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Abstract

Farmers need information at all stages of the farming life cycle to make optimal decisions. The required information includes not only prior knowledge but also real time (dynamic) information such as market prices and current production levels. Some valuable information needed by the farmers is produced by government organizations and is available in different locations in different formats. Although farmer is the most important stakeholder in agriculture, there has not been much effort to provide the essential information to farmers on a real time basis. This lack of information is creating many difficulties for farmers as they are not being able to make the correct decisions relating to their farming activities. Through field studies we have identified information required by farmers at various stages of the farming cycle and official sources where this information is available. Next we developed an information flow model that connects various information sources to farmers' information needs. Based on these findings we are now developing a mobile phone based information system to deliver the required information to farmers in real time.

Keywords

Mobile based Information System, Disseminate knowledge, Farming lifecycle, Information flow model.

INTRODUCTION

During the last decade the digital revolution has impacted how we live and penetrated significantly through different sectors of developing countries transforming the society from an industrial age to an information age. As a result now we are surrounded by vast amount gadgets that can provide instance access to information. Though, such possibilities now exist still there are some sectors in developing countries, which have not utilized these sources to enhance the well being of the people. Eventually, lack of proper information visibility has led into poor interaction between people, processes and technology creating a drastic impact on the sustainability. Agriculture in developing countries is one such sector that needs urgent attention to ensure sustainability and to guarantee well being of the people. Even though farmer is the most important stakeholder in this sector currently information is not reaching the farmer at the right phase of the farming life cycle to make optimal decisions. This paper presents a farmer centred information flow model to meet information needs of the farmer at various phases of the farming lifecycle. We have also identified official information sources where some of this information is available, the format and granularity of the available information and new ways to aggregate this information using advances in technology to address the information needs of the farmer.

Agriculture has a long history since the development of the human civilization. It is the key to nurturing all living beings and the secret behind the successes of any country. Due to prevailing issues faced by the agriculture sector of Sri Lanka, we have selected this country as the test bed for our research. Owing to a rich nature and soil, Sri Lanka was well known as an agricultural country all over the world. Further, from ancient past it has been famous for its exports of tea, rubber and coconut. Irrespective of the exports, Sri Lanka is well ahead in catering for its inner demands of people by producing most of the country's rice, vegetables, spices, and fruits within small farm yards. Out of the total labour force in Sri Lanka, a significant percentage, around 32.7% are employed in the Agriculture sector (CentralBank 2010).

The people in this sector experience many issues due to the lack of information visibility. As a result they tend to take incorrect decisions at crucial stages of the farming cycle. This creates a drastic impact on farmers' revenue as the prices go down at the selling stage. Being unable to meet the expected demand or the yield quality at the

market level are some prevailing issues faced by the farming community. Due to this situation they face difficulties in selling what they have cultivated even at a lower price at the market.

Since, it has a direct impact on the revenue; the incentive towards cultivation has started to drop significantly. In farmers' point of view "price represents revenue" (McConnell et al. 2009) and acts as an incentive for the cultivation. The low prices at the market have discouraged, not only the current generation, but also the next generation from the farming industry, whilst creating a severe impact on the agriculture sector. Moreover, vegetable surplus has even lead to a huge wastage during the past few years (Derana 2011; Hettiarachchi 2011; Hettiarachchi 2012). In addition to that, farmers have not been able to meet the required quality of the yield due to various aspects such as seed quality and fertilizer. From time to time this has created a shortage at the market level and a loss of profits in view of farmers. They have also experienced the situations where the yield got destroyed before the time of harvesting due to unexpected factors such as weather changes.

This has led to frustration and dissatisfaction within the farming industry, threatening farmer sustainability and in turn the agriculture of the country. Incidents were also reported where farmers have committed suicide for being unable to pay their debts, as farming is the main source of income that they depend on. If this situation continues, it will badly reflect on the Sri Lankan economy in the near future. According to the Central Bank annual report, in the year 2010 the agriculture contribution to the Gross Domestic Product (GDP) (2010) of the country was around 7%. Factors such as land fragmentation, weak market linkages, information and knowledge asymmetries cater towards this situation (Lokanathan and Kapugama 2012). Thus it is essential to identify how this effect can be minimized to ensure sustainability of farmers while increasing the contribution towards GDP. Lack of appropriate usage of information systems within sectors such as agriculture is a major drawback for developing countries such as Sri Lanka. When compared to other countries which are in the process of rapid growth and industrialization, increased usage of Information systems within such fields furnish them to cater towards a higher GDP (Murugesan 2011).

This has laid us the foundation to further explore the possibilities of providing a solution based on information systems. During the study it was further identified that, the information required by farmers to make informed decisions are currently available from various sources in range of different formats. Some information of this information exists among farmers themselves without being communicated to each other. Thus, by first modelling the required information flow among farmers and other entities and then by developing an information system based on this model would provide a better way to address most of the issues faced by the farmers. Thereby, it will enhance the life of the farmers while achieving sustainability.

The remainder of the paper includes the following sections. Related research compares and contrasts similar work carried out within the domain of agriculture. The methodology section illustrates the systematic study of the methods adapted in this research to meet the research gap which was identified in the previous section. The techniques carried out in identifying the problem and the current information flow within the farming domain is described in the section 'Diagnosing the Issues'. The proposed information flow model is depicted to elaborate the proposed farmer centric solution. Finally, the paper summaries the work while elaborating the planned actions to be carried out in the near future.

RELATED RESEARCH

The Department of Agriculture (DOA) whose main focus is to "achieve an equitable and sustainable agricultural development through development and dissemination of improved agriculture technology"(Bhattacherjee 2012), invests heavily on the farmer community to attain this mission. Conducting awareness seminars, providing seeds and subsidiaries for a very low price and establishing new acts and regulations are some of such services rendered by the government of Sri Lanka.

Moreover, in collaboration with the Information and Communication Agency (ICTA), different projects have been implemented during the last few years. The "Govi Gnana" System is one such initiative implemented in Dambulla Dedicated Economic Zone (DDEZ) to view agricultural price information. The main aim of this system is to visualize price information to reduce the fluctuations at the market level and help farmers to get good prices for their cultivation. When the trading happens, prices are collected at that point via selected trader terminals. In addition to that, it uses hand held devices to capture spot prices. Once this is done, price lists are published on display screens at the DDEZ. This has been implemented to "empower the traders and farmers to benefit from greater access to information providing long term visibility" (Punchihewa and Wimalaratne 2010). These prices are only available at the time of selling or only when the harvest is brought to the market. However, at that crucial point farmer is compelled to sell the harvest at that rate or to throw it into garbage bins. This highlights the need for a more flexible system where farmers can get this information prior to plucking their harvest or taking it to the market. Such system can boost the enthusiasm of farmers.

At present, there are many web sites and special modules designed for knowledge dissemination within the farmer community. Different surveys (Pavitrani et al. 2011; Punchihewa and Wimalaratne 2010), have been conducted to identify the current impact on the existing ICT modules for the farmer community. According to the empirical study (Pavitrani et al. 2011) it shows that, irrespective of the functionality provided via such ICT modules, the usefulness is negligible due to the reasons such as poor ICT literacy, unavailability and access difficulties to internet facilities. These observations have been further confirmed during the surveys carried out as part of this study. None of the interviewees were aware of such modules as computer literacy and computer awareness is very low among those farmers. Thus, choosing the right technology plays a huge role in making the solution a success.

There are few mobile applications, such as Dialog trade net and 6666 Agri price index that were initiated by Dialog and Mobitel; two leading mobile service providers in Sri Lanka. According to our survey it was identified though such services are available at a reasonable price most of the farmers are unaware and very few uses these applications. Farming cycle consists of different stages and price matters only at the selling stage. At that point famers are not bothered much about it as they see there is no other alternative rather than selling the harvest at the market price. Thus, enthusiasm of such modules has recorded to be very low. As such it is essential to identify what information is required by the farmer and at what stage of the farming life cycle to make these modules appealing for a large farmer community.

Lokanathan and Kapugama (Lokanathan and Kapugama 2012) conducted a thorough survey with respect to information need of the farmers targeting four developing countries including Sri Lanka. They have categorized the information need into six stages of the farming life cycle. Beyond providing such information, the necessity of giving right information at the right phase has not been addressed in their research. In order to simplify and provide what is needed by the farming community at the right instant we have grouped these stages into three major phases namely crop choosing, crop growing and crop selling. Thus, when compared to other existing information models, the proposed model will enable the farmer to access information related to all these phases assisting them to make optimal decisions.

Irivwieri (Irivwieri 2007) conducted a study in Ethiopia East local government area of Delta State to identify the information need of illiterate female farmers. They have grouped, the information need into four major information categories namely, technical/scientific, commercial, social/cultural and legal. The researcher also pointed out the difficulty in bringing in scientific ideas due to high illiteracy among those female farmers. Further, due to the infrastructure scarcity no proper model has been identified during the study. Only possibility that was described in that paper is the dissemination of knowledge through agriculture extension officers and their community leaders. With respect to our findings this is also the current scenario in our domain. The efficiency of providing information in this way has been reported to be very low, as it requires high man power and time. Thus, this approach has been failed to address the issues faced by the farming community. In order to make optimal decisions farmers need a better coordinated system that is capable of providing the information they need from different information sources.

From the above studies we can identify the need for a better network or a system to enhance the flow of information from the information sources to farmers in order to meet their information needs. Kenya Agricultural Commodity Exchange (KACE) is one such initiative to link farmers and buyers in disseminating market information. Main aim of this system is to "*empower rural farmers with market information and provide capacity enhancement, business training and technical assistance*" (Karugu 2010). With the aid of this system the farmers have been able to get better prices for their harvest. This price has been reported to be significantly high, when compared to selling via a middle man.

There are studies that have been carried out in developing countries to disseminate agricultural knowledge to the farmer by linking the farmers with agriculture experts via a mobile phone when farmers have issues with respect to their cultivation. Most of these applications have targeted the farmers in rural villages. These studies have proved the success in linking stakeholders to get required information on time (Patel et al. 2008; Patel et al. 2010; Rajasee and Nagarkar).

METHODOLOGY

An information system (IS) has the capability of improving the efficacy based on the extent to which the characteristics of an organization is met (Hevner et al. 2004). As illustrated in the previous section there are many ISs for the farming community in Sri Lanka. However, these ISs are still unpopular among the farmers as these modules were unable to meet the needs or the characteristics of the farming domain. The ignorance of the domain when developing these information systems was also visible.

Having discovered this research gap we have initiated a collaborative project to provide a solution for the prevailing farmer issues. As such inputs for the proposed solution will be coming from varies research expertise from 4 countries namely Sri Lanka, Australia, Italy and USA. Thus, this whole project has different components comprised from various aspects in which the ultimate objective will be to create an artifact using design science approach (Ginige et al. 2012; Ginige and Richards 2012; Giovanni et al. 2012; Jain et al. 2011). Design science which has a great impact on Information Systems (IS) seeks innovation and creativeness while aiming at 'utility'. Thus, design science is mainly a "problem-solving" approach (Hevner et al. 2004). As such design science facilitates conducting "applicable, yet rigorous research" (Peffers et al. 2006) which in turn will implement and evaluate innovative artifacts. These innovations can be constructs, methods, models and instantiations (Hevner et al. 2004; Winter R. 2008). However, in order to get this done in a systematic way the problem we are aiming to solve is "how to make an ICT based intervention to enhance flow of information that is critical to achieve sustainable farming outcome". This is the interventional model which will generate specifications for the other collaborators, involved in designing the interfaces, knowledge base and the aggregation unit.

Thus, the issue we are dealing with is real and it involves a proportion of low literate people. Moreover, finding a solution for this issue is important for the sustainability of the agriculture sector while ensuring well-being of the farmers. To investigate such problems Information Systems have successfully used some research methodologies that have originated in Social Sciences. Ground level issues such as social aspect, background of the farmers, resistant to technology and rigid way of thinking are some barriers that needs to be addressed in this research. Thus, active participation of both practitioners and researchers in this regard is identified as an essential component. Necessity of such user involvement is highlighted due to the failure of some previous projects and software modules implemented with the aim of disseminating agricultural knowledge to solve the issues faced by the farming community.

As such action research has been identified as the most suitable methodology that can be adapted in this part of the study. According to O'Brien (2001) action research focuses in solving real issues in real situations. It also facilitates to get a clear picture of the problematic situation, while collaborating with all stakeholders of the domain. To best of our knowledge no such investigation has been carried out to identify how a solution can be proposed to bridge the information gap between the farmers and the other stakeholders of the farming industry. As a whole action research methodology has been adapted throughout this study. Kurt Lewin (1946) who is considered as the "father" of action research described it as a process of planning, action and searching. After further elaboration Susman and Evered (Susman and Evered 1978), have illustrated the action research life cycle with 5 main phases, namely, Diagnosing, Action planning, Action taking, Evaluating and Specifying learning.

DIAGNOSISING THE ISSUES

The first phase of the action research cycle is to diagnose the existing issues in a systematic and in-depth manner. This was performed with the aid of data collection techniques such as interviews, surveys and analysis of existing systems. Main aim behind this diagnosis phase was to identify causes with regard to the existing situation of the farming domain.

Following is a summary of the key features and findings from the surveys conducted during the study. Next a concept diagram was developed to elaborate the factors that determine the problems in the current practices. Also we modeled the current scenario to depict the information gap and to illustrate the inefficacy of the present scenario.

Key Features

Two surveys have been carried out involving 25 individual farmers via interviews and questionnaires. Separate interviews have also been carried out with 5 agriculture officers at the Department of Agriculture to identify what information is being gathered, analysed and how these are currently being used. The initial investigation was carried out with aid of 12 farmers representing different cultivation regions in Sri Lanka. This was mainly conducted to identify issues faced by the farmers at different stages of farming cycle. With the aim of further exploration the second survey was carried out in a rural village few miles away from Dambulla (largest agro-based area in Sri Lanka). This survey was planned based on the knowledge gained after analyzing the responses provided for the first survey. The questionnaire for the second survey was prepared based on the prior questionnaire used in the first survey. During the two surveys the depth of Information and Communication Technology (ICT) usage among farmers was also analyzed to understand as to what type of an intervention can be made to overcome the current situation.

A summary of user characteristics of the farmer participants of the two surveys are listed on Table 1. Survey1 and Survey 2 were carried out using a sample of 12 and 13 farmers respectively. According to the user characteristics, young and middle aged farmers have higher educational qualifications. Even one young farmer

found to be a graduate. On the other hand, 64% of the farmers were at their elderly age and have been compelled to follow the footsteps of their parents due to poor education. However, according to the survey it was found that most of their children were well educated and employed in other sectors. Further, it was identified that this has occurred mainly due to the frustration they had to undergo in this sector. Even some of the farmers at the time of the survey have started to look for other avenues to earn their living.

Table 1. Farmer characteristics

Characteristics	Unit of Measurement	Categories	Respondents Survey 1		Respondents Survey 2	
			Number	%	Number	%
Age	Years	Young (<36)	4	33%	0	0%
		Middle aged (36-45)	4	33%	2	15%
		Old(>46)	4	33%	12	92%
Literacy Level	Year of Schooling	Graduate	1	8%	0	0%
		A/L	4	33%	0	0%
		O/L	7	58%	3	23%
		Above 8th Grade	0	0%	4	31%
		Below 8th Grade	0	0%	6	46%
	R/W Capability (Native Language)	Ability to Read	12	100%	12	92%
		Ability to Write	12	100%	11	85%
	R/W Capability (English)	Ability to Read	1	8%	0	0%
		Ability to Write	1	8%	0	0%
Mobile Phone Usage	Model	Basic	11	92%	12	92%
		Sophisticated	0	0%	0	0%
	Purpose	Taking calls	11	92%	12	92%
		Sending SMS	11	92%	9	69%
		Playing games	0	0%	1	8%
		Getting price details	8	67%	6	46%

Moreover, young and middle aged farmers have expressed their willingness to use technology in their day to day activities than elderly farmers. As highlighted by Lokanathan and Kapugama (Lokanathan and Kapugama 2012) we also observed that the internet usage is unexpectedly low. Within the survey sample, more than 80% of the farmers have never used a computer and internet awareness was around 4%. Reasons such as cost, lack of education and traditional way of thinking were visible behind this low usage. However, due to the fact that low cost and mobility, almost all were carrying a mobile phone for communication purposes.

Besides, educated farmers consider that there is no proper mechanism for them to get required information on time. They further consider that there is valuable information hidden inside the farmer community. On the other hand, rigid way of thinking and inflexibility in crop selection due to the lack of awareness was a prominent social characteristic within the elderly farmers.

However, in most of the cases it was highlighted that due to the lack of information during their crop selection, growing and selling stages have been driven towards practices that has resulted in creating the issue that they are currently facing. Thus, it became clear to us, by giving and communicating this type of information to the farmer at the right stage will enable them to make better decisions.

Causal Analysis

Based on the responses received from these sources we have carried out a casual analysis shown in Figure 1 to obtain a broader view of the problem domain. We have identified crop choosing, growing and selling stages as the key phases that create a direct impact on the farmer revenue. In view of farming domain, revenue is determined by the selling price of the harvest. There are three main price determinants for a specific crop yield. Yield quality, supply and demand create a huge impact on price fluctuations at the market level. Market is the place where both buyers (demanders) and sellers (suppliers) come together to cater for each other's needs.

As illustrated in Figure 1, the yield quality is determined by weather, pest, diseases, fertilizer, usage of new farming mechanisms and seed quality. Thus, by knowing these factors beforehand would also help the farmer to maintain the quality of the yield. For example, having prior knowledge with regard to seed quality would help farmers to maintain the expected quality of yield at the market level. It thus creates a competitive market in deciding the price of a particular crop. As reported on the Sunday Times, farmers who have cultivated their fields using a new variety of carrot seeds have faced an issue recently as the yam is small (Hettiarachchi 2012). As a result the vendors have refused buying the harvest. Thus, knowing what seeds to buy and from where to buy at a lower rate would further help the farmer to maintain the quality of the yield.

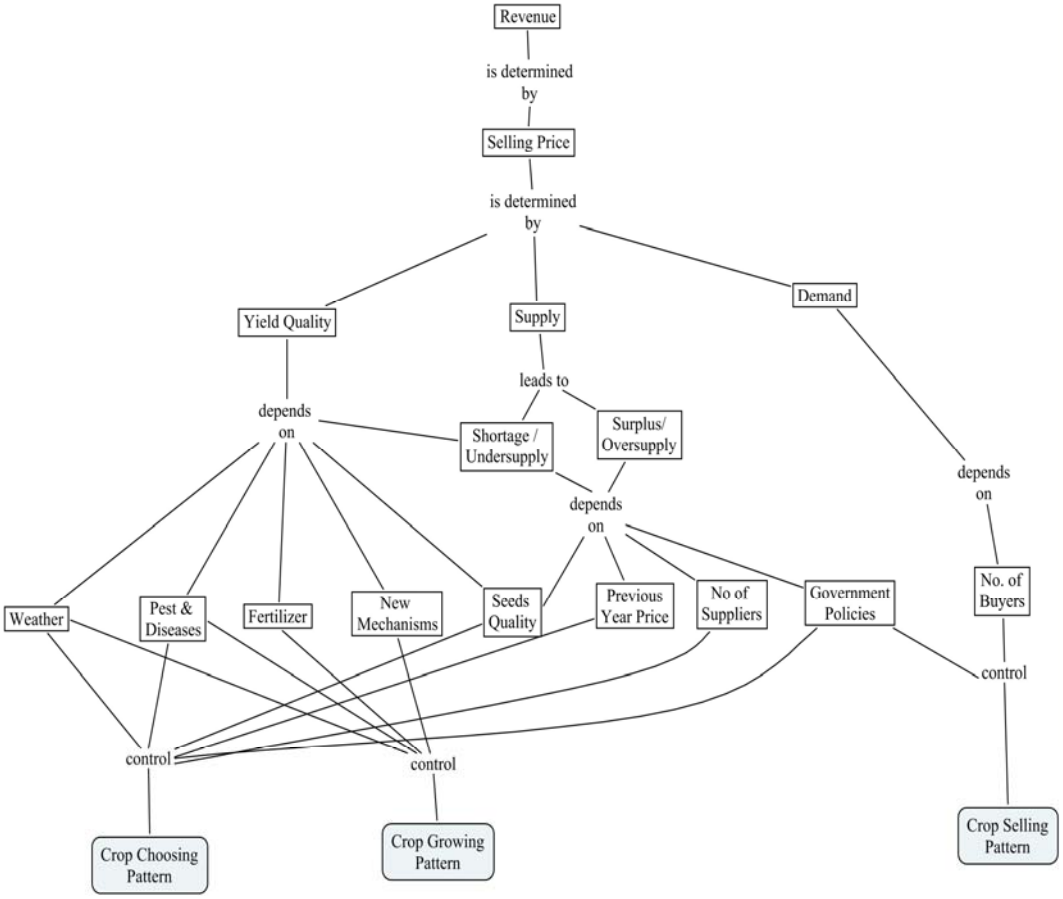

Figure 1: Causal Analysis of the Problem Domain

Secondly, supply at the market level may lead either to a surplus or a shortage condition. In economics, this is a known theory and occurs due to the effect on the demand and supply. The equilibrium price or market clearing price (McConnell et al. 2009) is the point where the price intentions of both buyers and sellers match and avoid neither a shortage nor a surplus. Other than that a shift in demand or supply may cater towards a shortage or surplus. In current scenario, number of suppliers, government policies, previous year's price and seed quality have been identified as the main contributing factors towards such fluctuations.

The number of suppliers at the market level varies due to the crop choosing pattern of the farmers. Currently, this is mainly determined by the farmers' prior knowledge based on the factors such as weather, long term crops (crops that can be kept for some time before taking it to the market), yield expectation and resource prices. According to the survey findings around 65% of the farmers depend on the long term crops that can be kept for some time, if there is a low price at the market. In addition to that, resource prices also influence the crop choosing pattern of the farmers. The crops that can be grown with less labor and cost were among their preferences. Thus, it was observed that tendency to chose a crop to meet their short term desires such as maximum profit with less effort have dragged them towards the issue that they are currently facing (i.e. everyone choosing the same crop).

On the other hand, the unawareness of what other farmers grow, in terms of crop variety, quantity and land extent also plays a major role in this scenario. As pointed by some farmers they only get to know a surplus situation once the harvest was taken to the market. Thus, farmers consider that if they had known such situations at the cultivation time they would opt for another crop preventing the surplus situation at the market level. Thus, it was identified that this unawareness can be overcome by means of increasing the awareness among farmers. A

65% the farmers participated in the 2 surveys mentioned that, they do consider what other farmers grow in their neighboring farm yards when selecting a crop to cultivate. Some young farmers have also mentioned that knowing this would enable them to understand whether there is a shortage or a surplus at the market level. They also pointed out that the importance of knowing these factors before hand in order to take the correct decisions in advance. In addition to that some farmers emphasized the need for being aware of what other farmers grow in different regions to take optimal decisions at the crop selection phase. However, this is still under investigation to understand as to what extent this information can be made visible in order to assist in decision making.

Similarly, unawareness with respect to government decisions such as imports, taxes and policy changes have also been identified as an essential contributing factor for current situation of over and under supply at the market. On the other hand, decision makers also face difficulties in predicting the demand and supply due to the lack of visibility within the current circulation of speculative information by government, media and other sources.

Furthermore, lack of information with regard to drought conditions that can be predicted beforehand can also be identified as a crucial factor at this stage in order to take correct decisions. If such situations can be predicted and warned a head of time the farmers would take precautions rather than investing on cultivation during such seasons. Thus, crop choosing pattern needs to be controlled in order to avoid such unexpected outcomes and to ensure sustainability. As illustrated on the Figure 1, by exposing factors such as number of suppliers, government policies, seed quality and weather predictions would help the farmer to take optimal decisions at the right time.

Likewise, in the growing stage farmers face difficulties due to the lack of information with respect to sudden weather conditions, fertilizer, pest and diseases. Unawareness with respect to best fertilizers and the amount to be applied affect the yield quality. Thus, exposing this type of information would help the farmer immensely to protect their cultivation and to control the yield quality by creating a better market at the time of harvesting.

In case of a surplus or to create a competitive market, need of a better network with other vendors such as food processing companies and food exporters were also identified as an essential factor to overcome the current situation. Currently, farmers do lack knowledge with respect to selling alternatives. According to the findings it was identified that 92% of the interviewees target the same shop keeper in the market due to the trust and personnel favors. Thus, most of the farmers take their harvest directly to the market. Such selling patterns also cater towards low revenue. Thus, a competitive market can be created by increasing the demand by means of identifying and disclosing information with respect to other buyers who are interested in buying different crops. Thus, controlling and providing necessary information at these stages would help the farmer to maintain the quality and to map food demand while achieving sustainability.

Current Scenario

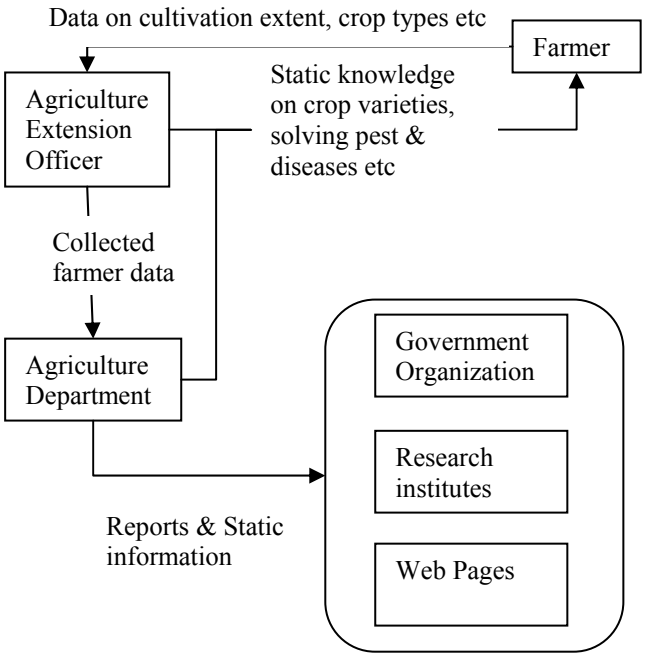

Figure 2: Current Scenario

As mentioned by the agriculture officers, the current information collection and how the information is flowing between the different stake holders of this problem domain are depicted in Figure 2. Although, farmer is the most

important stakeholder in the agriculture domain, as shown on Figure 2, currently very few information is given to the farmer to take most of the important decisions. Thus, most of the time they depend on the knowledge gained via ancestors. An officer appointed for each village is the only person who does frequent visits and meet farmers to give solutions for the issues that they experience during their cultivation. This officer is also responsible for gathering data such as the cultivation extent and different crops that the farmers grow. In return the findings will be reported to the higher authorities via hard copy (paper based) reports. In addition to that they make these data available via web sites. As we found in our surveys and interviews farmers do not have access to these websites due to the low computer literacy and unavailability. The decision makers use this static information to predict on the supply and demand and to decide on how much to import. However, such important decisions or the data gathered are never been flowed back to the farmer.

Thus, we have observed an information gap between the farmer and the other stakeholders. As a result farmer is being penalized due to this lack of information visibility.

PROPOSED INFORMATION FLOW MODEL

According to the field visit findings, we have identified the information need and where the real causes resides within the farming community. Moreover, we have identified there is a clear gap between the stakeholders of the problem domain as there is no proper coordination or information flow between them. Static information alone is not enough to take optimal decisions due to the dynamically changing behavior within this sector. Derived from above findings we designed an information flow model to address the gaps identified in the current scenario.

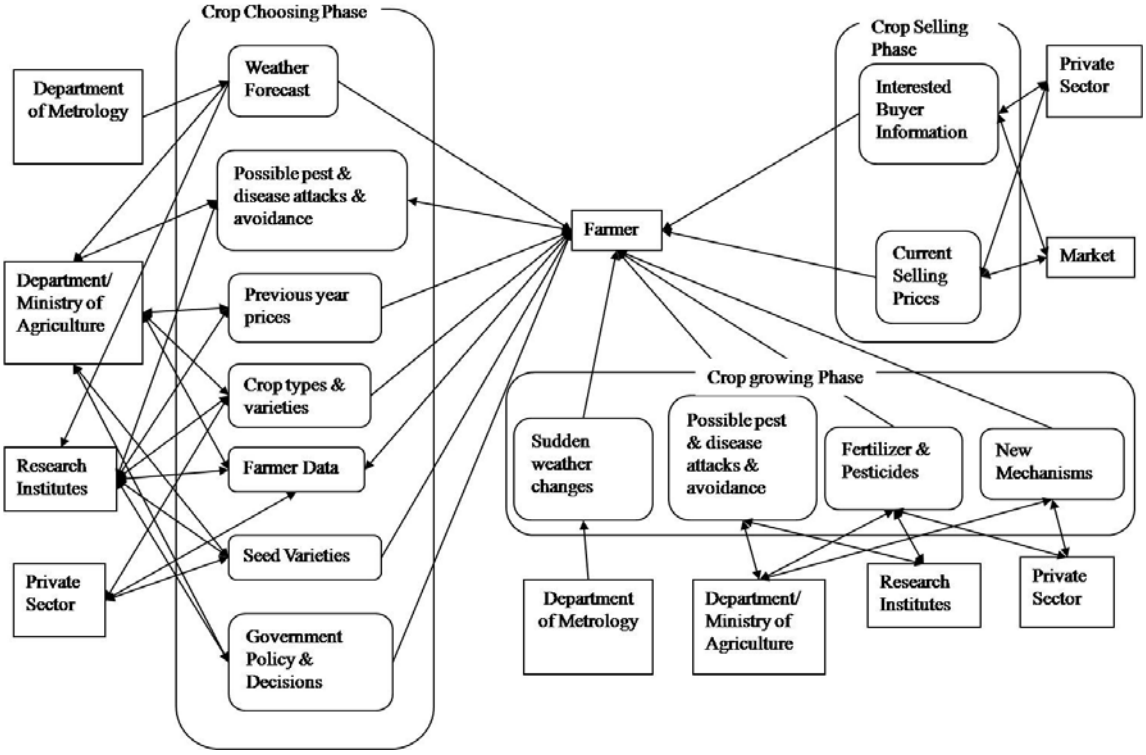

Figure 3: Proposed Information Flow Model

By providing information at the required phase will help the farmer to make better decisions at the right time. It was further observed that most important information that is needed by the farmer is available at different stakeholders of the agriculture domain in different formats. Thus, we propose an information model combining all these stake holders facilitating information transparency.

Figure 3, depicts the proposed information flow model with collaboration with all stake holders of the farming domain. When compared to the current scenario depicted in Figure 2, the proposed information flow model is farmer centric. This model will eventually create a better interaction between the different stakeholders in the farming domain. At the same time the model will also let the farmer to input some of the information needed by the other people involved in this domain. So that it will let all the stake holders to access both static and dynamic information as needed. This in a way will increase the information visibility and aid the farmer to take optimal decisions at the right time. This will create a greater impact on the selling stage ensuring financial sustainability of the farmers.

Compared to the existing information systems as discussed in related research, the proposed information flow model will let the farmer to access timely information throughout the farming life cycle. Due to the active collaboration between other stakeholders, farmers will find the proposed system more valuable to make optimal decisions. Further, due to the high mobile penetration among farmers we would be proposing the solution via a mobile phone. This in turn will address the technology gap which web based modules could not achieve. Thus, information gain via this new technology in an attractive way will further motivate the user to use the system.

CONCLUSION AND FUTURE WORK

Farmers need information at the right time to take more informed decisions within their day to day farming activities. Lack of information visibility at the main three phases namely crop choosing, growing and selling phases lead farmers to take sub optimal decisions leading to financial hardships. Thus, it is extremely important to present right information to assist the necessary communities to make informed decisions precisely at the right time. Review of related research highlighted systems that were developed to disseminate prevailing market prices have not been embraced by the farmer community with enthusiasm. A deeper analysis pointed out once the farmers have harvested a crop there is not much that can be done about the market prices apart from selling harvest at the prevailing price. This highlights the importance of providing the right information starting from the crop selection phase. Currently, the agricultural data is scattered in different locations making it difficult to find the right information at the right time. Thus, the need for a farmer centered information flow model connecting all stakeholders to aid decision making process is identified during this study. As shown in the study information need dependents on the current phase the farmer is in the farming life cycle; crop choosing phase, growing phase or selling phase. Thus in the proposed information flow model we categorized information sources from which farmer can get the right information into identified major phases of the farming life cycle.

Our findings demonstrated that a mobile based information system will be an effective way to make an intervention as most farmers have access to a mobile. We are planning the next few phases of the action research life cycle. Based on the above findings next step would be to plan the actions to make the intervention to resolve the issues faced by the farmers. For that the future research will be carried out in order to identify how the information from the identified sources can be aggregated using the emerging technologies. Next the intervention will be evaluated using a set of farmers. Reflecting upon the findings the model will be enhanced to ensure sustainability of this domain.In addition to that, how to create the Meta level model that can be generalized for the other domains to solve such issues is another challenge that will be addressed in the near future. This work will contribute to ensure farmer sustainability by providing timely information to support their livelihood related activities.

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