Supporting Pakistani Farmers Through Digital Means: An Exploratory Study

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Abstract
This study identifies the core agricultural information needs of the farmers of central Punjab. A lean model is adopted to develop an image based touch application with minimal text to deliver information such as weather forecast, pesticides and fertilizer information. The usage of the application was then evaluated and results show that such an application is a viable option to deliver agro-information.

Author Keywords
Punjab; Farmers; ICT intervention; Pakistan

ACM Classification Keywords
H.5.2 [User interfaces]: prototyping, evaluation/methodology.

Introduction
Despite Pakistan being a predominantly agrarian economy in nature, employing almost half of the country's work force and contributing to one fourth of the GDP [1], it is considerably far behind the world in per acre yield. There is an almost 40 percent gap per acre yield between Pakistan and its neighboring countries including India while this breach widens to 100 percent if compared to the developed world [2]. Over a period of time, the agriculture sector throughout the world has significantly improved and is becoming

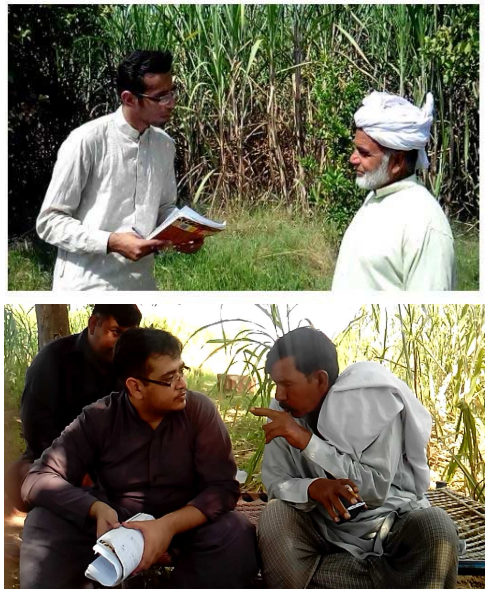

Figure 1. Contextual inquiry in a village

increasingly information-dependent [3]. Farming is a time critical business and there is a greater need to connect the farmers with real time information so that they can make better decisions for improving their production. In spite of that, development in Pakistan has been sluggish. As a result, most farmers are less productive, efficient and profitable than they otherwise could be. Currently, the main source of information for farmers is either through the television or radio. In the current era of science and technology, these methods have limited scope [1]. Consequently, the information is passed on by fellow farmers through word of mouth or by the retailers [4]. This information can also be unreliable and outdated. Generally, no effective mechanism is in place to disseminate reliable and up to date information [5].

On the contrary, literature [6] strongly endorses the intervention of ICT to improve the living standards and prosperity of the rural residents in developing countries. E-Choupal is one such example where with the mediation of ICT, the farmers are being provided with real-time information and customized knowledge to improve their decision-making ability [7]. Awaaj Otalo, a voice based application for small-scale farmers, has also been keenly adopted by the farmers as no prior technical knowledge is required [8]. Such systems can significantly improve the dissemination of information in agricultural communities of the developing world.

Despite Pakistan being a predominantly agrarian economy, not much work has been done to address the information needs of farmers. There is one recent work in progress, which identifies a number of requirements of the Pakistani farmers, but no technological solutions are designed and tested by researchers [4]. Our project aims at understanding the information needs and designing digital solutions for the farmers of central Punjab (the hub of the agricultural sector), keeping in mind their literacy level and socioeconomic background. In the first phase, we are primarily interested in providing them with real time information regarding the weather, pesticides and fertilizers and other key information e.g. pricing and canal scheduling etc., according to the priority we discovered in the user research phase, which could help them improve their crop yield.

User Research

The goal of the user research phase was to identify the core information requirements of the farming community and to determine the usage of ICT as a medium to transmit such information.

Participants and Procedure

We chose central Punjab (Faisalabad District more than 100 KM away from Lahore) where we conducted semi-structured interviews as this region has a large belt of cultivable land including crops such as wheat, cotton, rice, sugarcane etc. The selected participants had a minimum of 5 years of agricultural experience and had to be a *thekay-daar,* farmer who has leased the land, amongst others who owned the land. The size of farm each of the participants worked on was at least 4-5 acre. Due to their experience, these participants could rightly point out the problems, which they face regarding their crops.

Thirteen farmers were voluntarily interviewed, among which some were semi- or completely illiterate. The interviews consisted of open-ended questions to engage the farmers in discussions.

Figure 2. Final prototype of the home screen where user can select weather, pesticide, and fertilizer information options (right to left).

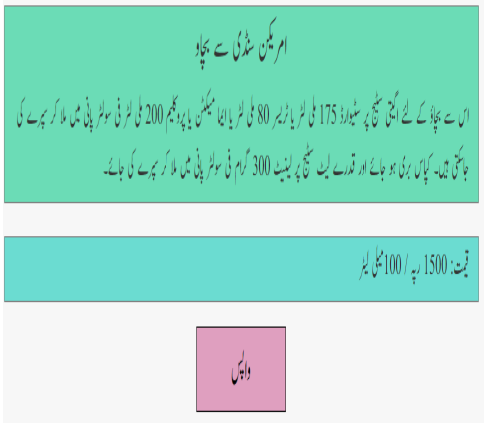

Figure 3. Screen showing the pesticide usage method for cotton pest, American Bollworm (green box) and its price (blue box). Pink box is to navigate to the previous screen.

Results

All interviews were recorded and later coded for qualitative analysis. Following are the major findings of the interviews:

Weather Uncertainty

The interviews indicated that farmers face the problem of weather uncertainty during the sowing, growing and harvesting phases of the farming cycle. The farmers pointed out that this uncertainty in the weather is adverse to the production of their crops. During the period of sowing, rainfall can damage their crops badly which directly impact their production, *"The rainfall should not occur at least one week after sowing the seeds of wheat"* (P #3, 5). For sugarcane heavy rainfall was said to be harmful as *"It can damage the roots of sugarcane and as a result its growth is stunted"* (P #8). The farmers claimed that if they knew of the forecast beforehand then they could easily irrigate their crops accordingly, as excess of water is not only detrimental but also financially burdensome.

Unreliable Pesticide, Fertilizer and Seed Information

One of the problems farmers face includes limited pesticide information. Many famers pointed out that when their crops face pests attack, they have to rely on market dealers for the right pesticides. *"We cannot claim any damages to our crops due to ineffective or wrong pesticide provided by the retailer"* (P#9). There is no standardized information available to them, neither by the government nor any other authorized personnel, who can guide them on buying effective pesticides at standardized rates. Thus, farmers are heavily dependent on the local market dealer who may or may not provide them with the right pesticide. Inline with the previous results [4], we also found that farmers are sometimes abused by retailers, who can give them adulterated and substandard sprays that can spoil their crops.

Similarly, information regarding fertilizers is not only scarce but, during the sowing season, some dealers often reduce its availability so as to sell it in the black market at higher rates. Hence, information regarding the usage, prices and the location of purchase outlets of the fertilizers is crucial to the farmers.

Canal Scheduling System

The ground water is salty in the rural areas of the Faisalabad district, as a result of which irrigation is highly dependent on the canal system. The canal (Upper Bari Doab) is closed for a month each year without any proper schedule and there is no reliable source exist which intimates farmer about each year plan.

Current Information Sources and Technological standing

The current sources of information are mainly the radio, television, retailers or peers. They argue that television and radio don't provide timely and dedicated agro-information. Retailers are arguably biased towards greater margins. Farmers often seek advice from their peers and follow suit if one of them is successful. The thirteen farmers, who were interviewed, all owned a mobile phone. Other than a couple of exceptions all had a basic knowledge of phones. Three of them had smart phones and were decently acquainted with touch interfaces. Generally, they preferred a visual system with audio feedback, which is inline with the findings of the previous study on Pakistani farmers [4].

A few participants seemed to have no confidence in such an ICT intervention and thought that the only way to improve their livelihood was to improve the overall agriculture policy, and increase the government intervention. Majority fretted over the low return on their

Figure 4. Screen showing weather information (in URDU) for a whole week.

Top navigation buttons: Red and Green to choose month Blue and Brown to choose week

1st row of the table: Date, Day, Temperature Range, Weather detail (right to left)

investment because of the monopolistic industries working in the sector of crop pricing, pesticide, fertilizer and seed.

Design and Development

The findings from the user research phase were translated into design guidelines. Initially, a set of problems were narrowed out that could be addressed through ICT intervention. After the finalization of requirements, different solutions were considered which included a mobile app, an IVR (Interactive Voice Response) based solution and a touch based KIOSK application. The majority of farmers still don't own a smart phone, which is why a smart phone app is not ideal. The IVR solution is the most accessible method to disseminate information but with some limitations as well. In the first part of our project, we decided to go with a touch based real-time KIOSK application because a KIOSK has an increased visibility, which can help our targeted audience to easily adopt and obtain any information [9]. A similar solution (E-Choupal) has been deployed in India and increased the overall agricultural productivity and improved the prosperity of the farmers [7].

The key features of the KIOSK include 1) a weather forecast information option through which farmers can view the forecast and plan their farming activities accordingly, 2) a fertilizers information option along with its usage details and prices, 3) a pesticides information option categorized according to crops that can help farmers to adopt remedies, in case their crop faces a particular pest attack. The initial design of the final prototype was design in an iterative manner. The lo-fi prototype was developed and based on users' feedback the final design a touch-based KIOSK interface was developed. As the farmers primary language is Urdu, the interface was entirely in Urdu. "Nasta'liq" (Perso-Arabic) script was used whose readability is better than other Urdu fonts. We integrated text alongside large sized real life images for providing ease of recognizing to farmers. A minimalistic design was followed so as not to overwhelm the users who generally are less accustomed to computers.

The farmers in Punjab are more comfortable with Punjabi calendar as opposed to the Gregorian calendar, therefore we integrated the Punjabi calendar in our weather forecast interface. We followed a horizontal design to construct all of the interfaces, instead of vertical design, because of the increased breathing space and for more natural look [10]. To facilitate the illiterate farmers, images were used to map input options and an audio response system, in Punjabi, was employed throughout the design. Research suggests that any alternative to non-numeric text in order to convey the information is preferable [11] [12].

Evaluation

Key objectives of early evaluation were:

- How effective our application is in disseminating information to farmers?
- Can illiterate, semi-literate and literate farmers use voice-based visual system and to what extent?

Procedure –Cultural and Experimental Setup

The testing was conducted in a veranda adjacent to the farms, where the farmers usually congregate for prayers. Fifteen farmers took part in the evaluation, out of which twelve were semi-literate or literate. Five of them owned a touch smart phone. The age group of the users varied from 18 to 70 years. Each user was initially given a brief tutorial of the touch screen and the possible actions that could be performed through the application. Each of them was then given

three tasks to complete and at the end, a semi-structured interview was conducted.

Results and Discussion

Post task results showed that farmers were interested in the system because this was the first time they were able to access agricultural information. They want such a system to be deployed in their nearby *Mandi* (vegetable/grain market) where these farmers visit frequently. Such *Mandi's* cater to almost 40-50 nearby villages. Majority of the participants, who used such an ICT system for the first time, mentioned that with basic training and a bit of frequent use would be sufficient to get well acquainted to the system. Overall the feedback of the farmers was satisfactory as most of them deemed the design to be simple and easy to operate due to presence of visual aid along with audio support.

Swift Understanding of Touch Screen

After the basic training of the touch interface, majority of the users were able to adopt and use the screen. Four of the participants were quite comfortable with the touch interface as they had been using touch screen mobiles while other participants declared that they would require training and practice. Three users faced problems with the touch screen as they would sometimes press the screen for prolonged period of time or would press either too lightly or too hard.

Immediate comprehension of voice feedback

Almost all users were able to comprehend the help feature with ease because audio is in their native language (Punjabi). This was seconded by the fact that audio feedback helped many users to complete their tasks. Some users, despite being able to read Urdu, preferred to listen to the voice feedback and few users at times referred help multiple times on a single page. In comparison to our quantitative results, we found that one of the tasks had been completed earlier by a user who referred to the help twice as compared to another user performing the same task that preferred to read the text instead of referring to the help feature. These results are inline with the previous work where the effectiveness of voice-based interfaces in a similar context is shown [7].

Correctness of information and subject involvement

Literate users, who were more comfortable with technology, were more eager to give us feedback. Two of these users had intermediate level education. Another user recommended an addition of a telephone helpline, which could complement the KIOSK application. Two users pointed out that the usage method of fertilizer information should be based on the type of soil, which had not initially been taken into account. *"The usage method of fertilizer completely depends on soil situation"* (P # 6, 7).

Hierarchy of the interfaces

Other than three illiterate users, all users understood the hierarchy of the application and even used it up-to 3 depths to retrieve information. The major issue, for those who could not cope with the hierarchy, was moving back to the previous level.

Effect of real images vs. icons

The interface consisted of real images along with text so that even if a user could not read the text, they could map it to the image. Inline with previous results [11, 12], illiterate users were able to understand the system. For example, a farmer instantly identified a fertilizer by the image of its bag (figure 2) and

specifically appreciated this information presentation approach. The weather interface in the application had weather icons, which had a mixed result by the users. The younger and literature user base who were more acquainted to phones and touchscreens, understood these icons but others found them confusing (figure 4).

Intimidation by either the test administrators or the technology

Some of the users, especially those who were illiterate seemed to be intimidated when performing the tasks. This could be seen by the fact that they were often responding with affirmatives to every question and were hesitant to give genuine feedback. On the other hand, they were quite (positively) surprised by seeing our application because they were not familiar with this kind of system. To get a more genuine feedback, we used a multi-method approach and engaged them in *peer discussions*.

Acceptance of technology and the government support

Once again we learnt that farmers consistently ask for government intervention and support. They, almost all of them, believe that such systems would be successful if the government 'systematically' supports them. This demand clearly shows that any solo movement or an effort at the private sector alone is not going to have a big impact. Moreover it was clear that only such ICT support is not enough for them. They link any such intervention with the general improvement in their lifestyle, which they claim is only possible if they get clear financial benefits. For example one fed-up user said *"on 4 acre, I sowed rice and each acre has cost around 50k but I have profit of 25K-30K only. How is this system is going to help me?"* For them it is important to link the benefits of such support systems with clear financial outcomes. This is a very important facet, which should be kept in mind while designing and most importantly while evaluating the acceptance of such support systems. Moreover, other pending non-ICT fixes and unfinished past projects at the govt. level, make them skeptical about the new support systems. For example one factor, which needs a quick fix was the low procurement rates of crops fixed by the government.

Conclusion

In this paper, we have presented a KIOSK application that disseminates real time and credible information for the farmers of central Punjab. Results showed that such a system is viable solution, which can be effectively used after basic training. However, it is important that such a system is maintained properly. Moreover, result shows that such a system is only sustainable when farmers perceive that the system will be installed on a long-term basis, is actually supported by a trustworthy group or an organization, and brings clear financial benefits. Our results also highlight that the challenges Pakistani farmers in particular and illiterate people in general face and the way they appreciate technology is common in the sub-continent [6,7,8]. This finding fosters interesting prospects for using existing best practices in the Pakistani context and coming up with new solutions and guidelines, which could be adopted at a much broader level. In future, we plan to extend this project by improving our system and installing it at a couple of *Mandis* in partnership with local NGOs. We also plan to integrate other technologies e.g. an IVR system, with our system to test the overall acceptance of this system.

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