COMBINING SMS AND WEB BASED TECHNOLOGY TO BOOST LIVESTOCK IN DEVELOPING COUNTRIES CASE STUDY OF RWANDA

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Abstract— The majority of rural populations in developing counties live on livestock or in a combination of livestock and agriculture. These farmers are facing many challenges. They have an insufficient number of veterinarians, and poor communication system which cause many problems in their livestock farming activities. Information communication technology's infrastructure in place, such as, internet penetration rate, mobile phone penetration rate, telecommunication coverage area should to be considered when proposing a solution to improve livestock stakeholders' communications. In many developing countries, the internet penetration rate is lower than mobile phone penetration rate. A combination of both internet and Short Message Service (SMS) in a solution covers the maximum number of farmers for a greater change. In this paper, with Rwanda taken as a case study, a solution of combining SMS and Web based technology to boost livestock is proposed. Its purpose is to improve livestock farming activities by providing communication groups, marketing pages and capacity building information. All expected functions and benefits are illustrated.

Index Terms— Communication groups, Livestock, Short Message Services (SMS) and Web based technology.

I. INTRODUCTION

The majority of developing countries' citizens are located in rural areas. They live on livestock and agriculture [11], [13]. Livestock farming is an action of raising domestic animal. It is one of the economic growths pivotal in developing countries. It supplies protein food to human being and organic fertilizer to agricultural crops [1], [2].

The idea of integrating advanced technology in livestock sector seems more advance in developed countries. Meanwhile, developing countries livestock farmers struggle with poor infrastructure, poor skills and poor communication systems.

Owning to the education level in the developing countries the number of veterinarians to care on animals' health is limited. Due to that, rural livestock farmers use their own imagination in animal treatments. Spreading existing skills from few veterinarians and expert farmers to a maximum number of livestock farmers is highly needed.

Livestock farmers also face market issue for their products. They attend the marketplace with their products and stay there waiting for unknown customer. In opposite side to this, buyers of livestock products are also searching where to find products. They sometimes attend different markets or they lose time in waiting for unknown supplier at marketplace. The incorporation of information communication technology (ICT) in livestock sector promises the improvement. It starts with basic infrastructures such as, internet telephones and electricity.

Rwanda is one of the developing countries. Currently its internet penetration rate is 28%. Mobile phone user rate is 70% [10]. The literacy rate is 68% [3], [12]. Based on these existing infrastructures applying SMS and web based technology can cover the maximum number of farmers in the Rwandan livestock sector.

In other chapters, existing applications in Rwandan livestock and their issues are discussed. A solution proposal of applying SMS and web based technology is given, with its expected benefits.

II. LITERATURE REVIEW

The integration of technology in livestock activities has been increasing in developed countries as well as developing countries. Its participation in different ways brought out some changes.

Technologies such as, mobile and web based applications, sensors, GPS, GIS and SMS have been applied in different country's livestock to fix some existing issues [15], [16]. In this study, we are focusing on the feasibility and effect of SMS and Web based technology in developing countries.

A. SMS technology

SMS technology is a mechanism of transferring or getting short messages by a cellular phone[4], [5]. Communication between web based applications and cellular phones is possible and useful. The short message service center (SMSC) and short message service gateways (SMS gateway) also named Mobile Switch centers (MSC) are included in process of sending and receiving short messages. See Fig.1. SMSC operates as storage and transmitter system for short messages. SMS gateway translates message into different formats and protocols. It acts as an

intermediary between destination and SMSC [4], [5], [6]. SMS text message is limited to 160 characters. The text beyond these characters is split into two or more messages [14], [6].

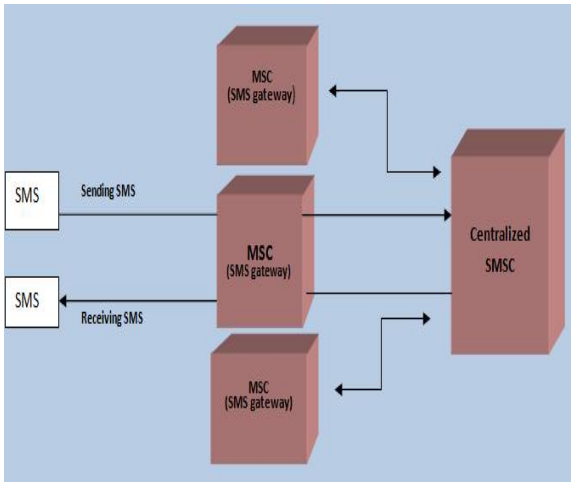


Fig. 1: SMS network architecture [5], [6].

B. Existing related systems

In Philippine there is a web based application of e-Learning for agriculture and fisheries. It provides information for capacity building to farmers [7].

Uganda Applab is another application found in Uganda. It provides information on market prices, animal diseases and weather information [8].

Rwandan Ministry of Agriculture and Animal Resources already started the integration of ICT in its activities and has some applications in use. Noz'UBZ application is a web based application. It provides capacity building information on agricultural and livestock [18]. Hinga Worora magazine broadcast information to the remote area where internet can not reach. It is in hard and soft copies means accessible on internet and in hard copies [17]. There is also an e-Soko application, which provides market price information by SMS [9].

C. Existing issues with current systems

Due to the internet limitations, livestock farmers in unreached zone are missing useful information for their development. A gap between these who are located in internet covered zone and uncovered zone is created [10]. All existing systems are one way communication process. Livestock farmers can receive information. However, they cannot ask for advice when they get confronted with something, like new disease, or any other issue which may occur in their daily activities.

III. PROBLEM STATEMENT

Rwandan livestock problems are mostly caused by poor infrastructure and education level. As Fig.2 shows, livestock problems are primary based on poor infrastructure such as, roads, electricity and limited internet accessibility. They are also based on education level such as insufficient number of veterinarians and poor skills.

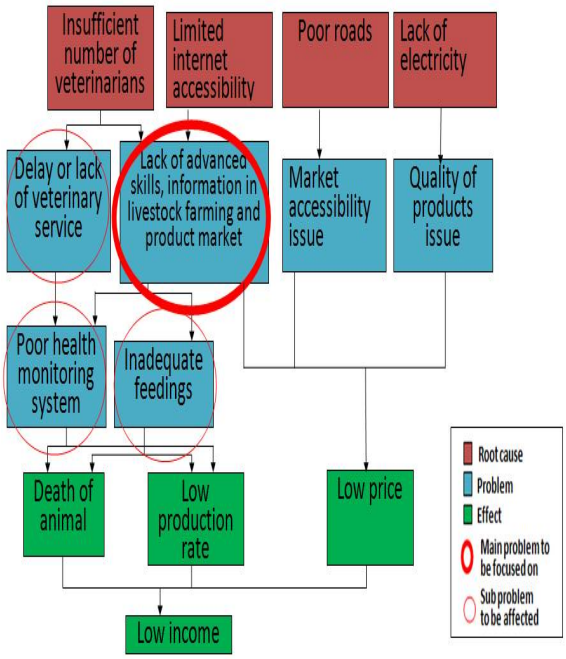


Fig.2. Problem analysis diagram

In broad-spectrum, Fig.2 shows the problems' root causes, problems and effects. Delay or lack of veterinary services, poor communication system, poor road, lack of electricity, lack of marketing system and lack of advanced skills are problems which are facing by farmers. Delay or lack of veterinary services and poor communication system also cause the inadequate feeding or poor health monitoring for raised animals. All these listed problems brought out negative effects such as, death of animal, low production rate, low price, whence low income to famers, see Fig.2.

D. Functionality considerations

1. Communication system

Existing applications are one way communication. A one way communication allows farmers to receive information. However, they do not have the ability to ask any question. Even if the received information seems to be incomplete to them, there is no way to ask for other clarification or for help. The government staff in charge of livestock use only phone calls and field visit in monitoring process.

2. Marketing process

Marketing is done voice by voice, from one person to another. In the meantime, there is no existing system to facilitate livestock farmers in marketing. Famers are losing their time at the marketplace waiting for unknown customers for their products. Buyers who are in seek of livestock products are also doing the same.

3. Capacity building Skills in livestock farming

Due to the insufficient number of veterinarians, advanced skills in livestock farming are not received by all farmers. Some skills are shared on internet. Because of the internet accessibility limitations, farmers in remote areas cannot access existing information.

Livestock farmers need skills on how to improve their raising production. Skills such as, artificial insemination, feeding formulas, vaccination, and other animal health care methods are missing, especially to remote areas farmers.

E. Technological considerations

The internet penetration and mobile phone users have to be considered to maximize the targeted livestock users. In Rwanda at least one family has a mobile phone while the internet is still limited and mostly accessible in town rather than in remote areas [10]. To access internet, people in remote area use the public place named telecenter. Each district has one or two telecenter. An SMS length is limited, and based on that, the SMS length has to be taken into consideration. The information has to be filtered in order to deliver essential and useful information within SMS length capacity.

IV. NEW SYSTEM PROPOSAL

The proposed solution to the listed problems found is **a combination of SMS and web based technology to boost livestock.** The system should be a web based application, accessible on both internet and on cellular phone through SMS.

A. System functions

The system homepage will contain livestock farming categories such as poultry, cattle, rabbits, etc. System users select the farming category to visit on homepage based on their interest. Any user will be able to visit the marketing page and access all capacity building information. However, to access communication groups, or to post marketing information, a membership registration is required for information validity and security.

The registration is done by filling and signing a hard copy form. The filled form and identification card copy have to be given to the person in charge of livestock at sector level.

The main system functions are communication groups, marketing and capacity building information. To each function an SMS feature is added to broadcast information to farmers in remote areas.

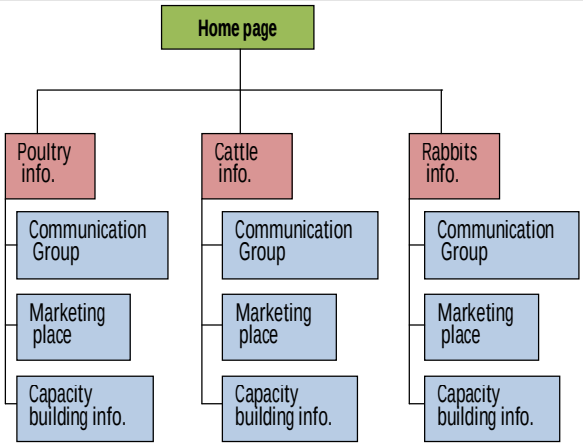


Fig.3. System functions overview

1. Communication group with SMS integration

Communication groups are livestock farmers' forums, where livestock famer can discuss with other livestock farmers who are raising the same type of animal, see Fig.4. The farmer can send a query to the communication group. The response from expert farmers or from veterinarians assigned to the same group will be generated. This way of sharing ideas will facilitate even the government staff in charge of livestock to know what is going on in livestock day per day. They can follow the discussions and intervene if necessary.

Considering internet accessibility limitations, SMS technology is applied, its integration is shown in Fig.4. The user can receive the communication group message through SMS and reply or initiate the new one by SMS.

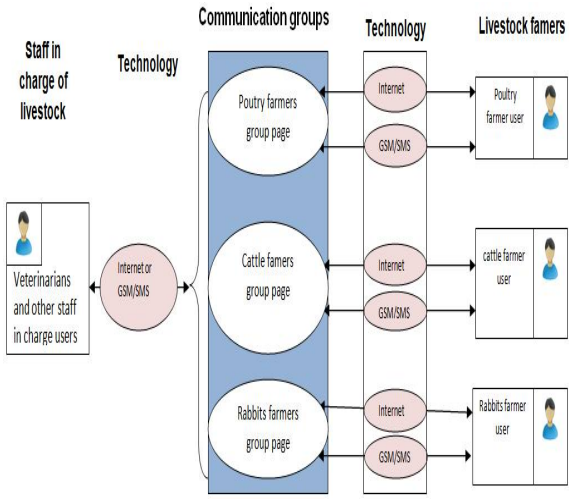


Fig.4. Communication group and SMS integration diagram

2. SMS integration into capacity building and marketing

Considering the length of an SMS, trainings and marketing information will be detailed on a web page, only the notification message to be sent as SMS to the registered cell phones.

B. System architecture

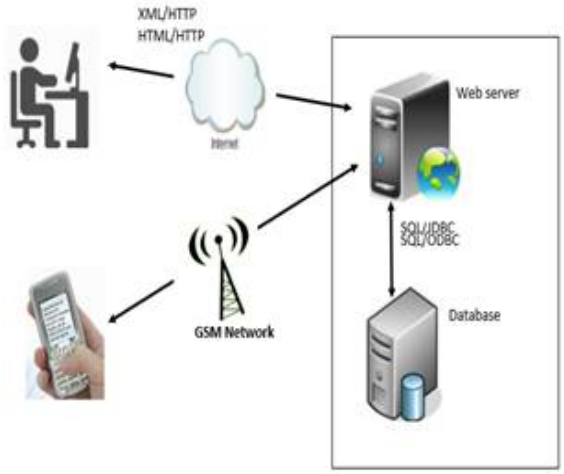


Fig.5. System structure

The system in general consists of database to store all livestock information. The database communicates with a web server for visualization. The web Server also communicates with GSM network. To access the system, users can use internet to visit web pages or cellular phone SMS by GSM network, see Fig.5.

V. EXPECTED BENEFITS

Livestock farmers will be able to send queries to the communication group, and get answers from the expert farmers or veterinarians in the same group. They will also find people who are interested in their products. Buyers who are in seeking of huge quantity of livestock products will be capable of sending their tender to farmers. High level staff in charge of livestock will get the ability of monitoring and communicate with veterinarians and livestock farmers. Livestock farmers who live in remote areas where facing difficulty with internet accessibility will use SMS for group communications. They will receive notification message related to the new livestock skills and advertised products on web pages. Then based on their interest, they can decide to visit the nearest telecenter or other internet access point for detailed information.

VI. LIMITATIONS

This system is limited to communication groups, capacity building and marketing abilities. It should be accessible on the internet and SMS. The SMS capacity is a challenge and due to its limited capacity all the information will not be sent through SMS. For capacity building and marketing, SMS as a notification message will be used. It may also be difficult to farmer to pay SMS price, there might be an understanding with telecommunication companies on SMS price.

CONCLUSION AND RECOMMENDATION

The proposed solution is SMS and web based system. It provides two ways communication facilities. The expected positive effects will eradicate existing gap of insufficient number of veterinarians, and strengthen communications, capacity building, and marketing process in livestock farming. The system implementation requires a feasibility study of each place, where it should be implemented. Some factors such as ICT infrastructure and literacy rate may be different and affect the system impact.

The system can be upgraded based on the ICT infrastructure in place. For some countries, with a higher penetration rate of smart phones, a mobile application version with the same functions is recommended.

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