According to Churi et al. (2013), existing communication methods, such as radio, television, extension agents, and face-to-face communication, are “not effective for farmers to access timely, understandable, and actionable agricultural information and technology” (p 236).

Decision Support Systems (DSS) have been seen as the resourceful use of numerous kinds of technology: spreadsheets, databases, hypermedia, expert systems, visual programming, intelligent agents, etc. (Beynon, Rasmequan, & Russ, 2002).

Classic DSS tool design is comprised of several components: (i) sophisticated database management capabilities with access to internal and external data, information, and knowledge; (ii) powerful modeling functions accessed by a model management system; and (iii) powerful, yet simple user interface designs that enable interactive queries, reporting, and graphing functions (Shim, et al., 2002).
In agriculture, spreading climate information and sharing agricultural knowledge can be enhanced by the application of Information and Communication Technologies (ICT). Churi et al. (2013) recommended that “efforts to improve adaptation capacity of the smallholder farmers should target extended use of ICTs, such as mobile phones for improved access to climate information and advisories” (p 246). However, the use of the web and mobile technologies to support interactive communication in agriculture has been inadequately explored (Churi et al., 2013).

B. Technology Acceptance Theory:

Technology adoption is the decision of a group or individual to make use of an innovation. Beal and Bohlen (1956) stated that people accept new ideas through a series of complex mental processes in which adoption is the final action. Rogers (1996) showed that technology diffusion from a global perspective can be tied to a classical normal distribution curve that can be explained by the demographic and psychographic characteristics of the adopters.
The rest of this literature review discusses some of the dominant technology acceptance theories that have been used for understanding farmers’ behaviors in order to identify an appropriate model for this research.

i. The Theory of Reasoned Action (TRA) and Theory of Planned Behavior (TPB)

Fishbein and Azjen’s Theory of Reasoned Action (TRA) is drawn from social psychology (Venkatesh et al. 2003). There are two core constructs in this model: attitude toward a behavior and subjective norm. These two lead to behavior intention (to perform the behavior), thus leading to actual behavior or action.

An attitude toward a behavior is “an individual’s positive or negative feelings about performing the target behavior” (Fishbein & Azjen, 1975, p. 216). A subjective norm is “the person’s perception that most people who are important to him think he should or should not perform the behavior in question” (Fishbein & Azjen, 1975, p. 302)
Figure 2. Theory of Reasoned Action

Source: (Fishbein and Azjen, 1975)

Ajzen’s (1991) Theory of Planned Behavior (TPB) is the extended model of TRA, adding perceived behavioral control as a third core construct (Venkatesh et al., 2003). Perceived behavioral control is “the perceived ease of difficulties of performing the behavior” (Ajzen, 1991, p. 188).

Figure 3. Theory of Planned Behavior

Source: (Ajzen, 1991)
ii. Technology Acceptance Model (TAM)

Davis’ (1989) TAM is designed to predict information technology acceptance and usage on the job (Venkatesh et al., 2003). The two core constructs of TAM are perceived usefulness and perceived ease of use. This model was later extended as TAM2 by Venkatesh and David, and included social norms adapted from TRA/TPB as another key construct in the model (Venkatesh et al., 2003).

Perceived usefulness is “the degree to which a person believes that using a particular system would enhance his or her job performance” (Venkatesh et al., 2003, p. 428; Davis F. D., 1989, p. 320). Perceived ease of use is “the degree to which a person believes that using a particular system would be free of effort” (Davis F. D., 1989, p. 320). Perceived Social Norms is adapted from TRA/TPB.

**Figure 4. Technology Acceptance Model**

![Technology Acceptance Model Diagram](adapted from Venkatesh at al., 2003)
iii. Unified Theory of Acceptance and Use of Technology (UTAUT):

UTAUT is a widely used model in information technology (IT) acceptance research, by Venkatesh et al. (Venkatesh et al., 2003). It includes both TRA/TPB and TAM models along with six other models from IS literature. The model has three direct determinants of intention to use: performance expectancy, effort expectancy, and social influence, as well as two direct determinants of use behavior which are intention and facilitating conditions (Islam & Gronlund, 2011). Intention and facilitating conditions are mediated by experience, voluntariness of use, gender, and age.

Performance expectancy “is defined as the degree to which an individual believes that using the system will help him or her to attain gains in their performance” (Venkatesh et al., 2003, p. 447). Effort expectancy “is defined as the degree of ease associated with the use of the system” (Venkatesh et al., 2003 p. 450). Social Influence “is defined as the degree to which an individual perceives that important others believe he or she should use the new system” (Venkatesh et al., 2003. p. 451). Facilitating conditions refer to “the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system” (Venkatesh et al., 2003, p. 453).
iv. Rural Technology Acceptance Model:

Islam and Gronlund (2011) developed a conceptual research model named Rural Technology Acceptance Model “to investigate the factors influencing the adoption of mobile technology among the farmers in Bangladesh” (p. 4). This model draws upon major and commonly used factors to determine the usage behavior of rural farmers in Bangladesh. TAM strongly influences this model (Islam & Gronlund, 2011).

Source: (Venkatesh, et al., 2003)
This model distinguishes external and individual factors of perceived usefulness and perceived ease of use. It also introduces two new external factors: tech service promotion and tech-service attributes. Tech service promotion “is the process of creating awareness of individual’s extent of alertness and ability to draw the inference in a certain time and space towards an object or situation” (Islam & Gronlund, 2011, p. 6). Tech-service attributes “refer to the properties or characteristics of a certain technology, system, or service that distinguish it from other technologies, systems or services” (Islam & Gronlund, 2011, p. 6).

Figure 6: RuTAM Model

Source: (Islam and Gronlund, 2011)
From the reviews above of different technology acceptance models, it seems that RuTAM best suits the goals and context of this study because it discusses the technology acceptance factors of farmers in the rural Bangladeshi context. This conceptual research model includes useful factors of acceptance models that relate to rural communities in Bangladesh.

Research Questions

This study posits the following research questions:

1. How do the end-users (farmers and extension officers) define the decision support system to be useful in their work?
2. Is it easy for farmers to use the mobile applications for farming? Conversely, are the applications creating complexity in their normal duties?
3. What factors play an important role in using the decision support system?
4. How essential are the facilities provided by the agency in using the decision support system?

The first question will help illuminate farmers’ experiences with the system, shedding light on its perceived usefulness and its relationship to the creation of the behavioral intention to use the system. The second question will help to understand the perceived ease of use of the system. The third question will help to learn about the factors that can play a role in the adoption of the decision support system. The fourth question will help determine the important conditions facilitating behavioral intention. This research study will help to collect user’s opinions of the system which can help community organization in future design and evaluations of the system.
Research Methodology

This interpretive case study aims to investigate the factors influencing the adoption of a decision support system among farmers in southwest and central Bangladesh. This study helps to achieve a broader purpose of offering a better understanding of how to provide useful information to a farmers’ community in developing regions. The case study approach is particularly relevant to this study as the approach is “aimed at producing an understanding of the context of the information system, and the process where the information system influences and is influenced by the context” (Islam & Gronlund, 2011, p 8). This project investigates the situation using qualitative methods, including interviews and focus groups in order to collect data about the farmers’ thoughts. Participant observation also helped to achieve comprehensive insights about the social settings of the farmers in Bangladesh. Data was collected using observations with the relevant actors in both natural and formal settings.

i. Interviews:

The interview gives us access to the opinions of other people. The information provided by the different respondents in the interviews can tell us their collective attitudes, observations and appraisals. In this study, interviews helped in developing a holistic description by putting together interrelated behaviors to learn about the system (Robert, 1995).

In this study, I interviewed 41 users of the mobile applications. Of these half-hour-long interviews, 25 were conducted over the phone and the remainder were done in person. Seven
were conducted with farmers and 34 interviews are with extension workers. Interviews were conducted following a semi-structured approach. The respondents and I engaged in a formal interview with an interview guide that included questions aimed at learning about a user’s attitudes towards the mobile applications. This approach was chosen because it is one of the best-used methods for situations in which the author gets one chance to interview respondents, and allows interviewees to go astray in the conversation when appropriate (Cohen and Crabtree). In addition, I interviewed five of mPower’s project employees to understand the project goals, interventions, initiatives, key hindrances, and initial outcomes.

The interview guide was reviewed and approved in the expedited review process for Human Subjects research through the Florida State University IRB. FWA00000168/IRB number IRB00000446. [Appendix B]

Interview transcripts were analyzed following the six generic steps for qualitative data analysis as outlined by Creswell (2003): (1) organizing and preparing the data, (2) reading through the data carefully to gain an understanding, (3) coding the data, (4) categorizing the data (providing a description of people, places, and events), (5) representing the data through a narrative discussion, and (6) providing an interpretation that assigns meaning to the data (Creswell, 2003).
ii. Focus Group Discussions:

Focus group discussions were conducted with the farmers and private extension agents in the project region. The author conducted two focus groups with farmers of Ishapur, Jessore and Varashimla, Shatkhira. One focus group discussion was done with public extension agents in Faridpur. A discussion checklist consisted of system usefulness, system satisfaction and dissatisfaction, system availability, and system usability. Discussions lasted about half an hour. The discussions were recorded on digital audio tape with the permission of the participants. The first group with farmers included eight participants and the second had ten participants. The extension agents’ group had five participants.

iii. Participant Observation:

Participant observation is a fundamental approach to gaining insight into behaviors (Wasson, 2000). The author’s notes based on participant observations were collected during the visits to the project field. The visits to each of the places were for one day and I participated as a team member of the community organization and helped the other employees of mPower with their tasks. However, I do not participate actively in the training sessions.

Participant observations were organized by the author into three distinct themes by the author that help to understand three distinct sets of users of the Decision Support System in the case.
study. They are 1) ICT Farmer Leaders and Input sellers, 2) AICC Agent (Private Extension Agents), and 3) SAAO Agents (Public Extension Agents).

After collecting data from interviews and participant observations, the author coded data into themes and subthemes for data analysis. The interviews were converted into transcripts. To learn how the quotes are relevant to the study, the author looked for:

- Repeated quotes from different users
- Explicit statements related to the study
- Statements related to previous literature reviews and theories
- Statements related to observations of the researchers
- Other reasons
Chapter 3

Case Study: Analysis and Discussions

This section discusses the following: 1) the DSS developed by the mPower Social Enterprises Ltd., 2) the users of the applications, and 3) the relationship between the users and other community farmers. It also examines the author’s experience of visiting the project sites, and observing the training sessions of new users. Lastly, it discusses the findings as they address the research questions.

A. Understanding Mobile Applications

There are seven applications that have been developed by mPower Social Enterprises Ltd. These can be categorized into three services: (1) Agro Advisory Services (Farmers Query System), (2) Farm Decision Making Application (Crop Diagnostic and Seed Variety Recommendation), and (3) E-Administrative Application (Field Challenge Capturing, SAAO Reporting/Scheduling, SAAO Area Information, and Crop Statistics). The combination of these applications creates a decision support system for wise managerial decision making, and for making better agro-decisions at the root level.
A brief description of each application is given below:

1. Farmer Query System

   The users of the Farmers Query System are input sellers, ICT farmers leaders, government extension agents, private extension agents, and field facilitators. The Farmer Query System provides real-time solutions for the farmers within 12 hours after a question has been submitted to the query system. An agro-expert in the Dhaka office looks through the queries and provides the possible solutions. mPower created a dashboard for experts to look at the questions and the geographical location of the senders. He/she responds through a phone call, SMS, or voice message to the users.

2. Crop Diagnostics

   The users of Click Diagnostics are input sellers, ICT farmer leaders, government extension agents, and private extension agents. This application is a mobile-based tool that provides information about curative measures for pest and disease related problems. This application automatically provides information about diagnosis and suggests corresponding curative/preventive measures.

3. Seed Variety Recommendations

   Currently, this application is used by public extension agents. This application provides helpful suggestions about seed varieties and fertilizers to farmers based on their lands. Though it can be used by ICT farmer leaders and input sellers, it is now only being used by the public
extension agents. Sometimes it is hard for the farmers to determine if the given solution can work in their field. Public extension agents can distinguish whether the given solution is good for the farmers’ field or not through the analysis of the field and other sources they receive in local government agriculture offices.

4. Field Challenge Capturing Application

The Field Challenge Capturing Application is designed for the public extension agents to collect their daily field data in digital format. This application helps to collect, preserve and visualize field data. Later, this field data is analyzed by policy makers. The application assists the public extension agents in logging their day-to-day solutions provided to the farmers. Further, the application assists researchers in tracking the efficiency of the solutions, and the severity of problems faced in the field.

5. SAAO Reporting/Scheduling

SAAO Reporting/Scheduling is also designed for the public extension agents (Sub-Assistant Agriculture Officers-SAAO). SAAO reporting/scheduling is a mobile-based tool for agriculture field extension agents to capture information about their work area. The objective of this application is to retain the knowledge of the catchment area and pass on the information to a new SAAO if there is change/transfer. SAAO make 15-day schedules with their mobile devices and send this to their superior UAO (Upazilla Agriculture Officer).

6. SAAO Area Information
SAAO Area Information is an internal application for the public extension agents. This application collects and creates a directory of farmers, input sellers, and seed and fertilizer shops in the community. The application users can later go to the directory and find information about the local farmers and shops that they want to refer to the information consumer (farmers).

7. Crop Statistics

Crop Statistics is specially designed to enable public extension agents to capture crop cultivation statistics for their working region in a digital format.

B. Understanding the users of the applications

1. ICT Farmer Leaders and Input Sellers

ICT Farmer leaders who have experience in using ICT tools are chosen by mPower. ICT leaders are well aware of technologies, and they are the leaders among the community. They are farmers and educated. They live in the village. They are available all the time for providing solutions. ICT Leaders help the other farmers to implement the solution they received via mobile technology. Any farmers in the community can take advantage of having an ICT farmer leader near them and can ask for their expert opinion. ICT Leaders share knowledge with other community farmers. Farmers do not hesitate to go to an ICT leader. Input sellers are also a great information source for farmers to whom they go to buy fertilizers, pesticides, seeds, and other agriculture goods.
Extension agents are not always available. There are a limited number of government extension officers who are employed to serve the farmers with farming advice. On the other hand, the ICT leaders and input sellers can serve the best interests of the farmers by providing the necessary and required information. Farmers can get the solutions for their problems from the person next to them. However, the main concern for getting information from a fellow farmer arises if farmers do not trust using the solutions provided to them. An information gap could arise if some community members are not comfortable going to fellow ICT leaders or input sellers.

2) Private Extension Agents (AICC Agent)

The Agriculture Information and Communication Center (AICC) is an initiative of Agriculture Information Services (AIS) of the Bangladesh Agriculture Ministry. Currently, there are 95 AICCs across the country of which 10 are situated in the project area. Centers are situated near the community, and farmers can become a member of a center. However, any farmer in the community can access the facilities. AICCs are self-sustaining, and they are a combination of a single room with ICT tools (computer, printer, multimedia projector, digital camera, webcam, etc.) and a meeting room for farmers. AICCs are the places where farmers can get access to the computers and Internet. The AICC Agents I visited for the study know how to use computers and the internet, and they have previous experiences with smart phones. Farmers come to the center to get help from an AICC agent. Sometimes they call to the agent to get solutions. The AICC
holds member-based meetings that help farmers to receive up-to-date information about the new technologies.

3) Public Extension Agents (Sub-Assistant Agriculture Officer)

The Sub-Assistant Agriculture Officer (SAAO) at least holds an Agriculture Diploma Degree. An SAAO is recruited through a comprehensive evaluation. SAAOs work as interns for about six months with their line supervisor, Upazilla Agriculture Officer (UAO). SAAOs are the paid government employees who are officially in charge of a block (a relatively smaller region than a sub-district). An SAAO works to increase crop production as well as to help farmers in different circumstances. Along with communicating with farmers, he or she also does official work such as reporting to their supervisors about their daily work. Farmers trust SAAOs’ advice because they are the voice of the government. For farmers, SAAOs are a trustworthy source for information. Farmers rely on them for accurate information.

C. Relationship between the Users and the Community Farmers

The USAID AESA project is in the initial stage. The applications have a limited user population (n=92). Everyone in the community cannot access the applications from smart phones devices because the applications are not openly accessible. Open accessibility for the users will be determined after this initial phase. During the time of data gathering, mPower was providing training to the new users of the applications. So, it is important at this point to learn
how the information disseminates from the users to the other community farmers, and the channels through which information is reaching the general farmers.

1. **ICT Farmer Leaders/ Input sellers to General Farmers:**

ICT farmer leaders are easily accessible by the other community farmers. ICT farmer leaders are from their community, so there is a friendly atmosphere between ICT farmer leaders and farmers. They live in the community, and farmers feel it is easy to go the ICT farmer leaders for a solution. There is no fear of going to them and asking questions about their problems. Input sellers are also members of their community. Farmers have regular interactions with input sellers to buy agriculture accessories. Most of the time farmers buy their agro-supplies from them, so they feel comfortable to talk with them about a problem.

2. **Private Extension Agents to General Farmers**

Agriculture Information and Communication Center (AICC) agents have modern ICT tools in their centers. For this reason, they are already knowledgeable about using the applications. They face less difficulty is using mPower’s applications. They need less time to get accustomed to the applications. The AICC centers are organized, and they can help the farmers to get faster service. The AICCs are situated close to the community. For example, the AICC in Varashimla, Shatkhira is located inside the village, and farmers of the village can come to the AICCs easily. AICC agents also have computers and Internet connections in their centers and use these connections if there is any problem with the cellular network.
The weakness of AICC agents in sustainable information dissemination is that the AICC centers are membership-based.

3. Public Extension Agent to General Farmers

SAAOs act as trustworthy persons among the farmers who provide farming suggestions. They are considered to be the voice of the government. This makes the government agents reliable as good information resources. SAAOs are well educated and experienced. Public Extension Agents have a good knowledge of how management works. However, one SAAO serves a large number of farmer households in one block. It is hard for them to give proper and quick service to every farmer in the community. Agents often get transferred into different blocks in one region. They are not available for farmers all the time due to other administrative tasks. Also, a few agents who have worked for a long time are afraid of change in their workforce. They are concerned about the changes that may require them learn a new method for doing their regular tasks.

D. Field Visits

The next sections in this chapter provide more detail about specific centers in order to help the reader understand the context in which these applications are being introduced and in which the interview and focus group research was undertaken.
1. Visit to AICC centers in Varashimla, Shatkhira

To learn about the Agriculture Information and Communication Centers, I visited one AICC center in Varashimla, Shatkhira. The AICC agent of this facility uses the Farmer’s Query System. He received his training from mPower and started using the Farmer’s Query System about a year ago. He did not face any difficulties in using the application because of his long experience with technologies. He knows how to use computer, internet, printers and to take photos using web camera. He is a self-taught computer literate, and he likes the mobile application because it is easy to use and portable. Because of the mobile phone, he can go to the field and take a photo of the problem and send it instantly. This helped him to interact with the farmers more efficiently than before. Before the application, he used to call SAAO in the region for suggestions. Sometimes it takes time to get solutions for the problem. He can now advise farmers by using the Farmers Query System.

“Before this application (the Farmer’s Query System), we used to seek out the SAAO agents for their suggestions. This year, we haven’t disturbed the public agents, not once in this year. When we totally failed to get the solution, we go to them. Otherwise, we find the answers in this application.”
### Visit to the AICC Center

<table>
<thead>
<tr>
<th>The AICC center in Shatkhira is located near Varashimla Village. The AICC agent who is in charge of this facility says that almost all farmers in the village are members of this center. According to the SAAO agent of this block, there are roughly 3,000-4,000 farmers in the village and 500 are female farmers who cultivate various vegetables in Varashimla village.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The center consists of one room with nine benches for sitting, and about 25-30 people can sit together.</td>
</tr>
<tr>
<td>There are several posters hanging in the walls that provide different information about agriculture, and, sometimes, social responsibilities. For example, one poster</td>
</tr>
</tbody>
</table>
is about “Women in agriculture” to encourage women to come forward for agriculture production. The poster is designed by Agriculture Information Services (AIS).

Besides giving agro-information, the center also provides assistance with other tasks. The center is called “AICC Computer and Digital Studio” which provides other benefits like taking photographs, photo printing, photocopy, scanning documents, FlexiLoads (prepaid mobile billing), and using the Internet.

The AICC agent of the facility says, “Before we built this center, we only cultivated one kind of paddy which is called “Amon.” When we formed this center, different government and non-government agencies come to us with various
suggestions. Agencies understand that if they provide us with different seeds, farmers can make good production levels. Then we were provided with wheat seeds....Now our land does not stay empty. We cultivate paddy, then wheat, mug beans, sunflower, corn. Before when we cultivated one type of paddy, farmers had hunger and poverty. Now we cultivate 12 months a year.”

Farmers of the community also said in the Focus Group Discussion that they get a variety of seeds from AICC centers and it gives them the opportunity to learn about the crops they should grow in different seasons. The picture in the right cell displays the varieties of seeds.

The AICC agent of Varashimla at first did not know how to use a computer. He is a self-taught computer literate and now he is helping farmers with their technology needs.
2. Visit To A Project Village at Ishapur, Jessore

Ishapur, Jessore is one of the villages where mPower selected an ICT farmer leader to provide support in the farmers’ community. The ICT leaders were given smartphones and trained to use them. The Ishapur ICT farmer leader completed his bachelor’s degree in management and decided to start jute farming on his ancestors’ land. He is a 27 year-old jute farmer and he has been using the Farmer’s Query System for one year. He has been working as a jute farmer for three years now. He is the leader of Ishapur Jute Cultivators group, and he helps the other jute cultivators in the village. According to him, one of the greatest benefits of using this application is that it not only gives solutions for the initial problem but also gives valuable tips about future problems that can happen in the field. He said that he also uses the mobile Internet for getting agriculture information, such as how to do irrigation, which variety of jute will produce well in his area.

<table>
<thead>
<tr>
<th>Ishapur Village, Jessore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ishapur village is just like many other villages in Bangladesh. It has been selected as one of the pilot regions for the AESA project. Also, they received help from different government and</td>
</tr>
</tbody>
</table>
non-government organizations to promote socio-economic changes.

For example, there is a project alongside the support system that gives instructions to the farmers about eco-friendly jute production.

<table>
<thead>
<tr>
<th>Photo: The signboard titled “Jute Production Tactics-Exhibition Plot” sponsors: USAID, mPower, Care-Bangladesh, Dhaka Ahsania Mision, Laal Tir Seed Ltd”</th>
</tr>
</thead>
</table>

The main strength of the ICT farmer leader role is that it builds a farmer-to-farmer relationship. The ICT farmer leader is well known to the farmers as he is one of the leaders in the community. Farmers are not afraid to

| Photo: A meeting with Agriculture Officer in the region. |
talk with him. He lives in the village.

As Bangladesh is a collectivistic society, villagers have close relations with each other. If one person knows about something, he or she exchanges the messages to the other community people.

ICT farmers leaders tell me that, “Earlier I thought that, if I can get rid of one plant disease, it may not get affected by another. Now I understand that it is not true. After getting this application, experts tell us what kind of problem may occur in the future in my field after using the solutions. This suggestion helps me a lot.”

[Appendix C: Interview Question guide for Farmers. Q. No 8]
3. Visit to Input Seller in Gorvanga Bazaar, Keshobpur

Gorvanga Bazaar, Keshobpur is a village market in Jessore. The main reason for visiting this site is to meet a 46-year-old input seller who has been using the Farmers’ Query System for about a year. He has owned a shop in village market for about 15 years. He sells fertilizers, pesticides, seeds, and other agriculture goods to farmers. Farmers come to him for suggestions about problems in the field. He makes suggestions to them about what is needed in the field based upon his limited knowledge. He has been giving suggestions to the farmers with the help of Farmer’s Query System, and he is happy with it.

“Farmers can now get fruitful advice from me. They do not have to go far. They do not have to search for local agriculture officers. If they want to go to officers it would take more than a day, and they can come to me day or night. It is easy for the farmers.”

He now goes to a farmer’s field and sends the description of the problem with a photo of the field. Then he receives the call from the expert with a proper solution to the problem. This process makes the farmers buy his product without any doubt, and he can give the suggested product with less risk of losing customers. He also uses this application for his personal farming problems.
Gorvanga Bazaar, Keshobpur

Gorvanga Bazaar is like any other village in a rural atmosphere. It has semi-paved roads and there are different stores side-by-side. The day I visited the store was rainy. The market was empty. There were no buyers on that day. It was a lazy day for the input seller. All the roads became muddy and slippery.

He said that the farmers of his community were concerned about saving the seedbeds from these two days of constant raining. Eventually, he sent his query to the agro-experts via the Farmer’s Query System. On the interview day, he received the call with a response, and the agro-expert suggested that farmers should cover the seedbeds with polyethylene bags and make dams surrounding the seedbeds with mud. The
agro-expert also said not to worry as it would not be a problem if the rain continued for 2-3 days. This rapid suggestion may not be possible without this support system.

He mentioned how this application helped his potato cultivation growth. In December 2014, he noticed a problem of folding leaves that hindered the plant growth. He instantly took a picture of it and sent the description of the problem via the Farmer’s Query System. Within 12 hours, he received a call, and experts suggested 1 ml. Imidacloprid17.8% with government approved hormones for growth increase. He used the solution and earned 18,000 Bangladeshi Taka more than what he expected. He earned 50 percent more profit than expected. This experience gave him the confidence to advise other farmers with the Farmer’s Query System.

[Appendix C: Interview Question Guide Q.
4. Training Sessions

Training sessions conducted by mPower are important events. Many participants in the training sessions are first-time users of smart phones. A very few users had smart phones for their personal use. In these sessions, trainers provided the users with smartphones. They started training lessons showing how to turn on a phone. I visited training sessions in Norail, Faridpur, and Jessore. At the end of the training, trainees made groups with other colleagues and they worked together to solve one specific problem given by the trainer. These training sessions are professional in structure. New users also got a hardcopy of a training manual. The manual shows the step-by-step process for every application, and it provides tips about how to increase smartphones’ durability. However, trainees suggested that this one-day training session is not enough to learn so much information. Trainers of the mPower team also felt the same.

One SAAO agents says that,

“In the training we have learned a lot of unknown things. We have learned how to use this application. I have not used this kind of agriculture based smartphone application before. I learned about different problems we may face in using the smartphone application... If we can get regular training then we can become accustomed to using the system.”
However, it was not possible in that time to do the training session for more than one day due to time and expense constraints. As one mPower employee says,

“We are not getting modern technology as quickly as we need it to implement. We are also giving training to a limited number of farmers. If we can give training to a larger community, the technologies like this (smartphone applications) would have widespread use.”

### Training Sessions

All the training sessions occurred in the hall with U-style seating arrangements. Each training session consisted of 33-34 users, and the trainer covered a lot of learning materials in a very short time. Sometimes this fast-paced training made the trainee become overwhelmed with information.
The training session started with the brief introduction of the project goals and why ICT is important to implement in agriculture. Then it discussed the basics of smart phone use. Finally, it covered each support system’s applications developed by mPower.
One interesting problem new users faced was using touch screens. All the users had feature phones for their personal use, but using smartphones was new to many users. They felt anxious and depressed when they unintentionally touched the screen and it changed their work. Some users pressed hard on the screen because of their habit with feature phones.

Trainers helped the users with individual problems. Also, users who knew how to use smartphones also helped persons who did not know how to use them.
The existing users whom I interviewed told me that it would be more fruitful if they had more than one day of training so that they could practice and ask questions the following day.

Findings

In the study, primary data collected from the sites was categorized according to the research questions in general and insights derived from the conceptual model RuTAM. In the following section, I discuss the factors influencing the use of the mobile-based decision support system and how end users feel about the usefulness of the system.

**A. Research Question One: The usefulness of the application**

The majority of the farmers came to the users with three problems: 1) crop disease prevention and pest control, 2) seed selection, and 3) fertilizer management and
recommendation. The Farmers Query System is the agro advisory service where farmers can submit a query to agro experts and get corresponding feedback. The Crop Diagnostics application and Seed Variety Recommendation are the two applications that can help farmers to make proper decisions. The Crop Diagnostics application is a mobile-based tool that provides information about the curative measures of pest and disease related problems. The Seed Variety Recommendation tool provides helpful suggestions about seed varieties and fertilizers to farmers based on their land. So it seems that users can get solutions for major problems from these applications. Also, SAAOs are provided with some other applications which can help the agents to record their day-to-day activities in a digital version.

The research question asked: How do the end-users (farmers and extension officers) define the system to be useful in their work? The mPower team conducted a survey in August, 2015.

The population of the survey was:

<table>
<thead>
<tr>
<th>Users group</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extension Agents (SAAO and AICC agents)</td>
<td>34</td>
</tr>
<tr>
<td>ICT Farmer Leaders and Input Sellers</td>
<td>7</td>
</tr>
</tbody>
</table>

According to the mPower’s User Satisfaction Report (2015), among the thirty-four respondents, fifty-three percent of the extension agent users thought that the applications were very efficient or efficient in doing their tasks properly. However, six percent of the users said
that the applications were only somewhat efficient. The users who were dissatisfied with
applications said that because of the unavailability of the network and improperly downloaded
software they could not adjust their smart phones to use in their daily work list. For example, one
SAAO agent mentioned about one of the applications,

“When the weather is bad, I have a weak network and I could not use the
application properly. In the Field Challenge Capturing application, we have to make
reports, and it takes a lot of time. When farmers come to me and want to learn about
something I could not give them the proper suggestions about the information they are
seeking. It makes the farmers upset and also sometimes makes me discouraged to use the
application. If I can get rid of these problems I may not be discouraged.” [Appendix C:
Interview Question Guide for Extension Agents Q No. 7]

One the other hand, 86 percent of the ICT farmer leaders and input sellers said that the
applications are efficient to use in obtaining proper information. When I asked one input seller
what he thought about the application (Farmer’s Query System), he said,

“Farmers can now get fruitful advice from me. They do not have to go far. They
do not have to search for government agriculture officers. If they want to go to officers it
would take more than a day, and they can come to me day or night [to buy the products].
It is easy for the farmers.” [Appendix C: Interview Question Guide for Extension Agents
Q No. 7]
When I asked one SAAO agent that why he felt that it is beneficial for him to use the applications, he said,

“The benefit of this application is that before using it, if I have any difficult problem, I could not come to a conclusion. Now, I can talk to the experts using this application... Before this application, I used to go to my superior for the solution. It took a lot of time to get a solution. Now, I can talk with the experts directly and give solutions to the farmers in less time.”

Similarly one AICC agents noted that,

“Before this application (Farmer’s Query System), we used to seek out the SAAO agents for their suggestions. This year, we haven’t disturbed the public agents, not once. When we totally failed to get the solution, we go to them. Otherwise, we find the answers in this application.”

The existing users saw the system as a useful tool to get proper information quickly. However, one main concern the mPower team emphasized is that users will use the information provided by the system, if it is accurate and beneficial.

B. Research Question Two: Perceived ease of use of the applications

The perceived ease of using the application depends on the experience of the users with information technologies. AICC agents who are more inclined to use information technologies on a regular basis found the applications easier to use than did the SAAO agents. SAAO agents are not required to use the computers in their daily work. This creates some complexity for the
SAAO agents. Some SAAO agents to whom I talked in the training session said that they are afraid of the change in their work routines. The SAAO agents who have been working for a long period of time became accustomed to the existing methods of providing services. The use of new technologies in the workforce is changing their long time practices.

In preparing the User Satisfaction report, the mPower team and I conducted a survey to learn about the perceived ease of use of the applications. According to this survey, 89 percent of the users responded that the applications were very easy or easy to use. The two users of Crop Diagnostics mentioned that this application is very easy because it provides pictures that help them to identify the disease easily. They said that the Crop Diagnostics application is easy to use in their jobs because they can get the solution instantly.

However, one input seller in the Magura district said that his lower level of education is one of the reasons that makes the application hard for him. He said,

“This application (Farmers Query System) is hard for me. I am less educated, and if I fell in any technical issues, I become hesitant of what to do next. For example, in the mobile there is an option to write in Bangla, but I always change the settings and could not find it how to fix it. There are cases when someone fixed the problem for me, but then I again changed it. I cannot write in English either.” [Appendix C: Interview Question Guide for Extension Agents Q No. 7]

C. Research Question Three: Factors playing an important role in using the system

RuTAM identifies the individual factors, such as individual characteristics, demographics, and social influence, and external factors, such as facilitating conditions, tech-
service promotion, and tech-service attributes, that play important roles in using new technologies. In the following I will discuss some important influencing factors in subjects’ decision to use the Decision Support System relating these to the categories in the RuTAM model.

a. Individual Factors

I. Individual Characteristics

Willingness to use the technologies is one of the important variables in choosing the new system. For example, one SAAO agent who has been working as public agent for a long time and is retiring soon said that he is not willing to use this application because he has only three months before his retirement. However, it is not the same case for all SAAO agents. SAAO agents in general want to learn to use the system so that they can do their tasks efficiently.

Awareness is also important where individuals know how the application can help them. The input seller in Ishapur, Jessore told me about what he thinks about the solutions provided by the agro-experts,

“Earlier I thought that, if I can get rid of one plant disease, it may not get affected by another. Now I understand that it is not true. Now after getting this application, experts told us, after using the solutions, what kind of problem may occur in the future in the field. This suggestion helps a lot.” [Appendix C: Interview Question Guide for Farmers Q. No. 7]
II. Demographics

1. Age:

The age range of the respondents is from 19-52 years old. The average age of the users who were interviewed is 39 years old. In the training session, it was observed that the young users are faster in learning the application than relatively older people. Sometimes, older agents ask the younger agents to help him with the technologies. One interesting fact I found in the focus group with the extension agents is that agents are dependent on their children to learn about the mobile applications. One agent describing to the group that he goes to his son when he has any problem with the smart phone.

2. Gender

In Bangladesh, women are not directly involved in traditional farming. However, women use their home yards to cultivate vegetables and fruits. One ICT leader mentioned his concern about women coming forward to contribute to agriculture,

“Women cultivate many things in home yards. If they can come forward in an institutional way then they may have a lot benefits. If they can come forward in a group then it would be fruitful. A family’s success depends on women. If we can inspire women for agriculture our next generation will be more agriculture driven. If one mother can give inspiration to her children, then our next generation will think about agriculture without any hesitation, they will feel comfortable in working in the field.”
The AICC Agent in Varashimla mentioned that women farmers always call him when they have any issues in the yard. The most significant strength of mobile phones is that they do not have to depend on their male family members to ask for help. Some women are also members of the AICC. In the training sessions there were a few women SAAO agents.

3. Occupation

The occupation of the current users of the applications can be categorized into four groups: a) public agent (SAAO), b) private agent (AICC agents), c) input sellers, and d) ICT farmer leaders.

The occupation of the users is important in using the system. SAAOs need to use the applications because it is included in their official task. They use it as a government tool, and their job is supervised by the superior authority. AICC agents are technologically sound and their job is related to the use of modern information technologies. They regularly use computers, the Internet, printing, camera operations, and word processing software. Using a mobile-based decision support system is not a new technology for them to use. AICC agents whom I interviewed also have smartphones that they use for personal use. Input sellers and ICT farmer leaders used the service voluntarily and there was no obligation to use it.

III. Social Influence

One important social influence is the peer pressure on the job. One SAAO agent mentioned that,
“The time has changed. I have to use these new applications whether I want it or not. If I do not use it, the relatively young officers will pass me. The new generation already has skills in technology... our generation started to use this technology because we know that we need it... Those who are older than us will hesitate to use new technology at first, but they will get accustomed to it.” [Appendix C: Interview Question Guide for Extension Agents Q. No. 8]

Relatively new SAAO agents are well aware of the new technologies, and the existing SAAO agents are willing to learn to use them because they can give them the help to compete with the young agents.

b. External Factors

i. Tech Service Promotion

In the project, users have no option to choose their own network or devices. The project includes the devices, network, and data plan for the users. The users receive 2G technology on their mobile devices. Also, each user can use a one-gigabyte data plan from the project. There is no charge for the data plan. However, users do not get any talk time on their phones.

The device they are provided is from either Samsung or Symphony. The user’s smartphone specifications and regional prices are given below:
<table>
<thead>
<tr>
<th></th>
<th>Symphony</th>
<th>Samsung</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>W125 and W160</td>
<td>SM-G360H</td>
</tr>
<tr>
<td>Internal Data Storage</td>
<td>2 GB</td>
<td>8 GB</td>
</tr>
<tr>
<td>Price</td>
<td>11,500 BDT (148 USD)</td>
<td>11,000 BDT (142 USD)</td>
</tr>
<tr>
<td>OS</td>
<td>Android OS, v4.1 (Jelly Bean)</td>
<td>Android 4.4.4 KitKat</td>
</tr>
</tbody>
</table>

The users need to sign a legal document when receiving the mobile devices so that they cannot misuse or resell the devices. Also, if public and private agents transfer or move from the project region, they must hand over the devices to the newly assigned agent.

Farmers of the community mainly learn about the service via word of mouth promotions from the users. There is no advertisement or promotional banner for the service. Users do not get any kind of certification for providing this service. One input seller said that he wanted to have a certificate to show his customers, and thus increase his sales in the market.

ii. Tech Service Attributes

The services which make the mPower’s mobile applications distinct from others is that users receive training before using the applications. They can receive technical assistance if they come forward with any problem with the devices. The Farmer’s Query System also gives the
users the ability to take the picture of the problem and send it to the agro-expert. It makes the work easier for the agro-expert in learning about the problem visually.

The users obtain this service free of charge. This free availability may raise the question about whether ICT farmer leaders and input sellers would still use it with a charge. If so, how much are they willing to pay? When I asked this question, respondents replied with the possible options of charging, which are:

<table>
<thead>
<tr>
<th>How much would you like to pay for the services?</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10 tk/solution</td>
</tr>
<tr>
<td>10-15 tk/monthly subscription</td>
</tr>
<tr>
<td>50 paisha/sms, and 1 tk/min call</td>
</tr>
</tbody>
</table>

According to mPower User Satisfaction Report (2015), it is feasible to implement charges as seventy-two percent (72%) of the existing users current budget of 500-1000 BDT for mobile phone usage (Data and Talk time) per month. Fourteen percent (14%) use more than 1000 BDT and 14 percent use less than 500 BDT. Among the expenses, thirty percent (30%) of the mobile expenses have been used for agriculture purposes. Seventy-one percent (71%) of the respondents said that they could pay for the services produced by these mobile applications.
Many new users are accustomed to use feature phones and they are new to the smartphones with touch screens. The touch screens are often assumed to be easy to use. However, one observation from the training session was that new users felt uneasy in using the touch screens. However, when they followed the same instructions for several times it became easy.

D. Research Question Four: Facilitating conditions

According to a Katalyst Agroquest survey, 84 percent of rural farmers are using cell phones in Bangladesh (Katalyst, 2013). This shows the high chance of success in providing assistance with mobile phones. Mobile payment centers and mobile banking agents are growing and this is creating a behavior change in using cell phones. For example, bKash, a part of BRAC social enterprise, was the fastest growing mobile financial services globally during 2013 (Chen & Rasmussen, 2014). It creates the opportunity for rural people to do mobile banking via their cell phones or through bKash agents. Rural people are now seeing cell phones as a useful and convenient way of doing a lot of things besides communicating with each other.

The growth of Internet use can help the users to use the support system that sits on the same platform. One SAAO agent shared his opinion of using the Internet,

“\[\text{I use Facebook (social networking site) with my smartphone, I share my work with my friends and others. I can now also gain access to different research centers, which I could not get access to physically, but the internet helped me to get into it. This information helped me to help farmers by giving them more fruitful information. If I do not know something asked by the farmers, I can collect information regarding the issue through the Internet. It became possible only because of the internet.}\]"
Choosing the users who work directly with the farmers is another important facilitating condition. It can allow the empowerment of the users who are working directly with the farmers. As one SAAO agents said,

“Being a SAAO agent means we are directly working with marginal farmers. In our country farmers face different limitations. They have limitations in modern farming knowledge and financial barriers. We have to work within these barriers. When we give training to the farmers we have to keep these things in mind. Most of the time, we cannot give them up-to-date training...due to the financial limitations of our department. We are not getting modern technology as quickly as we need it to implement. We are also giving training to a limited number of farmers. If we could give training to a larger community, the technologies like this (smartphone applications) would have widespread use.”

Appendix C: Interview Question Guide for Extension Agents Q.No.6]

The training session with the users is another important facilitating condition. It is the first impression of introducing the support system to the users. One SAAO agent mentioned,

“In the training we have learned a lot of unknown things. We have learned how to use this application. I have not used this kind of agriculture based smartphone application before. I learned about different problems we may face in using smartphone applications... If we can get regular training then we can become accustomed to using the system.” [Appendix C: Interview Question Guide for Extension Agents Q.No. 13]

Similarly, one ICT leaders said,
“Before the training I had limited knowledge about smartphones. After this training, I have learned some valuable things, such as how to properly handle smartphones. How long I should charge my phone to keep the battery healthy? How to use chargers? How to use the applications? I have learned a lot of things.”

[Appendix C: Interview Question Guide for Extension Agents Q.No. 13]

Also, the Bangladesh Governments’ Vision 2021 campaign of a digitalized Bangladesh has been received positively among the general population. The recent government initiation of the Access to Information (A2I) program takes big steps to implement e-Agriculture among the rural population. Nationwide network infrastructure, affordable smart phones and data plans, and proper government policies in e-agriculture may lead to an adaptable support system.

E. Behavioral Intension and Use

Perceived ease of use does not directly lead to the intention to use the technologies. However, the application’s perceived usefulness can lead to use of the application.
Flow Chart 1: The above flowchart is showing the factors with associated variables in RUTAM influencing the adoption of the decision system support
Conclusion

This paper has explored earlier theories and models explaining technology acceptance. This study used the conceptual model RuTAM, which helps to address the important factors influencing the adoption of a new mobile-based decision support system in a rural context (see chart above for proposed relationships). Also, this case study helps to draw a richer picture of the introduction and use of a mobile-based DSS in a rural environment.

According to the RuTAM model, external and individual factors are directly related to users’ perceptions about usefulness and perceived ease of use of the applications. It is beyond this research scope to prove each of these relationships (as it is uses a qualitative approach). However, this study can help to identify relationships and variables that researchers could consider for future quantitative study. The mPower team can also benefit from understanding users’ opinions about the system. Users’ opinions can help to implement a user-centric design for effective and long-term use of the system. Also, exploring the relationship of the users and the community farmers describes the information dissemination from the users’ perspectives.

Individual characteristic factors such as willingness and awareness may lead to users’ perceived usefulness (PU) and perceived ease of use (PEU). Demographic factors such as age may influence users’ perceptions of usefulness and ease of use. Young users are more comfortable in using the system than relatively older users. Users’ occupations also dictate how the users perceive the system. The users who are more inclined to technological duties in their workplace perceive the system more positively than those with jobs that are not directly
involving technologies. Gender does not seem to primarily influence users’ perceived behavior, however, this factor is not observed closely in the study.

Peer pressure is an important factor that may influence PU and PEU. A newly recruited government employee may create pressure for the existing users to become accustomed with the new technology. Tech service promotion and tech service attributes are also factors influencing the users’ PU and PEU.

The factors that are related to users’ PU are system supportiveness, productivity, and convenience. User experience and education are the factors of the PEU. The more experience users have in their regular tasks with technology, the more easily they use the system. Having no education or less education can lead the users to find the technology to be difficult to use.

The facilitating conditions, such as regular use of mobile phones and Internet in rural areas, can lead users to use agro-based applications. Training and government policies could help the users to use new technologies.

A limitation of this study is the small user population contacted and limited scope of the overall project region. Further study should include a wider user population and discuss a broader range of perspectives about using mobile applications in agriculture. Personal biases were kept in minimum during the research. However, as the researcher was directly involved with the day to day work of the community organization, the findings could reflect personal biases about the overall use of information technology. Also, the general farmers’ opinions should also be included more fully in any future study.
Appendix A: Community Organization Approval

Dear Mr. Omar Ismail,

We are pleased to inform you that your research proposal titled “Decision Support System in Behavioral Change Interventions with Smallholder Farmers in Southwest and Central Bangladesh,” has been accepted for support by mPower Social Enterprises Limited. You will be working closely with our Agriculture project titled AESA in South-West Bangladesh in Khulna and Barisal Divisions to conduct the research.

We expect you to arrive by the end of May, and stay with us for a period of 12 weeks, at the end of which you will produce a report and presentation outlining your findings and recommendations. We will provide you in-kind support from our team, but our fellowship does not come with any other forms of cash or financial remuneration.

If you have any questions, feel free to direct them at fellowships@mpower-social.com.

We look forward to having you with us this Summer.

_________________________
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mPower Social Enterprises Ltd.

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Appendix B: IRB Approval

Office of the Vice President for Research
Human Subjects Committee
Tallahassee, Florida 32306-2742
(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 05/14/2015
To: [Redacted]
Address: 1418 Nlys Street, Apt. 11 Tallahassee, FL 32304

Dept.: COMMUNICATION

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research
The Use of Decision Support System in Behavioral Change Intervention with Smallholder Farmers in Southwest and Central Bangladesh

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Exempted per 45 CFR § 46.110(b) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 05/14/2016, you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any changes in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed changes in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to ensure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Stephen McDowell, [Redacted], Advisor

HIC No. 2015-15438
Appendix C: Interview Question Guides

Individual Interviews and Focus Group Discussions
Questions Guide
(Farmers)

Thank you for participating in this interview. I will ask you some questions. Do you agree to give this Interview?

1. What is your age? আপনার বয়স কতহবে?

2. How long are you working in this occupation? আপনি কতদিন ধরে কৃষি পেশায় আছেন?

3. What major kind of problems you face in farming? মাঠে কি ধরনের সমস্যায় আপনাদের বেশি পড়তে হয়?

4. Could you describe one or two problems you faced recently? সম্প্রতি আপনি কি কৃষি বিষয়নিয়ে সমস্যায় পড়েছেন? হ'একটা ঘটনা কি আসাকে বলতে পারেন?

5. When you fall into this problem what you did? যখন একুশ ঘটনায় পড়লেন তখন কি করলেন?

6. Who is the first person you contact when you are looking for solution? যখন কৃষি সমস্যায় পড়েন, তখন কার সাথে প্রথম যোগাযোগ করেন?

7. What do you think about the new system? How it can help you in your daily work? নতুন এই সিস্টেম সম্পর্কে আপনার ধারণা জানতে চাই?এটা কিভাবে আপনাদের সহায়তা করবে?

8. Could you tell me any benefits or difficulties you come into while using this system? আপনি কি আসাকে এই নতুন প্রযুক্তিতে কোন সুবিধায়া অসুবিধায়া কথা বলতে পারবেন যা আপনি পেয়েছেন?
9. How do you feel about getting farming information via mobile phone?
এই যে নতুন প্রযুক্তি যেখানে আপনি নোবাইলের মাধ্যমে ব্যবহার করে কৃষি তথ্য পাচ্ছেন, এই ব্যাপার আপনি কিভাবে দেখছেন?

10. For what other reasons you use mobile technology?
আপনি আর কি কারণে নোবাইল ব্যবহার করে থাকেন?

11. How do you learn about this system at first? এই প্রযুক্তি সম্পর্কে আপনি প্রথম কিভাবে জেনেছেন?

12. What kind of Mobile Phone and network do you Use? আপনি কি ধরনের নোবাইল ফোন ও নেটওয়ার্ক ব্যবহার করেন?

13. Tell me about your experience with the agriculture extension project.
আপনাকে এই কৃষি সম্প্রসারণ প্রকল্প সম্পর্কে আপনার অভিজ্ঞতা বলেন?

14. Do you want to use this system in future? আপনি কি এই প্রযুক্তি ভবিষ্যতে ব্যবহার করতে আগ্রহী?
Individual Interviews and Focus Group Discussions
Questions Guide
(Extension Officers)

Thank you for participating in this interview. I will ask you some questions. Do you agree to give this interview?

1. What is your age?
   আপনার বয়স কত হবে?

2. How long are you working as an extension officer?
   আপনি কতদিন যাবৎ কৃষি সম্প্রসারণ করা হয়েছে বাকি কাজ করছেন?

3. What kind of problems do farmers have in the field?
   কৃষিকরা নাটে কি ধরনের সমস্যার বেশি পড়ে?

4. Could you tell me some recent experience with farming problems you are asked to solve? How you solve it?
   আপনি কি আপনাকে কোন সমস্যার সম্পর্কে জনসাধারণের কাজ করেছেন? আপনি কিভাবে সমাধান করেছেন?

5. Which one you feel comfortable with? Using technology such as computers and mobile or pen and paper? Why? কোনটা আপনার জন্য সুবিধা মনে হয়? কম্পিউটার, মোবাইল কিভাবে কাজ করে?

6. From your experience, what do you think about using this technology? Is it efficient to give service to the farmers?
   আপনার অভিজ্ঞতা হতে বলবুলতে, এই নতুন যে সিস্টেমটা করে কৃষকদের সেবা প্রদানে কত উপকারিত করে?

7. Could you share any benefits or difficulties in using this system?
8. What do you think about the mobile application in agriculture?

9. Is using mobile phones fit into your everyday work style?

10. Do farmers come to you in a group or they come alone with problems?

11. What kind of Mobile Phone and network Do you Use?

12. How do you share the information about this system to the farmers? Which communication medium do you find useful?

13. Do you have any training prior to this project?

If yes, Could you describe the format of the training?

If no, do you need training in future?

14. What do you do when you have any technical problems?

15. Do you want to continue using this system in future? Why or why not?
References


Hossain, Ismail. Personal Interview with Ismail Hossain, Associate in Process and Innovation at mPower-Social Inc. Omar Ismail. 07 12 2014.


Mahmud, Sujan. "mFQS." 31 May 2014.


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