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Importance of Mobile Technology in Food and Agribusiness Value Chains: Electronically Linking Farmers with Markets

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Introduction

The easy accessibility of cell phones and their relatively inexpensive costs have made them the most popular communication device in the world. Since the early 2000's the interest in the use of phone apps as a means of communicating important information relative to agriculture issues has increased. It is only natural then to assume that the desire to expand markets has included this technology and has been effective in linking producers to urban markets. A number of private and public sector efforts to introduce phone-based market apps have, thus far, met with limited success. We believe that the basic idea of using this technology to expand markets for producers is sound but that previous attempts imposed technology that did not have the appropriate features. A successfully managed food supply chain enables the fluid and agile movement of product, market intelligence and capital that results in the most optimal distribution of resources. A supply chain model where supply chain actors work cooperatively to maximize profits should be the goal because a model where the profits for one group within a supply chain are derived at the expense of another is not economically sustainable. Improved market access and new efficiencies in sustainable production and distribution are all key elements to a food market system that improves the well being of all of its participants.

This project solicited information from the users and designers to better understand which cell phone features are both desirable and feasible for connecting rural farmers with urban markets. Concept mapping addresses questions like these within planning and evaluation projects by combining quantitative and qualitative analysis methods with participatory group processes, in a way that clarifies the understanding and analysis of overall stakeholder thought. It helps individuals to think more effectively as a group, but without loosing the uniqueness of their individual contributions. It also helps the group to manage the inherent complexity in most planning and evaluation situations without trivializing or losing important detail.

Goal and Objectives

The goal of this project is to offer specific recommendations that will lead to the development of cell phone platform technologies that will assist local farmers in maximizing profits and accessing markets. Access to technology is important to the marketing process but adoption of new technologies is dependent in part on a clear understanding of their utility and value. To that point the use of "Concept

Mapping" insures high levels of participation by all stakeholders and a process that produces a technology that is compatible with the needs of the end user. The audience for this project is broad and includes: policy makers, NGO's, farmers, brokers, retailers and extension professionals. The results of the Concept Mapping can be presented in a variety of ways that best meet the needs of any one group; i.e. brief visual displays of the high priority outcomes or more academic examination of relationships between priority areas. We have used Concept Mapping in a broad variety of projects that required high levels of stakeholder involvement and address the complexities of merging input from audiences with different viewpoints, literacy levels and expertise. In developing programs, curriculums, policies, and evaluations this tool moves the process forward mixing broad input with statistical analysis. We designed the MEAS project with a commitment to inclusion and analysis.

Research Methodology

We have used a process based on the" Concept Mapping" methodology to collect the information. Concept Mapping is a process that allows information to be collected from a variety of stakeholders and to be organized using sophisticated statistical analysis that produces a visual representation that captures common trends. This process combines "bottom up" participation with rigorous analysis. The MEAS project staff from Cornell University conducted Concept Mapping workshops and interviews in Bangladesh, Rwanda and Ethiopia including representative stakeholder groups i.e. producers, agricultural extension agents, and agribusiness representatives (retailers, wholesalers, distributors, buyers, packers), government officials, and IT specialists to determine the technologies they are using and the technologies and features they desire..

The Concept Mapping process requires a "prompt statement" that will generate a single idea to complete the thought. The prompt statement used was "I would be much better able to market and distribute my products if...." This prompt was shared in two ways; first, during group meetings with participants where they "brainstormed" responses; secondly, during the course of one-on-one interviews that we conducted in market and community settings. Together these activities produced between eighty and ninety statements for each of the three countries. The statements were reviewed and printed on cards creating a "deck" of statements. Each participant was given a deck of statements and asked to sort them into piles and to name each pile of statements that they had sorted. Next each participant was asked to rate each of the statements on two five-point "Likert" scales. One scale measured importance and the other feasibility of each statement. Finally each participant completed a small demographic form to establish their affiliations and if they used a cell phone. The research team again collected this information and all data was entered into the Concept Mapping software.

Data analysis consists first of quantifying the sorting process by performing regression analysis that produces a point map. Researchers are able to create "clusters" of statements by suggesting a total number of clusters for a map. The researcher reduces the number of clusters in a map until the point that the "bridging value" suggests that this is the minimum number of clusters that can be presented and still maintain the efficacy of the individual statement groups. The researcher then asks the program to name the clusters and the software chooses from among the names participants gave piles of statement with similar composition. The Ratings that participants gave each statement are now totaled and used to provide a mean value for each statement. The Rating data allows the researcher to determine which individual statements are relatively more important or feasible as well as which Clusters are viewed as more important or feasible. Next the researchers can produce a "GO-ZONE" chart for each cluster. This chart is a product of creating a four-quadrant diagram with the mean scores of all statements within that Cluster displayed. The quadrants are created by determining the mean score for all statements in that cluster for both importance and feasibility and plotting those on the X

and Y-axis. Plotting an overall Cluster mean "importance" score on the X-axis and an overall mean feasibility score on the Y-axis creates four quadrants. Then each statement point is placed at the intersection of the Importance and Feasibility scores for that statement which indicates its position relative to both Importance and Feasibility. Statements that are displayed in the upper right quadrant of the "GO-ZONE" chart are items that were rated above the mean in both importance and feasibility are thought of as likely successes for implementation or support. Statements that are only above the mean on one dimension are displayed in either the High Importance or High Feasibility quadrants and those statements that are below the mean in both measures are in the Low Feasibility and Importance quadrant.

Research Findings

ETHIOPIA: The Concept Mapping project for MEAS conducted in Ethiopia had over 50 participants who generated a total of 85 statements to the prompt "I would be much better able to market and distribute my products if…". Statements were gathered through interviews in community settings and at formal group meetings. The participants included farmers, brokers, distributors and government officials. These responses were rated and grouped by 37 participants with expertise in crop production, distribution, marketing, and food related businesses and then analyzed using the Concept Mapping program. This program uses regression analysis to create point maps that represent the collective thinking of groups about the value and relationship of generated statements. Participants rated each statement on a five point scale with 5 representing Most Important and 1 the Least Important. Values for all statements rated by participants were collected, combined and generated a mean score for each statement within a Cluster. The collected value of these statements can then be used to generate a Mean Score for the entire Cluster. The Cluster Map shows the overall value of a Cluster by the number of levels displayed. A nine-cluster Concept Map is produced for Ethiopia that included the following clusters: Mobile Phone & Agriculture, Market Analysis, Market Coordination, Producer/Market Linkage, Agricultural Information, Capital, Increased Production, Training, and Transportation (See Figure 1).

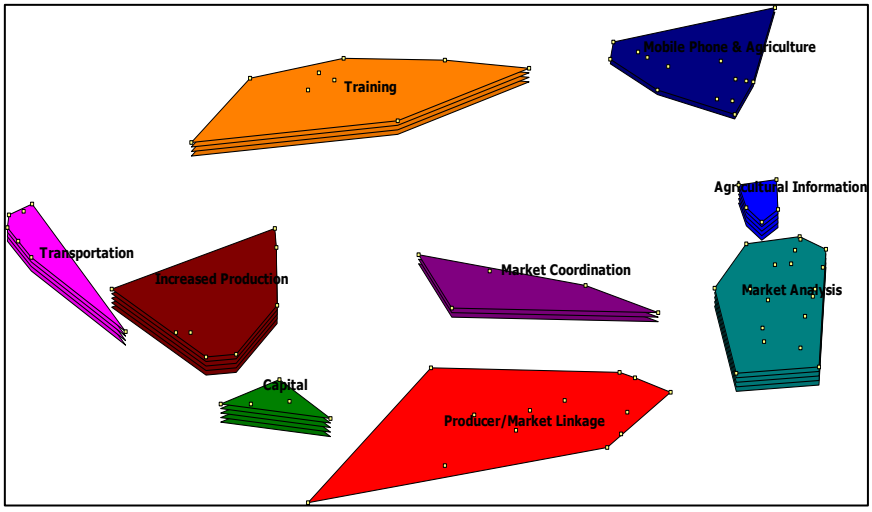


Figure 1: Point Cluster Rating Map for Importance Ratings in the MEAS Project in Ethiopia

Figure 1 shows the Cluster Rating map for the importance ratings in the MEAS Market Information study in Ethiopia. The results suggest that Increased Production and Market Analysis are considered relatively more important than Mobile Phone & Agriculture, Agricultural Information, Market Coordination, Producer/Market Linkage, Capital, Training, and Transportation. Increased Production has two primary foci; first the need to know more about improving crop production, soil, farming techniques, general agricultural education, etc. and second post harvest issues of processing, and value-added activities. Market Analysis has a focus on customer preferences but adds the notion of direct marketing if the potential customer/market could be located. The group rated almost all the Clusters of statements as high in Feasibility with the notable exceptions of Transportation.

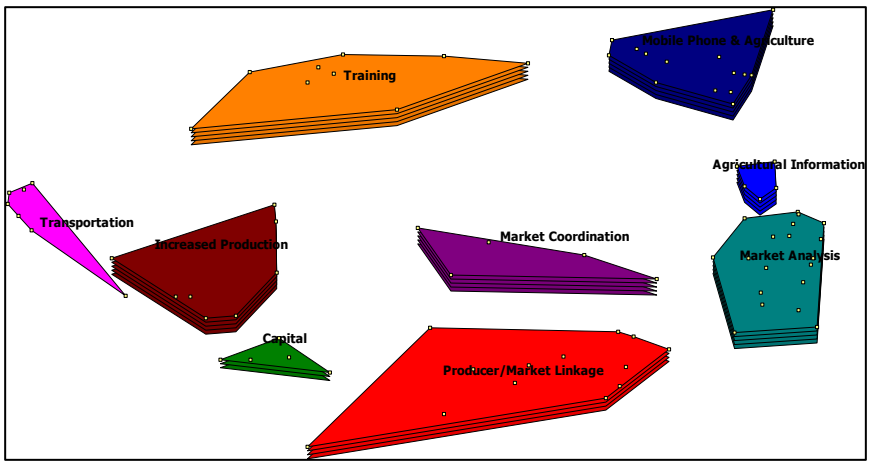


Figure 2 shows the Cluster Rating map for the feasibility ratings in the MEAS Market Information study in Ethiopia. Mobile Phone & Agriculture was seen as relatively less important, however this cluster was seen as high in feasibility.

Figure 2: Point Cluster Rating Map for Feasibility Ratings in the MEAS Project in Ethiopia

Figure 3 shows a GO-ZONE Chart for Mobile Phone & Agriculture Cluster. The X-axis is created by creating a horizontal line representing the highest and lowest mean score for statements rated for Importance within that Cluster. Using the highest creates the vertical line and lowest mean scores for the statements within this cluster as they are rated for Feasibility. The mean values for feasibility and importance are established and then intersecting lines form the four quadrants. Statements that fall in the green or GO-ZONE are those statements that were rated above the mean in both Importance and feasibility. The statements that fall in either the brown or yellow quadrants are interesting but not as likely to be easily adopted or supported. The items in the gray zone will be the most difficult to accomplish (See Figure 3; Box 1).

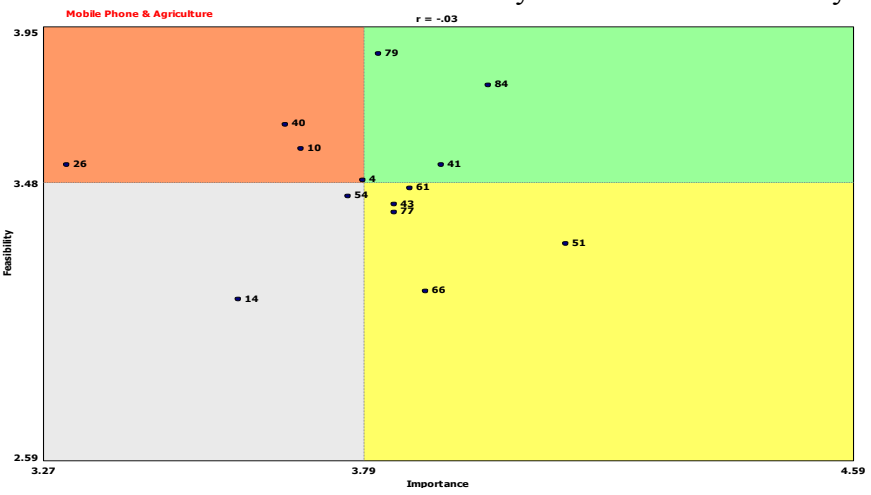
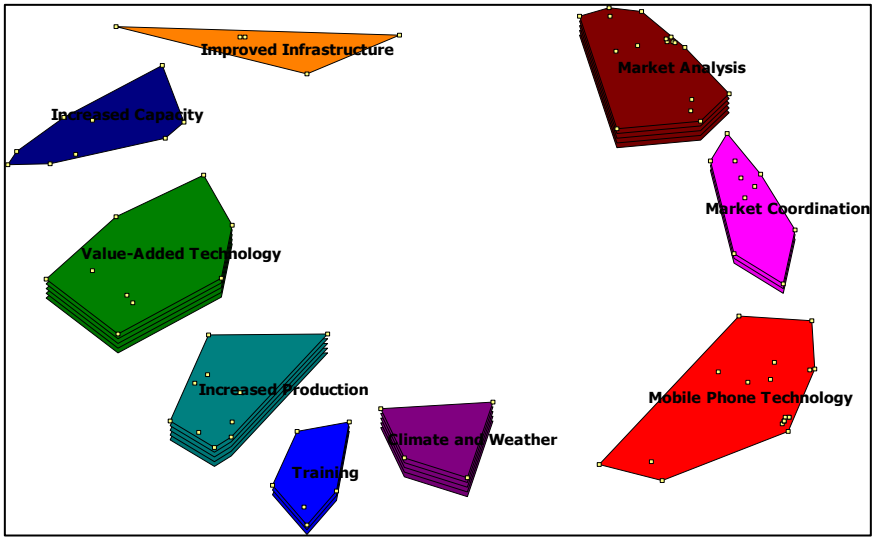


Figure 3: Go-Zone from the MEAS Project showing Average Ratings for Importance and Feasibility for Mobile Phone & Agriculture (Ethiopia)

Box 1: Go-Zone Statements for Mobile Phone & Agriculture (Ethiopia)	
4	Mobile phone marketing information technology was slowly introduced into the market place
41	I can receive marketing messages on my cellular phone
79	Telecommunication industries encouraged the use of mobile phone marketing technology
84	Farmers' use of mobile technology increased
43	Mobile phone usage costs were affordable for farmers
51	Mobile phone marketing information was coordinated with existing marketing information resources
61	Mobile phone messages were simple and clear
66	Literacy levels of mobile information were appropriate
77	Farmers' had access to mobile phone for marketing information
10	I can use my mobile phone with simplified text messaging system
26	Mobile phone marketing was introduced with only one or two popular commodities
40	Mobile phone marketing information was tested in the areas around Addis Ababa
14	A mobile phone application for marketing information was inexpensive/free
54	Mobile phone for farmers were affordable

RWANDA: The Concept Mapping project for MEAS conducted in Rwanda had 96 participants who generated ninety (90) responses to the prompt "I would be much better able to market and distribute my products if…" These responses were rated and grouped by 47 participants and then analyzed using the Concept Mapping program. A nine-cluster Concept Map is produced that included the following clusters: Mobile Phone Technology, Market Analysis, Market Coordination, Value-Added Technology, Climate & Weather, Increased Production, Training, Increased Capacity, and Improved Infrastructure.



One aspect of this map is the ability to determine which statements and groups of statements are seen as either important or feasible. The Rwanda Concept Map is interesting in the Statement Clusters that were seen as important to the group. These included; Value Added Technology, Market Analysis, Increased Production and Climate & Weather (See Figure 4).

Figure 4: Point Cluster Rating Map for Importance Ratings in the MEAS Project in Rwanda

Value Added Technology focuses on issues related to quality of products and customer preferences there is also some reference to the need for storage facilities. Market Analysis again has a focus on customer preferences but adds the notion of direct marketing if the potential customer/market could be located. Increased Production has two primary foci; first the need to know more about improving crop production, soil, farming techniques, general agricultural education, etc. and second post harvest issues of processing, value-added activities. Climate & Weather the overall request is for more weather information that is accurate and timely. In addition there is a need to know what crops should be grown given changing climate conditions. Mobile Phone Technology cluster was rated lower in importance the research team believes this was a product of having the existing system (e-Soko). Consequently we view these statements as consumer preference for adaptations or improvement on the existing system. This is not to suggest that all participants were using the e-Soko system but many were familiar with it.

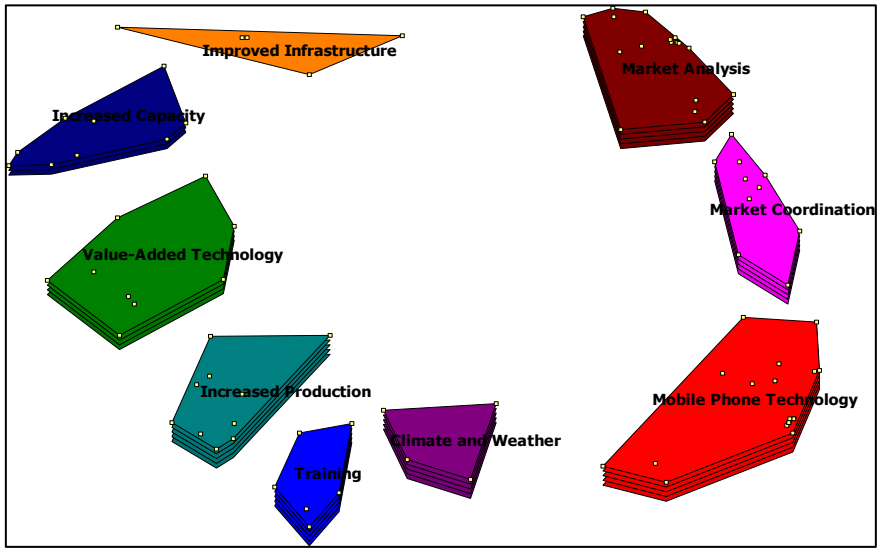


Figure 5: Point Cluster Rating Map for Feasibility Ratings in the MEAS Project in Rwanda

The group rated almost all the clusters of statements as high in feasibility with the notable exceptions of Improved Infrastructure (See Figure 5). We cannot place a directional interpretation on these results but some antidotal observations are helpful. Of the countries studied Rwanda was the only one with a mobile device system (e-Soko) in place. Feasibility could be influenced by the observation that such a device is in place and so it is obviously possible to provide these services.

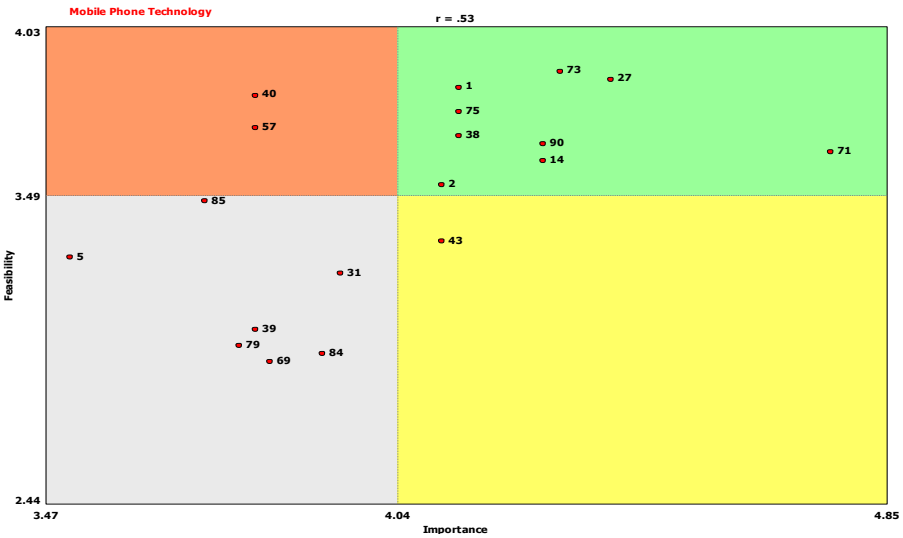


Figure 6 shows a Go-Zone Chart for Mobile Phone Technology Cluster with the average Importance and Feasibility ratings displayed on the X-axis and Y-axis and statements that fall in each quadrant (See Figure 6; Box 2).

Figure 6: Go-Zone from the MEAS Project showing Average Ratings for Importance and Feasibility for Mobile Phone Technology (Rwanda)

Box 2: Go-Zone Statements for Mobile Phone Technology (Rwanda)	
1	There was a mobile phone based market information system to access to urban markets
2	Literacy levels of mobile phone information were appropriate
14	Mobile phones for farmers are affordable
27	There were improved system for delivering important information to farmers
38	I had the ability to recharge mobile phone
71	Farmers preference for local language instead of French on mobile phone
73	I had a mobile phone with a user friendly system
75	I had mobile phone system that connected buyers and sellers
90	There was a mobile phone text message system with language easy to understand by Farmers
43	Mobile phone text messages were simple and clear
40	I had training for both purchasing and using mobile phone
57	Mobile phone marketing information was coordinated with the existing marketing information resources
5	Farmers had geographically specific weather information using mobile phone
31	I had short and simple information about best practices of crop technology on my mobile
39	I had access to variety of mobile phones
69	There was training for small farmers who seldom use internet and mobile phone
79	There was a web site available to create virtual buyer and seller connection
84	Telecommunication industries encourage the use of mobile phone marketing technology
85	Mobile phone marketing was introduced initially with only one or two popular commodities

BANGLADESH: We have conducted the Brainstorming session of Concept Mapping workshop at the Department of Agricultural Extension Education (DAEE), Bangladesh Agricultural University (BAU) in Mymensingh. About 60 stakeholders of different categories such as farmer producers, traders, wholesalers, retailers, businessmen, field extension workers/agents, extension officers, faculty members and graduate students of DAEE participated in the workshop. They responded to the focused question, the prompt "I would be much better able to market and distribute my products if…" and were able to generate a list of 90 statements that represented key areas for marketing as well as significant barriers to improving access to markets. These responses were rated and grouped by 50 participants. In the case of the Bangladesh Concept Map this produced a nine-cluster map that included the following

clusters: Mobile Phone & Agriculture, Market Analysis, Market Coordination, Sourcing Quality Products, Farmer Awareness, Government Initiative, Training & Technology, Seed & Pesticide Regulations, and Transportation. The Bangladesh Concept Map is very interesting in the Statement Clusters that Mobile Phone & Agriculture was seen as the most important to the group, Market Analysis, and Market Coordination were seen relatively more important than Transportation, Government Initiative, Sourcing Quality Products, Farmer Awareness, Training & Technology, and Seed and Pesticide Regulations (See Figure 7).

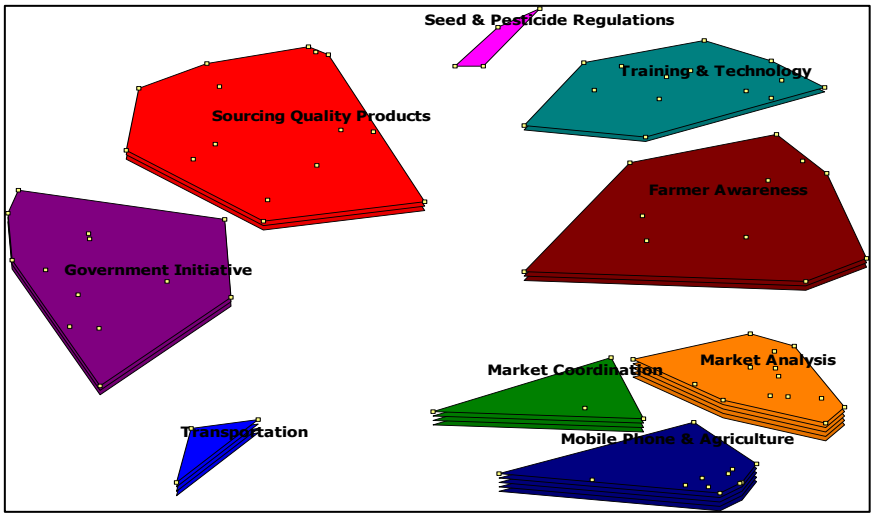


Figure 7: Point Cluster Rating Map for Importance Ratings in the MEAS Project in Bangladesh

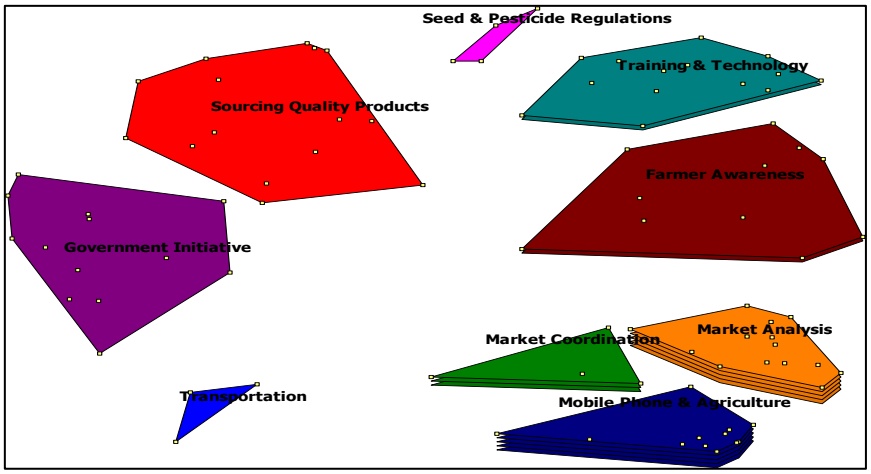


Figure 8 shows the Point Cluster Rating map for feasibility ratings in the MEAS market study in Bangladesh. The group rated Mobile Phone & Agriculture cluster of statements as the highest in importance and feasibility. Market Analysis and Market Coordination are rated as high in feasibility and the remaining clusters of statements are seen as low in feasibility.

Figure 8: Point Cluster Rating Map for Feasibility Ratings in the MEAS Project in Bangladesh

Figure 9 shows a Go-Zone Chart for Mobile Phone and Agriculture Cluster for Bangladesh with the average Importance and Feasibility ratings displayed on the X-axis and Y-axis and statements that fall in each quadrant (See Figure 9; Box 3).

Figure 9: Go-Zone from the MEAS Project showing Average Ratings for Importance and Feasibility for Mobile Phone & Agriculture (Bangladesh)

Box 3: Go-Zone Statements for Mobile Phone & Agriculture (Bangladesh)	
20	I could use mobile phone to inform the retailer before harvesting my product
21	I could use mobile phone to communicate to the retailer before marketing my poultry
24	I could talk to different middlemen/retailers using mobile phone before fixing price of my product
26	I could use mobile phone to know the latest market price and availability of seasonal fruits
34	There was a mobile phone system that provide honest and accurate market information
44	I had access to internet based market information system in combination with mobile phone system
76	Mobile phone marketing technology was slowly introduced into the market place
28	More training and information about 'mobile marketing' and or 'internet marketing' was available
13	I could receive more advice from a veterinary surgeon by using mobile phone
23	I received fair price through direct marketing in Mymensingh
33	There was internet facility to know accurate market information
54	Government and NGO support for SMS and mobile device agricultural information system existed

Conclusions, Recommendations and Policy Implications

Analysis of a Concept Map provides a wealth of information about perceptions of issues or needs and wants and desires. In the case of these three countries the maps provide three kinds of information. First each Map has identified a single Cluster of statements that deal specifically with SMS or cell phone technology and addresses the features that are most needed by farmers and distributors. Secondly, each Map has a set of Clusters that deal with the "Market Place" including the "Analysis of" or "Availability of Marketing Information". Many of these statements suggest direct ways that the mobile device could be used to address Market needs. Third, each Map has a set of Clusters that are contextual. That is to say they represent needs associated with the food distribution chain but that might not be directly addressed by the cell phone technology. Examples of this might include a Cluster named "Transportation" or "Training". Some of these statements could be addressed by using the mobile technology to link to other information sources and others by policy or regulatory activity on the part of government or agricultural related entities.

While the Concept Mapping process clarifies questions related to the attributes and issues in cell phone applications to agricultural marketing it will also highlight other needs. Clearly, there are a variety of issues associated with how farmers create business models related to their activities. For some farmers the shift from a passive producer to a more assertive small business owner will require training and fundamental shifts in their thinking. The ability to access more information will create a need for more training in methods of decision making and planning. Entrepreneurship is a learned activity and in societies where this has not been modeled or reinforced this has the potential of blunting efforts to improve productivity and profitability.

In reviewing the concept maps generated by participants in Ethiopia, Rwanda and Bangladesh, there are some common themes across the countries. Those themes can be summarized as following:

- All three countries having needs for commodity prices based on local markets and available in a timely manner, although it would appear that at least in Ethiopia, improved production capacity might be the first order of business.
- All three countries require a mobile device platform that is simple to use consistent with local language preferences at literacy level appropriate to users and includes basic commodities.
- Cost of purchasing and using mobile devices can become a significant deterrent to the success of a mobile device system for marketing and needs to be addressed by government or NGO involvement.
- Participants suggested that any mobile device marketing system be introduced slowly beginning with a few commodities.

- ❖ In all cases training programs related to purchasing and using mobile devices and how best to use them for marketing purposes are required at all steps of the food chain.
- ❖ Participants stated that a mobile device system should include accurate local weather information.
- ❖ SMS platform should include information about accessing agricultural resources i.e. e, seed, fertilizer, equipment, pesticide, packing and processing.
- ❖ As a mobile device system matures there should be an opportunity to create a virtual market place that would allow producers and retailers to connect directly as well as any stakeholders in the food distribution chain.

Any Information and Communication Technology (ICT) pilot project should be defined by the needs and capacity of the countries involved however the following are seen as considerations that are important regardless of the region.

Building Human Capital: In all cases, technology development is secondary to the development of human capital. Simple technologies that can engage the most members of the supply chain are preferred to complex technologies that leave out those with limited IT access and/or literacy.

Blended Technologies: Even though market information can be disseminated much more quickly with technology most regions will need to implement a hybrid system that employs technology when the appropriate infrastructure exists but can still connect with parts of the supply chain that don't have the same level of access. Farmers with no ICT resources may rely on an information aggregator who can use technology to gather important market information and in turn share it with local farmers. In some cases more sophisticated ICT systems can be linked with simpler technologies to relay important information until it reaches the individual farmers.

Financial Sustainability: Any plan to move forward must include features that make the system financially sustainable. What features and functions can and will be embedded into the platform, which will be revenue generators in the long term. The MEAS team can offer menus of potential revenue models but the viability of those models are based on the countries themselves.

Educational Support: The broad and instantaneous adoption of ICT to advance food systems in developing countries cannot be presumed. Education is perhaps more critical to the successful development of ICT platforms than the technology itself.

Clear Identification of Information Needs: What information do farmers, food buyers and intermediaries need to know about one another to make the best decisions? What kinds of market intelligence broadly shared would help farmers' access to new markets. While price is obviously the minimum amount of information buyers and sellers there are many other things that should influence buying a purchasing decisions.

Typically, a good information sharing system can answer the following:

- WHO are the farmers, buyers and middlemen in a particular region?
- WHAT products do they produce, purvey and/ or purchase and at what price?
- WHERE are the farmers and markets located that need to be connected?
- WHEN are the products available and when are they needed in the marketplace?

Future Outlook

This study examined three countries and the needs of farmers, middlemen and retailers in regards to moving products to and through the food chain. While the study has generated information about preferences related to a SMS platform for delivering market information, it has also brought to light larger contextual issues that would need to be addressed if a mobile phone program was to be fully successful. The results of this study can be examined from three perspectives. First, there is a high

degree of similarity in the features that farmers consider most desirable. Issues of affordability, ease of use, language preferences, daily commodity prices at the market and weather information are common desires. Secondly, there are common issues around the type of market information that farmer's desire. While most want basic commodity prices at the market on a daily basis, there are additional expectations around market location information, ability to deal via cell phone with brokers and retail representatives as well as information about product quality, consumer preferences, and contact information. Lastly, there are contextual issues; many farmers wanted to use technology as a means of organizing themselves into co-ops, and influence policy in regard to quality and price of storage, pesticides, seeds and equipment.

Additional study conducted in another cohort of countries would serve to validate the initial finding and to further explore these common themes. A second study would also allow the researchers an opportunity to solicit more information about "contextual" issues. Using the results of the first study we can construct a universal model for market data collection and distribution and invite commentary from these additional countries. A second study could be more prescriptive in suggesting not only what the audience desires but also how to achieve it. These recommendations could form a significant impetus for modernizing extension and advisory services in the role of extension professional in developing countries.

Acknowledgements

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References

Cho, K. M. and Tobias, D. (2012). Mobile and Wireless Applications in e-Agriculture for Improved Livelihoods and Food Security: Assessing the Requirements for Electronically Linking Farmers with Markets. Paper presented at the third IAALD Africa Chapter Conference, May 2012, Johannesburg, South Africa. http://www.iaald-africa.org/conferences_en.html

Cho, K. M. and Tobias, D. (2011). Assessing the requirements for electronically linking farmers with markets. Research pilot project report prepared for USAID, September 2011.
http://www.meas-extension.org/meas-offers/pilot-projects

Cho, K. M. and Tobias, D. (2010). An Impact assessment of direct marketing of small and mid-sized producers through electronic infrastructure MarketMaker. Proceedings of the annual conference of the Deutsche Tropentag 2010.
www.tropentag.de/2010/proceedings

Kane, M. and Trochim, W. (2007). Concept mapping for planning and evaluation. Applied social research methods series. Volume 50, SAGE publications.

Trochim, W. and Kane, M. (2005). Concept mapping: An introduction to structured conceptualization in health care. *International Journal for Quality in Health Care, 17 (3), June 2005, 187-191.*

Trochim, W. (1989). An introduction to concept mapping for planning and evaluation. *Evaluation and Program Planning, 12(1), 1-16.*