Design and Implementation of SMS Based Cattle Healthcare System for Mandera County, North Eastern Kenya

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***Abstract* - In general, across Africa, livestock sector provides a large proportion of agricultural value added, almost one third and in some countries more than one-half. Close to two third of the value of edible livestock products is generated by cattle (meat and milk), sheep and goats (meat and milk) and poultry (meat and eggs) contribute about quarter each. However, Mandera community in North Eastern Kenya province are pastoralists and does not settle in one place. With the increase of disease diagnosis, and lack of available veterinary created the need to limit animal health-related risks and major consequences of disease outbreaks. In this paper, the authors analyse the current cattle healthcare issues in Mandera County and proposes an SMS bases system that farmers themselves query for animal healthcare information. Finally, at the end a further recommendation and suggestions are presented.**

***Keywords*: Cattle Healthcare, SMS Based System, Kenya**

I. Introduction

The livestock sector in Mandera County provides livelihoods for majority of the residents who are mostly small-scale livestock producers. It is a key source of food and nutritional refuge for consumers and producers and, for some people; livestock are a "mobile bank" providing security in times of drought or disaster (Waithera 2011). For this reason fighting livestock disease is an inevitable task and a big headache to this marginalized community.

Additionally, there is also lack of Information and Communication Technology (ICT) support to the livestock, such as, Mobile healthcare system which can lower costs and improve the quality of livestock healthcare as well as shift behavior to strengthen prevention, all of which can improve health outcomes over the long term(Anand and Srivatsa 2014, Qiang et al. 2011). Other constraints to livestock production in the target production systems include limited extension services, cattle rustling, limited access to financial services and insurance facilities, corroding of traditional institutions and coping mechanisms, and loss of common property resources.

The livestock producers, though extremely experienced in disease diagnosis, indigenous knowledge and ethno-veterinary medicines, lack the knowledge to determine the ethical use, dosage rates, route of administration and quality the available veterinary pharmaceuticals (Munyua, Farrah and Kahiu 1999). Government veterinary services were the least accessible and available service provider. In most pastoralist areas, they are rarely seen beyond vaccination campaigns (Leyland et al. 2014).

The objective of this paper is to develop and deploy a working prototype of SMS based livestock health information system and a database with information livestock symptoms and treatment. The system is user initiated SMS enquiry. A web portal for detailed diagram representation of the practical aspects is available both on computers and internet enabled mobile phones.

In the coming section 2, a summarized brief on current issues of cattle health in Mandera and existing approaches are discussed in detail. In addition, the followed methodology and analysis results are presented in sections 3 and 4. More so, the proposed system is detailed in section 5 and finally, the conclusion and further recommendations are presented in section 6.

II. Mandera County

Mandera County, as shown in figure 1, is located in North Eastern Kenya borders Ethiopia to the North, Somalia to the East and Wajir County to the South. The distance from Nairobi to Mandera town is about 1,100km by road. The approximate population of the county is about 1,025,756 persons and covers a total area of about 25,991.5 km2. Administratively the county is subdivided into six Sub-counties namely Mandera West, Banisa, Lafey, Mandera South, Mandera North and Mandera East and further to 30 administrative wards.



Figure 1: Mandera County, North Eastern Province, Kenya

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People in Mandera are pastoralist and depend on cattle although majority of the cattle die due to lack of treatment. Pests such as ticks and tsetse fly and diseases such as rinder pest, anthrax and east coast fever are common in Mandera. Areas in Mandera are inaccessible and veterinary services are inadequate hence it is difficult to treat or improve the animals given that the pastoralist are always on the move. Due to all these problems, there is a need to develop a system that will assist to reduce the cattle death and which is readily available regardless of one's locality at any particular time in Mandera County.

Farmers lose their livestock to treatable and manageable conditions because of lack of immediate healthcare attention since animal healthcare services are far away in the county headquarters and the farmers keep moving from one place to another in search of pasture. This system hopefully helps farmers get information about what a sick animal could be suffering from and the necessary treatment. The farmer would then administer the medication while monitoring the cow/ goat for improvement.

III. Background Study

Surveillance and monitoring efforts are major components for effective disease prevention and control[1]. Because many infectious diseases are emerging in animals in low-income and middle-income countries, surveillance of animal health in these areas may be needed for forecasting disease risks to humans (Robertson et al. 2010). As a preventive measure, disease surveillance is aimed at reducing animal health-related risks and major consequences of disease outbreaks on food production and livelihoods[2]. Timely and good-quality information about disease events are needed in order to understand the disease situation, support decision-making, prevent potential disease incursion and respond quickly in an emergency situation (FAO 2011). Robertson et al (2010) further argue that establishing links between animal and human health data has been difficult because data from animal and human health surveillance systems are obtained at different resolutions and scales and for different purposes. Early warning of animal disease outbreaks with a known zoonotic potential enables health authorities to advise at-risk populations. Public health measures – including behaviours to be avoided and controls to prevent human illness and mortality – can be implemented (FAO 2011). In a study of Mobile Phone–based Infectious Disease Surveillance System, Sri Lanka, it was concluded that mobile phone–based surveillance of animal populations is acceptable and feasible in lower-resource settings (Robertson et al. 2010).

As in most other technical and management fields, information management is fast becoming the key to effective action in animal health. A modern veterinary service requires effective systems for gathering relevant information from the field, processing it in ways which provide maximum value, and presenting it in a form which is easy for national policy-makers and field staff to use in implementing appropriate actions to achieve effective disease control[3]. According to Ngouambe (2013) animal disease will no longer be a major problem when there are more ICT applications allowing farmer to get immediate solution via their mobile phones.

Some of the existing approaches are iCow and mKRISHI systems. iCow is an SMS based information and education platform, which has been developed by a Kenyan company called Green Dreams Ltd (Green Dreams TECH LTD 2015). It is conveniently available in English and Kiswahili and currently has three main modules: 'Mashauri' gives education and advice, sending regular 'tips' to farmers on animal husbandry and management; 'Kalenda' is a calendar, which can be tailored to specific individual cows, calves and heifers, assisting with the management of oestrus cycles and gestation periods; and 'Vetenari' gives access to a database of registered veterinary personnel and support services. Effectively iCow acts as a virtual veterinary nurse, midwife and farm business consultant, giving advice on gestation, milk production, animal health and nutrition[4]. In Kenya, iCow helps more than a million farmers in prevention and cure of milk related diseases via mobile phone. The platform allows farmers to alert the system immediately when there are disease outbreaks, allowing everyone to react to it quickly[5].

The mKRISHI service recently piloted by Tata Consulting Services in India is a prototypical example of remote extension services that allow two-way interactions. A farmer uses the platform to access best practices and query agricultural experts through low cost mobile phones, mostly using SMS. The experts interact with a system that resembles email; they are able to see attached photos and soil sensor information with each message and their response is sent back to the farmer by SMS. The advisory service has so far helped individual farmers significantly reduce costs associated with inputs, increase yield and improve quality of produce, thereby positively impacting their profit margins[6].

The above systems do not address issues to do with pastoralist community who move from one place to another in search of water and pasture. The pastoralist community does not depend on one community center and always may be in far place to get help from the authorized centers. These systems are created for such community that stay close to the community center. In addition, these systems do not provide a localized system which is delivered in their local language. Therefore the proposed system intends to develop a system that farmers themselves query for animal healthcare information.

IV. Methodology

The study participants included livestock keepers who were the system users sampled from the 6 Sub-Counties at Mandera which involved simple random sampling of 17 livestock keepers at each Sub-county and 5 veterinary doctors (3 public and 2 private) who were the stakeholders at Mandera County. Based on the collected data, there was 97% response rate among livestock keepers and 60% response rate among veterinary doctors. Systems requirements and design considerations were obtained from interviews and questionnaires with stakeholders and users. Quantitative data was analysed using SPSS version 20 while qualitative data

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was analysed through content analysis. . The respondents were provided with information on the research and its intended purpose and informed consent was obtained from them. The interviews were based on voluntary participation and all the responses got from respondents were treated as confidential.

The study consisted of two data collections. The first stage of data collection was preliminary study for the collection of the needs and requirements of the system and demographic study. The second data collection state was testing and validating the proposed system.

The design of this system followed the systems development life cycle (SDLC), also referred to as the application development life-cycle. This included: planning to establish the high-level view of the intended project as well as its goals; Systems analysis, requirements definition to refined the project goals into defined functions as well as end-user information needs analysis; Systems design to describe desired features and operations in detail; writing the real codes; special testing to check for errors, bugs and interoperability as well as usability testing.

For the development, we used PHP, JavaScript and HTML for programming and scripting the user interface, and MySQL for database management.

V. Preliminary Findings

Majority of the livestock keeper respondents were aged between 30 and 39 years, male livestock keeper respondents composed of 72.2% while those with no formal education composed of 74.2% of the respondents.

On the other hand, majority 88(90.7%) of the respondents owned a mobile phone of whom 93.2% owned a basic phone which they were using mostly (52.3%) on a daily basis. Most (78.4%) of these phones owned by the respondents were charged at the local centres. None of the respondents had previously used a mobile phone to access animal health information while all the respondents reported to consider using a mobile phone based system providing animal health information. According 97.9% of the respondents, they would prefer to use Somali language while accessing animal health information on mobile phones.

Moreover, majority (74.2%) of the respondents kept goats while only 43.3% kept camels. According to majority of the respondents; cattle (65.2%), goats (59.7%) and sheep (57.4%) sometimes fell sick while camel rarely (40.5%) fell sick. According to the KIIs diseases common affecting cattle, goats and sheep were babesiosis, CCPP, helminthiasis, trypanosomiasis and PPR while diseases affecting camels were black quarter, anthrax and camel trypanosomiasis.

As shown in figure 1, nearly half (48.5%) of the respondents administered drugs from agro vets to their sick animals, 35.1% did nothing about their sick animals while an equal number (8.2%) administered local medication or sought veterinary advice from a doctor. The respondents attributed lack of seeking veterinary advice from doctors to general inaccessibility of veterinary doctors both in terms of their unavailability, geographical distance and unaffordability of their services.

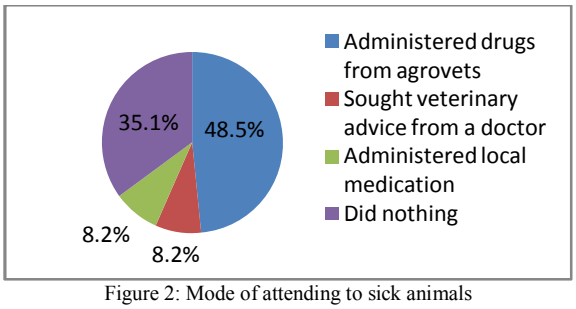


Figure 2: Mode of attending to sick animals

In addition to that, majority (76.3%) of the respondents as shown in figure 2 had never sought veterinary advice from doctors for general heard health. This was attributed to general inaccessibility of veterinary doctors both in terms of their unavailability, geographical distance and unaffordability of their services.

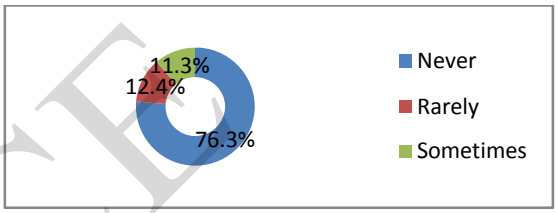


Figure 3: Frequency of seeking veterinary advice

From the presented analysis and the confirmation of user requirements by the public and stakeholders as shown above the following was discovered: there was no existing system in use and the proposed system would help a lot in educating farmers and helping them seek the first treatment of their cattle. In the next section, the proposed system design and application is discussed.

VI. The Proposed System

Following the objectives of this system and the user requirements gathered from the participants who were interviewed or returned completed questionnaires, the proposed system envisaged the following functional requirements

i. The database should be able to receive and respond to cattle disease and treatment enquiries sent through SMS.
ii. The system should be able to compare the different search based on language and content of the disease symptoms and treatment searched.
iii. The system should provide Options to guide the users on the available cattle disease options.
iv. The SMS interaction should take the form of SMS chat but with specified options to guide the user.

The Cattle Disease and treatment system comprised of different interrelated and interacting entities which required a model to help in its comprehension, while at the same time achieving various user requirements and supporting decision

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making. We designed with screen layout in mind and took care of all functional and non-functional requirements. For the purposes of the objectives of this project modelling emphasis will be on the SMS interaction with the database. Figure 3, shows the conceptual diagram of the system.

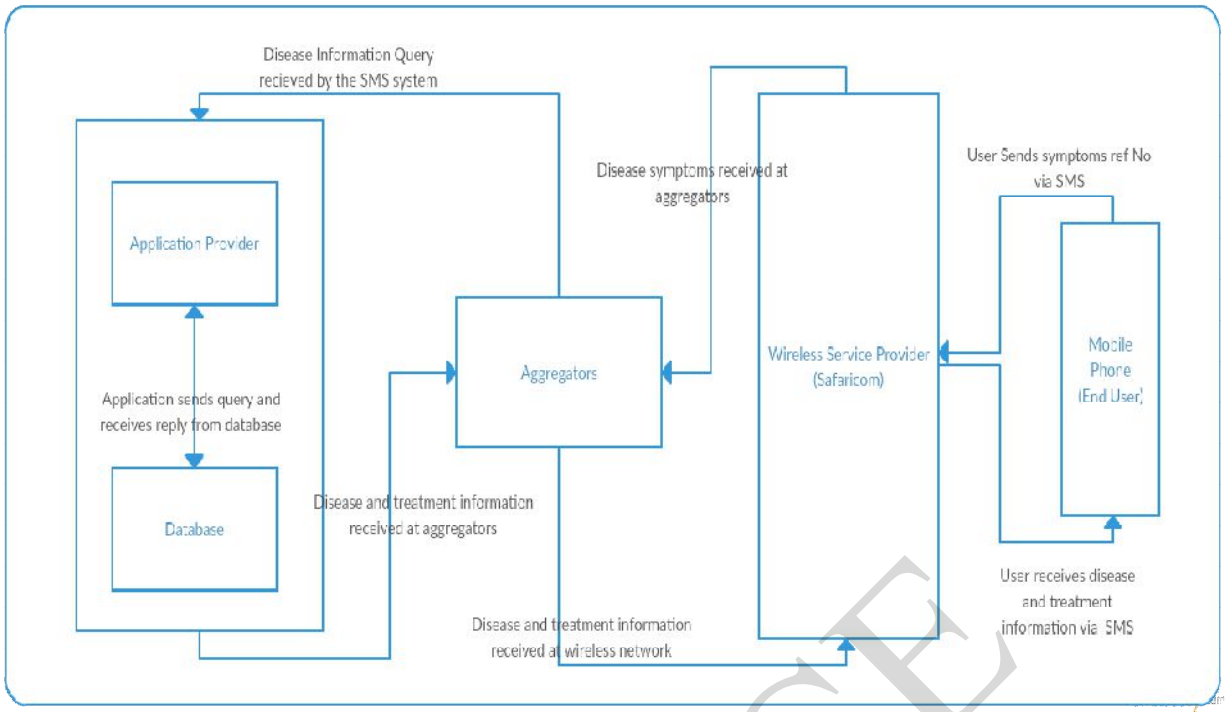


Figure 4: Conceptual Diagram

The end product of the developed system was a fully working Cattle disease and treatment SMS system with operational short-code SMS functionality. The user shall initiate the system by sending "110" to the Safaricom short-code 21446. Upon receiving the initiation code the system will respond by asking the user to choose the language they would like to interact with in the system either English or Somali and then the user is then given a list of cattle disease symptom criteria based on established diseases. He will then be required to identify the criteria which best fit his cattle and then reply with the respective code with the disease and treatment for the symptoms identified.

VII. Results and Discussion

To test the system usability 50 livestock keepers were targeted, however 46(92%) responded to the testing

To test the system usability, 5 point Likert (1 – strongly agree to 5 – strongly disagree) scale items relating to system interaction, speed, language, clarity and accuracy was used. As shown in the table 1, the respondents were elated by the system interaction, speed, language, clarity and accuracy. SA – Strongly Agree; A – Agree; N – Neutral; D – Disagree; SD – Strongly Disagree.

questionnaires.In terms of disease inquiry about, an equal number (73.9%) used the system to inquire about Helminthiasis and Babesiosis as shown in figure 5.

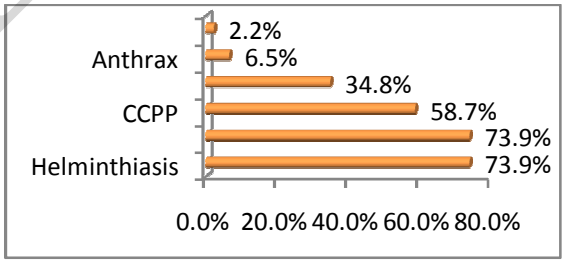


Figure 5: Disease Inquiries

As shown in the table, the validation and testing of the system was based on these five domains. The result shows that majoring of the respondents satisfied with the developed application. The overall satisfaction and meeting the required needs of the pastoralist communities has being met by the system.

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TABLE 1: SYSTEM INTERACTION, SPEED, LANGUAGE, CLARITY AND ACCURACY

Domain	Statement	SA	A	N	D	SD	Median
Interaction	Overall, I am satisfied with how easy it was to use this system	37 (80.4%)	8(17.4)	1(2.2)	0(0)	0(0)	SA
	It was simple to use this simple	10 (21.7)	25 (54.3)	11(23.9)	0(0)	0(0)	A
Speed	I was able to get information I needed quickly using the system	17(37.0)	21(45.7)	5(10.9)	3(6.5)	0(0)	A
	I liked using the interface of this system	21(45.7)	15(32.6)	7(15.2)	3(6.5)	0(0)	A
Language	I felt comfortable using this system language	20(43.5)	17(37.0)	7(15.2)	2(4.3)	0(0)	A
	It was easy to learn to use this system	17 (37.0)	21(45.7)	6(13.0)	2(4.3)	0(0)	A
Clarity	The information provided with this system was clear	15(32.6)	21(45.7)	8(17.4)	2(4.3)	0(0)	A
	The interface of this system was pleasant	14(30.4)	18(39.1)	6(13.0)	0(0)	8(17.4)	A
Accuracy	The information was effective in helping me get information I needed	16(34.8)	19(41.3)	7(15.2)	3(6.5)	1(2.2)	A
	This system has all the functions and capabilities I expect it to have	24(52.2)	13(28.3)	6(13.0)	2(4.3)	1(2.2)	SA

The SMS based system starts with sending 110 message to 21446 using Safricom telecom. The system responds by choosing either English or Somali language. After that, the system displays treatment based on the symptom they select or give them a veterinary contact details for further information. The below figure 6 and 7 shows a sample of the English version of the system.



Figure 6: English Sample 1

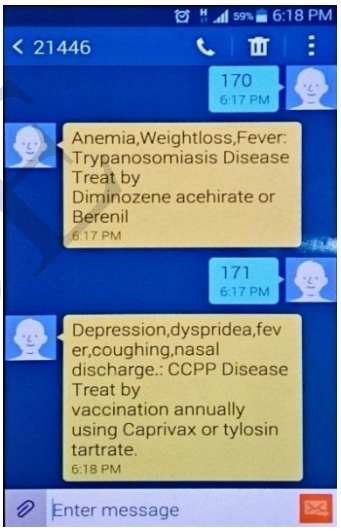


Figure 7: English Sample 2

Below figure 8 and 9 shows a sample of Somali version of the system.



Figure 8: Somali Sample 1

REJECT

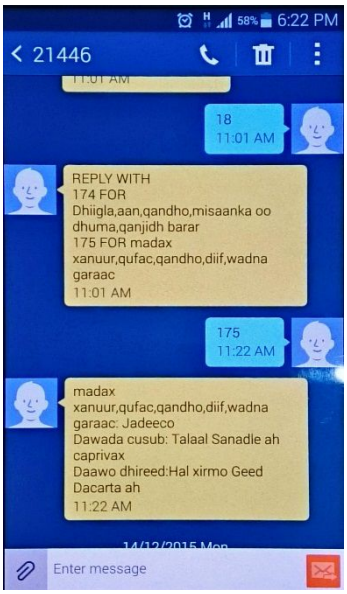


Figure 9: Somali Sample 2

The system has being used by several users since the deployment of the application. Below figure 10 shows a graph of number of users called the system and which symptoms they selected.

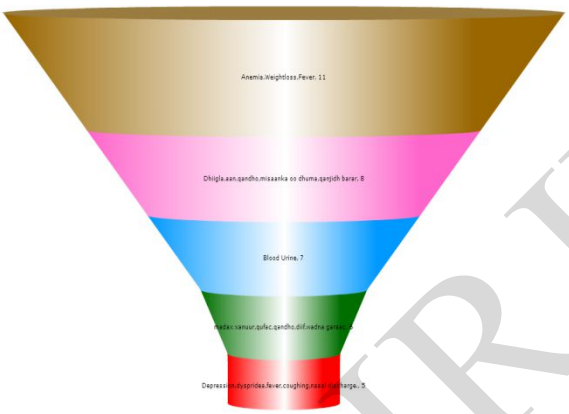


Figure 10: Query Report

VIII. Conclusions and Recommendations

From the study findings, we found that most of livestock keepers in Mandera County owned basic mobile phones, however none of them had used it to access animal health information but all were willing to use their phones to access this information.Animals kept by livestock keepers, i.e. cattle, goats and sheep, in Mandera County equally sometimes fell sick. As their animals became sick the keepers administered drugs from agro vets without consulting veterinary doctors because of their inaccessibility both in terms of unaffordability, geographical distance and unavailability.

As most of the livestock keepers had no formal education, a system based on Somali language was designed which they reported to being comfortable while using this language in accessing animal health information. Thesystem was appropriate for the type of phones owned by the livestock keepers since it aided them to access animal health information instead of just administering drugs from agro vets without knowing the type of disease their animals were suffering from.

Since most livestock keepers in the study area owned basic mobile phone, it would be the most appropriate means of delivering of animal health information which were currently non-existent. This implied that system developers should target systems designed with basic phone features in mind. As livestock keepers tend to administer drugs from agro vets directly without consulting veterinary doctors posing a great danger to their animals, there is need of scaling up of such prototypes of systems to increase accessibility of expert animal health information to the livestock keepers. Finally, lack of formal education renders system applicability relevant if only accessible in the Somali language, thus such systems can only designed with users own comfortable language.

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