

**WEB PORTAL DESIGN AND IMPLEMENTATION FOR LIVESTOCK FARMERS
IN MANDERA COUNTY**

BY

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**A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF
SCIENCE IN INFORMATION TECHNOLOGY, DEPARTMENT OF
INFORMATION TECHNOLOGY, SCHOOL OF INFORMATION SCIENCES**

**MOI UNIVERSITY
ELDORET**

2018

DECLARATION

DECLARATION BY THE CANDIDATE

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DEDICATION

To my supervisors who helped me in preparing this thesis

ABSTRACT

Livestock farmers in Mandera County are faced with the devastating effects of climate change, lack of access to quality information services and absence of effective marketing means. An alternative marketing platform acting as an early warning system on critical information such as droughts, climate and diseases, and other issues affecting the farmers in the county, relevant to the donor community, the government and the farmers is therefore required. This study therefore aimed at assessing the information needs of livestock farmers in Mandera County in order to come up with a web portal that serves their needs. The study's specific objectives were to: investigate the information needs of livestock farmers in Mandera, establish existing channels of disseminating information to Mandera livestock farmers, survey existing livestock-based information systems and portals serving Mandera livestock farmers, model the collected data for system analysis and design and develop a web portal addressing the concerns of Mandera livestock farmers. This study was informed by Activity Theory, Wilson's information behavior theory and the Systems Development Life Cycle (SDLC). A single case study made up of a structured interview and observation was used to collect data for the study. The target population was livestock farmers living in Mandera County with a current population of 1.2 million. A stratified sampling technique was used to draw a four-cluster sample comprising herders, traders and livestock officers and for every cluster, a purposive technique was used to select the respondents. The collected data was analyzed using thematic analysis and descriptive statistics, presented in the forms of tables, pie charts and texts. The findings of the study show that the respondents critically needed information on market, weather, veterinary and lost and found animals, and mainly used local FMs, friends, *barazas*, national dailies and social sites for information sharing. No information system specifically designed to serve livestock farmers in Mandera County was found. The study concludes that the modes of information dissemination currently available to the farmers are inadequate to serve their needs and therefore modernization in this area is required. Based on the findings the study recommends to the concerned actors the use of modern methods of information dissemination to reach the farmers, provision of biotech services to improve yields, timely availing of satellitic data on vegetation cover status to the farmers for early drought warning and development of an online information portal that can provide information services needed by the farmers. Further, findings were used to develop a web and mobile portal that can avail the needed information to improve livestock farming in Mandera County.

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ACKNOWLEDGEMENTS

I offer my special thanks to my supervisors, Ms E. Milgo and Dr. D. Odero, who reviewed my thesis, and kept me on the right track with their advices and communications,.

I also want to thank Dr. Gichoya and Dr. Kemoni for assisting me to formulate my title and for giving me motivation and a general introduction to doing research.

In addition, I also like to acknowledge Moi university librarians, finance officers, security personnel, secretary, university administrators and nurses. Their support and assistance were highly appreciated.

Finally, I thank my friends and mates for their valuable support and sharing of ideas and resources of great value to me.

ABBREVIATION AND ACRONYMS

FAO:	Food and Agriculture Organization of United Nations
GOK:	The Government of Kenya
ICT:	Information Communication Technology
NLMIS:	The National Livestock Marketing Information System
USAID:	The United States Agency for International Development
XP:	Extreme Programming

CHAPTER ONE: INTRODUCTION

1.0 BACKGROUND OF THE STUDY

This chapter presents statement of the problem, aim of the study, specific objectives of the study, research questions and significance of the study and is organized into ten sections: background of the study, statement of the problem, aim of the study, specific objectives of the study, research questions, assumptions of the study, significance of the study, scope of the study, limitations of the study and chapter summary.

1.0.1 INTERNET AND PASTORALISM

The internet has generated massive changes in markets, private and public sectors and economies of today's world. One aspect of internet application that is gaining renewed interest and fame is the use of internet for development and poverty reduction. Both national governments and donor communities are realizing huge benefits the Internet can bring to poor communities living in remote areas, particularly the livestock farmers and are adopting strategies to maximize this potential. The internet reduces transaction costs, changes markets structures, integrates global and local markets, and creates employment opportunities. As such the Internet can have a big impact in stimulating local micro-economies and raising the purchasing power of rural peoples.

Success stories and experiences from Far East and other developing countries about how the internet has lowered poverty levels in those areas have encouraged the government and many NGOS in Kenya to adopt rural automation.

In addition to implementing the East African Marine Systems and the National Terrestrial Fiber Optic Project to connect cities and counties, the government of Kenya is planning to

establish digital villages and rural ICT enterprises in all counties as is clearly evident from the ministry of Information and Communications strategic plan 2008 –2012. The objectives are to encourage the growth of rural ICT SMEs, to facilitate online delivery of government services and to bridge digital divide.

Similarly, the NGO sector and the donors are concentrating their efforts on applying ICTS and the internet to raise the status of pastoral systems.

A number of livestock-oriented information systems have been developed by donor communities to manage East African genetic resources. Some functional ones include:

FAO AGRIMARKET

AVAILABLE AT: <http://www.fao.org/english/newsroom/highlights/2000/000401-e.htm>

An Agrimarket is a marketing information system developed by FAO and provides up-to-date market information services. It uses Microsoft Access as its main database system for entering and processing the market data. Market Information services are provided for both crop and livestock farmers.

LIVESTOCK INFORMATION NETWORK AND KNOWLEDGE SYSTEM (LINKS)

AVAILABLE AT: <http://www.lmistz.net/Pages/Public/Home.aspx>

LINKS is a Livestock Information Network and Knowledge System developed by USAID 2003 with an aim of providing regular livestock prices and volume information on most of the major livestock markets in Ethiopia, Kenya and Tanzania along with information on forage conditions, disease outbreak, conflict and water supply to support decision making at multiple scales.

THE KENYA NATIONAL LIVESTOCK MARKET INFORMATION SYSTEM (NLMIS)

AVAILABLE AT: <http://www.lmiset.net/>

NLMIS was funded by USAID and Kenyan government and its deployment began October 2003 with the main aim of filling critical gaps in livestock marketing information particularly in the major livestock producing areas in the arid and semi-arid lands of Kenya. NLMIS was developed to respond to livestock marketing information needs by providing an information communication technology infrastructure for reporting and requesting information on livestock prices and volumes from a network of different markets. NLMIS users include livestock keepers, traders and policy makers.

IGAD LIVESTOCK INFORMATION PORTAL

IGAD Livestock Information Portal was developed by the IGAD Livestock Policy Initiative (IGAD LPI) to act as a web-based gateway or one-stop shop information management system to provide IGAD Member States and stakeholders in the livestock industry with comprehensive information to strengthen evidence policy making for the sector. The information provided included documents, spatial datasets, and links to key data and information sources, link: <http://www.igadportal.com/index.php/documents>.

1.0.2 LIVESTOCK FARMING IN MANDERA

Mandera County is located in north eastern part of Kenya and borders Ethiopia to the north, Somalia Republic to the east and Wajir County to the south and south west. It is 1,100km from Nairobi by road. It comprises six constituencies: Mandera West, Banisa, Mandera North, Mandera South, Mandera East, and Lafey (IEBC 2012). The county is inhabited

almost exclusively by ethnic Somalis. Their population is estimated at 1,025,756 persons according to Kenya population and housing census of 2010 (KNBS, 2010).

The climate of Mandera is classified as arid (BW) under the Koppen climate classification (Encyclopedia Britannica online, 2012). Temperatures tend to be hot throughout the year. The County is prone to droughts with low rainfall most of the year. Daytime temperature is above 30 degrees Celsius and at night they can fall to 20 degrees. The county is still smarting from two consecutive failed rainy seasons. In June 2011, the county was rated by the arid lands drought assessment report as being at “emergency drought level” and ‘deteriorating’ (Kenya ALRMP, 2011).



Figure 1.0: Map of Mandera County

Livestock is the main backbone of the county's economy. It is estimated that Mandera has over 4 million goats, 2 million sheep, one million camels and one million cattle as shown in table 1.0. Animal husbandry is an important activity throughout the county.

Table 1.0: Livestock population by type and constituency in Mandera County

Constituency	Cattle	Sheep	Goats	Camels
Mandera Central	467713	745295	1767102	385085
Mandera West	302474	344581	656442	366021
Mandera East	306791	542948	1506703	179713
Total	1076978	1632824	3930247	930819

Source: [Livestock Census 2009, KNBS]

The main livestock species in the county are indigenous cattle breeds, sheep, goats and camels. The herds are raised on the rangelands, open plains and along the shores of river Dawa.

In terms of geographical distribution, cattle are the most common along the shores of rivers, followed by sheep and goats. The camels are found in the mountainous regions where taller vegetation for browsing is plenty.

During dry seasons, water and pasture may become scarce, resulting in animals dying out in large numbers. The watering patterns of livestock are such that cattle are frequently watered every second day, and small ruminants twice a week, while camels can endure for weeks before being watered and remain substantially productive.

Overgrazing and bush clearing are the major root causes of land degradation and increase in desertification.

1.1 STATEMENT OF THE PROBLEM

Residents of Mandera County have been facing a myriad of problems affecting their livelihoods and endangering their herds. Firstly, climate change and increasing desertification have caused a major decline in grazing grounds and a strain on water supplies- the two key ingredients needed for survival of pastoral economy. The impact of these is enormous, often resulting in a wave of herd die-offs, decreasing per capita ownership of herds and crashing livelihood options (Christian aid, 2006 and Pavanello, 2010).

Secondly, the local livestock market faces widespread fraud and limited access to international market (CARE, 2009 and IDRC, 2010). Brokers and other unscrupulous elements buy animals at very low prices from the farmers, taking advantage of their ignorance of prevailing market rates resulting in farmers losing millions of pounds worth of their business. The current circumstances have also denied the farmers the opportunity of accessing the international market and expanding the volume of their trade. Unless this condition is significantly addressed through a vibrant marketing service, farmers will continue to lose real value for their business and face increased odds in trade.

Thirdly, the information services offered to the farmers by both the government and non-governmental players have been wanting. Radios, public *barazas*, newspapers and oral communication dominate approaches used to disseminate critical information. The currency and integrity of the contents provided are at risk (U4, 9 and Picard, 2009). Modern technologies such as the Internet have not been exploited.

Fourthly, existing livestock management information systems (MISs) such as FAO Agrimarket and NLMIS provide marketing information only and are not in a form easily accessible to Mandera livestock farmers.

In a desire to resolve some of the challenges of digital disparities, the government of Kenya has undertaken since 2006 a major project to increase ICT uptake across the counties as evidenced by the formulated ICT policies aimed at realizing this. These include the national ICT policy of 2006 (GOK-NICT, 2006), freedom of information policy of 2007 (GOK-FIP, 2007) and the Kenya strategic plan of 2008 (GOK, strategic plan 2008-2012). The goals of the policies are to make Kenya a knowledge-based society through electronic provision of all government services and a guarantee of universal access to ICT services. Amongst the suggested plans are the construction of digital villages and rural ICT centers in all counties to stimulate rural businesses and wealth creation and completion of the East African Marine Systems (EAMS) and National Terrestrial Fiber Optic project to extend ICT infrastructure to counties. Such initiatives provide a platform for the exploitation of web-based information systems that can effectively be exploited by a sparsely and remotely located population such as Mandera.

1.2 AIM OF THE STUDY

The aim of the study is to assess the information needs of livestock farmers in Mandera County in order to come up with an online Web portal that serves their needs.

1.3 OBJECTIVES OF THE STUDY

The specific objectives of the study are to:

1. Investigate the information needs of livestock farmers in Mandera county;
2. Establish existing main channels of disseminating information to Mandera livestock farmers;
3. Survey existing livestock-based information systems and portals serving Mandera livestock farmers;
4. Model the collected data for software analysis and design; and
5. Develop a web portal that will address the information needs of Mandera livestock farmers.

1.4 RESEARCH QUESTIONS

The study was guided by the following questions:

1. What are the information needs of Mandera livestock farmers?
2. What are the main channels employed to disseminate information to Mandera livestock farmers.
3. How do the existing information systems specifically serve the needs of Mandera livestock farmers and how effective are they if any?
4. Which software analysis and design tools and techniques are most suitable for developing a web portal for livestock farmers in Mandera?
5. How can a web portal be designed to sufficiently serve the information needs of Mandera livestock farmers?

1.5 ASSUMPTIONS OF THE STUDY

The study is anchored on the following assumptions:

1. An online livestock marketing system serving livestock farmers already exists in Mandera County
2. A good number of Mandera County residents have access to at least one mobile network.

1.6 SIGNIFICANCE OF THE STUDY

The study findings add new dimensions to the fields of mobile computing and livestock management information systems through advancement of a new mobile technology-based approach to solve persistent problems in livestock farming. The findings are further, hoped to solve, via the proposed web portal, the main problems bedeviling livestock farmers in Mandera such as inability to access international market, low animal prices and frauds in livestock supply chain.

1.7 SCOPE OF THE STUDY

The scope of the study was limited to establishing the information needs of livestock farmers in Mandera County and developing a web portal to serve these needs.

1.8 LIMITATIONS OF THE STUDY

The study limitations were shortcomings of the case study method used, self-reported data and the scope of the proposed Web portal. Study samples were convenient samples drawn using Purposive sampling due to uncertainty in sample strata numbers. Purposive sampling which is prone to researcher's personal bias and incalculability of its sampling error may

make the findings relatively incredible and hard to be generalized. Harrison (213) observes that purposive sampling is less demanding in terms of costs, time and effort, but has a risk of gathering poor quality data, resulting in poor research outcomes and as such, difficult to convince others to accept the findings of research based on poor foundation.

A single case study method was used to collect data from the respondents. Chihen (2004) argues that the subjects of a single case study are chosen based on the researcher's consideration of research questions and purposes and therefore the outcomes may only be meaningful to the subjects in that particular case. He further argues, given that the number of subjects in a single case study is usually small, there may be reluctance to believe in any theory drawn from a small group of people who were unscientifically selected by the researcher.

Much of the data collected from the respondents were self-reported data and the respondents' own stories. Brutus (2013) notes that self-reported data collected through interviews, focus groups or questionnaires contain many potential sources of bias such as:

- (1) selective memory [remembering or not remembering experiences or events that occurred at some point in the past];
- (2) Telescoping [recalling events that occurred at one time as if they occurred at another time];
- (3) Attribution [the act of attributing positive events and outcomes to one's own agency but attributing negative events and outcomes to external forces]; and,
- (4) Exaggeration [the act of representing outcomes or embellishing events as more significant than is actually suggested from other data]. These biases may affect the validity of the findings.

In addition, the developed web portal lacked online payment module but instead was limited to market information, file sharing, market analysis, user and weather modules.

1.9 CHAPTER SUMMARY

Discussed in this chapter are the background of the study, problem statement, aim and objectives of the study, research questions, significance of the study and limitations of the study. The next would either justify the need for the study or dismiss the study.

1.10 DEFINITION OF WORKING TERMS

Pastoralist:

: A way of life of peoples who do not live continually in the same place but move cyclically or periodically. It is distinguished from migration, which is noncyclical and involves a total change of habitat. Nomadism does not imply unrestricted and undirected wandering; rather, it is based on temporary centers whose stability depends on the availability of food supply and the technology for exploiting it. The term '*nomad*' encompasses three general types: nomadic hunters and gatherers, pastoral nomads, and tinker or trader nomads (Encyclopedia Britannica, 2011).

Transhumance:

: A form of pastoralism organized around the migration of livestock between mountain pastures in warm seasons and lower altitudes the rest of the year. The seasonal migration may also occur between lower and upper latitudes. Most peoples who practice transhumance also engage in some form of crop cultivation, and there is usually some kind of permanent settlement. Transhumance is practiced in those parts of the world where there are (Solomon, 2002) (Igwerson, 1996) mountains, highlands, or other areas that are too cold to be inhabited (Encyclopedia Britannica, 2011).

Web:

: The leading information retrieval service of the Internet (the worldwide computer network). The Web gives users access to a vast array of documents that are connected to

each other by means of hypertext or hypermedia links—*i.e.*, hyperlinks, electronic connections that link related pieces of information in order to allow a user easy access to them. Hypertext allows the user to select a word from text and thereby access other documents that contain additional information pertaining to that word; hypermedia documents feature links to images, sounds, animations, and movies (Encyclopedia Britannica, 2011).

Web application:

: A client/server application that uses the web browser as its client and performs an interactive service by connecting with servers over the Internet (Leon, 2003).

Web portal:

: A Web site or service that offers a broad array of resources and services, such as e-mail, forums, search engines, and online shopping malls, online services such as AOL, and Google (Webopedia , 2011).

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

A literature review is an evaluative report of studies found in the literature related to the area of study under question. It describes, summarizes, evaluates and clarifies this literature [Queen's university library, 2015: link, http://library.queensu.ca/webedu/grad/Purpose_of_the_Literature_Review.pdf].

The main purposes of literature review are to provide a context for the research, show where the research fits into the existing body of knowledge, outline gaps in previous research and to show that the work is adding to the understanding and knowledge of the field (Queen's university library, 2015).

The two types of literature are traditional and systematic reviews. A systematic review is a comprehensive review of literature conducted in methodological and unbiased manner, according to a pre-specified protocol with the aim of synthesizing the retrieved information through Meta analysis, often using statistical tests (Dictionary of Key social sciences research concepts, 2015) while a traditional review is a type of review that critiques and summarizes a body of literature and draws conclusions about the topic in question; it is useful in gathering together a volume of literature in a specific subject area, summarizing and synthesizing it (Patricia, 2008). The study adopted the traditional review to identify, appraise and select a summary of literature relevant to the objectives of the research.

This is organized into five sections: introduction, theoretical and conceptual frameworks, software models, information seeking behavior of livestock farmers, and chapter summary.

2.1 THEORETICAL AND CONCEPTUAL FRAMEWORKS

A theoretical framework is the structure that can hold or support a theory of a research study (Richard A, 2014). It introduces and describes the theory that explains why the research problem under study exists.

This study was informed by Activity theory and Wilson's information behavior theory.

Wilson's information behavior theory was developed in 1981 by Wilson and describes information-seeking behavior as arising from a consequence of a need perceived by an information user, who, in order to satisfy that need, makes demands upon formal or informal information sources or services, which may result in a success or failure. If successful, the individual uses the information found or shares it with others and in case of failure, the search process is restarted (Wilson, 1997). The theory was used to analyze information seeking behavior of the livestock farmers

Activity theory was advanced by Vygotsky (1978), Leont'ev (1981) and others in 80s. Activity Theory has been built on the premise that a human being interacts with others through tools. Mediated interaction provides a basis for investigating human activity (Vygotsky, 1978, and Leontev, 1981). Activity Theory investigates human interaction with others through an activity, which is a basic unit of analysis for understanding human behavior. Activity theorists have argued that human activity is composed of three basic elements: a subject, an object and a tool. A subject can be an individual or a group of people. More than one subject constitutes a community when they share an object. All human activities are driven by a certain purpose or motive, which is called "object".

From the Activity Theory point of view, a web portal can be viewed as a human activity involving objects, subjects, tools and virtual communities in an online environment. Subjects are individual users or a group of users who login to the site to seek services and interact. Objects are motives that drive the users to act while tools are the web sites that mediate the communication process. Users include a wide variety of target audiences ranging from individuals, organizations, governments and the general public and hence constitute a community.

2.1.1 CONCEPTUAL FRAMEWORK

The Activity theory provides us with a conceptual framework on good portal development. It provides us with a means to analyze the dynamics of the application as it distinguishes between motives, goals and conditions. When conditions change, operations are interrupted and the system adapts to the new situation automatically. When goals are disturbed, new goals are constructed, providing that motives remain stable. The activity changes when the motive changes. This distinction between goals, motives and conditions affords us the means to define levels of collaborative activity: condition, goal and object-based.

We can derive a conceptual model, a task model, from Activity theory which will be very useful in two key areas of portal development, namely:

- ✓ To clarify the purpose of the portal
- ✓ To analyze the requirements and functionalities of the portal

Clarifying the Purpose of the Portal

It is important to clarify the motives and goals of the activity system in order to understand the context within which activities occur and to get a solid understanding of the motivations for the activity being modeled. To analyze context, we need to know the beliefs, assumptions and methods commonly held by the group members, how individuals refer to their experiences in other groups, what tools they found helpful in completing their problem. Uden, et al (2008) suggested the following questions to be asked in order to clarify the context and motive of the object:

1. How are the tasks organized to work toward the object?
2. What is the structure of the social interaction surrounding this activity?
3. What activities are considered to be critical?
4. What are the activities, goals and sub goals to be supported by the portal?
5. Who are users involved?
6. What is the purpose of the activity and actions for the users?
7. What is the user trying to achieve?
8. How do the user's activities fit into the objectives of seeking information from the portal?
9. What are the expectations about the outcomes?

Analyzing the Requirements and Functionalities of the Portal

In order to analyze an activity system, we begin by:

- ✓ Defining all the components of the given activity, namely: the subject, object, community, rules and division of labor as shown in the activity triangle (figure 2.1)
- ✓ Decomposing the activity into simpler actions and operations

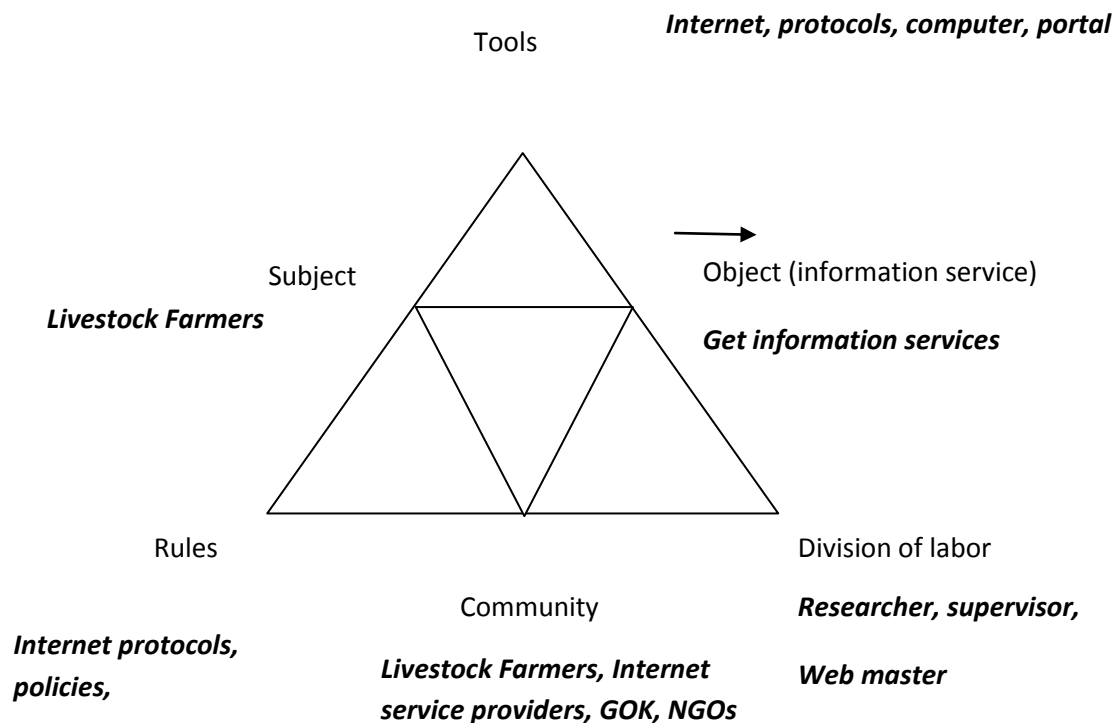


Figure 2.1: Activity System for Web Portal.

The model shows the relationships and interaction of components of portal activity system. The subject of the portal consists of livestock farmers and others, while the object will be the relevant information and services the subject gets from the portal. The outcome will be user satisfaction and gained knowledge.

Analysis of Action

To capture the requirements of the web portal, we must analyze the three levels that activities have: activity, action and operation.

To hierarchically represent an activity we make clients describe how this activity must be performed and we associate to each action a template that allows us to characterize it in the context of the whole activity. These templates are made up of the following fields:

- **Goals:** objectives that must be reached after the action performance.
- **Users:** The list of kinds of users that can achieve the action.
- **Additional Information:** information that allow us to understand better the context in which each action must be performed. This information can be related to frequency, performance, security, availability, etc.

Table 2.0: Typical Description of Login Action

ACTION	LOGIN
Goal	The subject logs in to access the portal
Subjects	Livestock farmers , web master and other users
Additional information	This action is estimated to have a frequency of 20 times per day

2.2 INFORMATION SEEKING BEHAVIOR OF LIVESTOCK FARMERS

Information need could be viewed as data or a set of data specially required, enabling the user to make an appropriate decision on any problem facing him/her at a particular time (Solomon, 2002). Information is vital because it impacts on individuals' living activities.

Researches on information seeking agree that information is tailored to individuals' jobs and to their tasks within those jobs (Ingwerson, 1996, Zeffane and Gul, 1993).

Mudukuti and Miller (2002) suggested that dissemination of information and applying this information in the process of agricultural production will play a significant role in development of farm settlements.

Similarly, Sligo and Jameson (1992) have also stressed that farmers must be given training on latest technological skills to maximize production. Studies on information sources used by most rural farmers, especially in developing countries, have described the following variety of sources used for seeking information: colleagues, friends, neighbors, relatives and family (Kaniki, 1994, Rezvanfar & Mandape, 2000), professional and modern media (Shilaja & Jayaramuah, 1992), personal network and business contracts (Barton & Bear, 1999).

According to Saleh (2011), livestock farmers use both informal and formal channels for communication. The formal channels include radio and television, Local Government information office, agricultural extension workers, primary health care workers, and Public Libraries while the informal channels include local leaders, friends and relatives, husbands, and local NGOs.

There are advantages and limitations to these various channels of information exchange. Oral forms are clearly favored by rural communities in Sub-Saharan Africa (Bembridge & Tshikolomo 1992, 82; Leach 2001b, 57) owing to prevalence of long oral traditions and relatively low levels of literacy in this region. However, drawbacks of verbal

communication are that people may not recall exactly what was said in a given situation, and the content of such verbal exchanges is restricted to those present (Meyer 2002b, 221). Sharma G.R.K (2006) concluded that informal sources such as family members, friends, local leaders and colleague farmers do not satisfy the individuals' information needs and that ICTs could play a pivotal role in improving access to information by rural people. The importance of information and Communication Technologies (ICTs) for rural farmers cannot be gainsaid. ICTs help to break down the isolation of individuals living in remote rural areas (Anie and Otolu, 2007).

Radio, tape recorders and videos are examples of electronic media used successfully in rural areas, while the growing ICT movement promises better access to information via the Internet, especially the World Wide Web (Food and Agriculture Organization (FAO) 2007) Munyua (2000) further asserted that television, audiovisuals, print technology, etc, would be of great help to rural farmers in this information age. He further noted that other types of ICTs that would be useful to rural farmers include email, news groups, file-transfer protocol, telecenters, CD-ROMs, Internet, electronic conferencing and networking, web sites and portals. Information derived from the above ICT sources would help livestock farmers to enhance livestock development and raise their standard of living.

Rasmussen et al (2015) observed that pastoralists primarily acquire information by calling friends and family in nearby areas, and the results point to a strong disconnect between the parameters and scale of information that pastoralists need and those currently provided.

2.3 INFORMATION NEEDS OF LIVESTOCK FARMERS

The information needs of livestock farmers vary significantly. It ranges from information needs on animal husbandry such as breeds, feeds, animal diseases, periods of fattening, available markets and veterinary services to non-animal related information such as health care, politics, economy, education, climate etc. Saleh (2011) who conducted a research on information seeking behavior of rural dwellers in northern Nigeria found out that farmers seek information in this order: agricultural information (53%), education (12%), economy (11%), health (20%), politics (03%), others (01%). Elly (2013) who conducted a research on agricultural information needs and sources of the rural farmers in Tanzania found out that 70 per cent of farmers' information needs is about crop and livestock husbandry, marketing, funding options and value addition and Rasmussen et al (2015) Outlined information needed by Sahel pastoralists as information pertaining to the availability of grazing resources in various areas, the onset date of the rains, flooding events, and fine-scale information on rainfall amount during the first weeks of the rainy season and noted that the pastoralists used such information to adjust the purchase of supplementary fodder, to make qualified choices on transhumance destinations, and to make changes in herd composition.

2.4 ONLINE PORTALS

As defined by IBM, an information portal is “a single integrated, ubiquitous, and useful [point of] access to information (data), applications, and people” (IBM, 2000). Christopher Connolly of Villanova University writes that “a portal is a gateway to the Web that allows the plethora of information available on Internet and Intranet Web sites to be organized and customized through a single entry point. A good portal provides seamless access for non-

authenticated users until sensitive information is requested, when it then prompts for a username and password. Authenticated visitors or those known to the site by cookies are presented with a more individualized view of the Web site”, (Web Portals and Higher Education, p. 112). As Straus (2006) suggests, there three kinds of portals:

1. Vertical portals providing access to a variety of information services about a particular area of interest. Such portals offer information and services customized for niche audiences.
2. Horizontal portals called mega portals target the entire Internet community. They include yahoo Inc, Netscape Corporation, Sun Microsystems, Google Inc etc.
3. Enterprise portals provide all the information services required by the members in an organization such as livestock keepers and government.

Portal development and implementation depend on a number of interrelated technologies such as search engine, authentication and security, caching, automated taxonomy engines, application integration middleware, relational databases, and metadata dictionaries (Richard, 2006).

Information portals will enhance rural livelihoods and combat rural poverty by enabling access to market information, weather information, disaster early warning and preparedness, government services, and access to finance through m-banking (Jayantha, 2008). Alfred (2010) further explains the contributions of portal technologies to rural farmers as strengthening social networks, increasing people’s ability to deal with emergencies; cutting down travel costs, increasing temporal accessibility and amplifying efficiency of activities.

Rural farmers are faced with many problems. The ministry of livestock development in its strategic plan of 2008- 2012 identifies key challenges facing livestock farmers in Kenya as disease outbreaks, recurrent droughts, shifting requirements in external trade, insecurity in livestock producing areas, feed and water availability, and low adoption of appropriate technology and recommends increased marketing of livestock and livestock produce.

2.5 CHAPTER SUMMARY

The literatures reviewed so far in this chapter show that livestock farmers have varied information needs, and that ICTs play a central role in addressing these information needs to effectively increase livestock productivity. They further, show that although older ICTs like radios and tapes positively contribute to the advancement of livestock farming, newer ICTs need to be incorporated to step up this progress to rip more benefits. These new ICTs include satellite crop monitoring, RFIDs, online portals, mobiles and biotechnology products. The study aims to adopt two of these ICTs – web portals and mobile-based solutions – to improve the quality of livestock farming in Mandera County.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 INTRODUCTION

According to Rajasekar (2013), research methodology is the procedures by which researchers go about their work of describing, explaining and predicting phenomena or the study of methods by which knowledge is gained. Sridhar (2008) defines it as behavior and instruments used in selecting and constructing techniques to collect data.

This chapter is organized into 10 sections: research design, study population, sampling methods, data collection methods, data collection procedure, reliability and validity of the instruments, data analysis, ethical considerations, and chapter summary.

3.1 RESEARCH DESIGN

A Qualitative research approach was adopted for the study. Qualitative research, also known as qualitative inquiry, is defined as an umbrella term used to cover a wide variety of research methods and methodologies that provide holistic, in-depth accounts and attempt to reflect the complicated, contextual, interactive, and interpretive nature of our social world (encyclopedia of research design, 2015, link:

<http://sk.sagepub.com/reference/researchdesign/n350.xml?term=qualitative%20research>)

or as a research using methods such as participant observation or case studies which result in a narrative, descriptive account of a setting or practice (online dictionary of social sciences, 2015: <http://bitbucket.icaap.org/dict.pl?term=QUALITATIVE%20RESEARCH>).

A single-case study was used to collect data from the respondents. A Case study is a versatile approach to research in social and behavioral sciences. Case studies consist of

detailed inquiry into a bounded entity or unit (or entities) in which the researcher either examines a relevant issue or reveals phenomena through the process of examining the entity within its social and cultural context (Salkind, 2010: 115).

A case study was selected because it offers an opportunity to investigate complex social phenomena in its real-life context and using multiples methods of data collection and analysis (stake, 2008). Since the study was about establishing the key information needs of the respondents and information needs are complex social phenomena involving people, channels of information and messages, a case study was warranted.

3.2 STUDY POPULATION

According to McColl and Easton (2015), a study population is the entire group a researcher is interested in; the group about which the researcher wishes to draw conclusions.

The study population comprised livestock farmers and livestock officers living in Mandera County at the time of data collection. According to the national population census of 2010, the county had a total population of 1.2 million persons, majority of them being livestock farmers (KBS, 2010). Livestock officers were six in number across the County, one in each constituency.

3.3 SAMPLING METHODS

A sample is a subgroup of the target population that the researcher plans to study for generalizing about the target population (Creswell, 2012; p142).

In livestock farming, there are various roles and occupation groups with distinct responsibilities and obligations.

Based on these distinct responsibilities, two categories of livestock farmers were identified: the herders and cattle merchants. Also involved with livestock-keeping were government livestock officers who offer cattle healthcare and counseling services.

The study used a clustered stratified technique. Stratified sampling is a sampling technique in which the researcher divides (stratifies) the population on some specific characteristic (e.g., gender) and then, using simple random sampling, samples from each subgroup (stratum) of the population (Creswell, 2012; p142). A stratified technique was used because the study sample comprised of subgroups with typical characteristics that needed to be investigated.

The sample population was divided into a number of strata based on criteria such as the farmers' distinct roles in livestock keeping and their spatial distribution in the County, resulting in the following strata:

- I. Role-based: Herders, Cattle Merchants, Livestock Officers
- II. Constituency-based: Mandera South, Mandera North, Mandera East, Mandera West

Finally, forty nine herders, forty nine merchants and two livestock officers from the two constituencies of Mandera South and Mandera west, were selected using purposive sampling. Purposive sampling is a non-probability sampling method that is characterized by a deliberate effort to gain representative samples by including groups or typical areas in a sample (Dudovskiy, 2015: <http://research-methodology.net/sampling/purposive-sampling/>).

Purposive sampling was used because the exact numbers of herders and cattle merchants' strata could not be determined during the period of the study. Samples were drawn based

on the judgment of the researcher, with a belief that the chosen samples were information-rich and could credibly represent the study population.

3.3.1 HERDERS

A herder is a worker whose main duty is caring for roaming groups of livestock over large area of pasture lands (National Geographic, 2015; link: <http://nationalgeographic.org/encyclopedia/herding/>).

The duties of a herder are to take the herds to grazing grounds and water sources, protect the herds from predators and rustlers, handpick ticks and spray the herds with pesticides and bring the herds to treatment centers for medications.

3.3.2 CATTLE MERCHANTS

They were important actors in livestock industry. Some of their duties included transporting animals to market centers for sale, negotiating prices and selling herds at negotiated prices.

3.3.3 LIVESTOCK OFFICERS

Livestock officers were intermediaries between the County government and the farmers.

They communicated to livestock farmers, important information on natural resources, economic use and storage of water, how to combat animal disease, and how to improve animal yields. Some of their duties were to advise farmers on matters relating to scientific livestock farming, report disease outbreaks to the County government, administer injections and de-worm animals.

3.4 DATA COLLECTION METHODS

The study employed structured interviews and non-participant observation to gather data.

The selection of the instruments was guided by the nature of data to be collected, academic backgrounds of the respondents and the aim of the study.

3.4.1 STRUCTURED INTERVIEWS

A structured interview is a fixed-format interview in which all questions are prepared beforehand and are put in the same order to each interviewee (Business Dictionary, 2015; link:<http://www.businessdictionary.com/definition/structured-interview.html#ixzz49x2qRwu4>).

Structured interviews were preferred because of the following reasons:

- ✓ Majority of the respondents had low literacy levels and could not even read and write. Only face to face interviews in vernacular language appeared useful.
- ✓ It provided the opportunity to appeal to the respondents and convince them about the significance of the exercise.
- ✓ It provided supplementary information not found in the schedules.

Welman and Kruger (2005, p.161) indicate that in a structured interview the interviewer is allowed to use probes with a view to clearing up vague responses or to ask for elaboration of incomplete answers and thus provides the opportunity to clear any misunderstanding, and reorder questions to prevent possible stalemates.

A four-part interview schedule (appendix 3) was prepared and used for gathering data from the respondents. Part a of the schedule deals with questions to be answered by all the respondents, pertaining to their roles, information needs and channels of information they use. Part b deals with questions specific to herders while parts c and d have questions specific to cattle trades and livestock officers respectively.

3.4.2 OBSERVATION

Observation is a systematic data collection method whereby researchers use all of their senses to examine people in natural settings or naturally occurring situations (Johnson foundation, 2015). Godfred (2016) enumerates advantages of observation method as obtaining first hand information on objects and eventful happenings, and minimizing distortion of facts and records.

Non-Participant Observation- observation with limited interaction with the respondents- was used to gather data in situations where interviews were not very much useful such as involving animal observations and information posters. The main animal market in Mandera town represented the chosen venue for the 3-day observation that started on November 15th, 2012 and ended on November 18th, 2012. The time of observation was from 8.00 am to 11.00 am, corresponding with peak hours of the market.

An observation checklist (appendix 4) was prepared and used during the observation. The checklist contains list of items to be observed such information posters providing operational market dates, tentative prices and announcements for animal treatment, live market transactions, preferred animal characteristics, and payment modes used.

3.5 RELIABILITY AND VALIDITY OF THE INSTRUMENTS

Reliability

Polit and Beck (2004) define reliability as the degree of consistency with which an instrument measures the attribute it is designed to measure. Reliability was achieved by administering the same sets of questions to all interviewees and ensuring every interviewee has answered all the questions of the interview, minimizing data collector bias, and

ensuring comfort ability of the venue environment. To minimize data collector bias, the interviews were administered to the respondents by the researcher alone in an environment of friendliness and comfort. The interviews were also conducted in a secure and comfortable environment where confidentiality and privacy of the interviewees were maintained.

Validity

The validity of an instrument is the degree to which an instrument measures what it is intended to measure (Polit & Beck, 2004). The two types of validity are content validity and external validity.

Content validity is the extent to which an instrument represents the factors under study while external validity refers to the extent to which study findings can be generalized beyond the sample used (Burns and Grove, 2005).

Content validity was achieved by triangulation and a fair literature review. Triangulation is the combination of two or more theories, data sources, methods or investigators in one study of a single phenomenon to converge on single construct (Sabina and Rahman, 2012). It is achieved by combining different research techniques. The study had used both interviews and observation methods to enhance content validity. Further, a comprehensive review of related literature in chapter two of the study informed the formulation of the right interview questions and observation checklist and thus helped in increasing content validity.

Also, external validity has been achieved by high response rate of the respondents. According to Burns & Grove (2005), as the percentage of respondents who decline to participate in a research inquiry increases, external validity decreases and vice versa. Out of 50 respondents, 45 were successfully interviewed and thus registering a response of 90%. The high response of 90% meant external validity has been achieved and the findings of the research can be comfortably generalized.

3.6 DATA ANALYSIS

The raw data collected was qualitatively organized, coded, categorized and clustered into key themes. The data was then analyzed using two approaches, thematic analysis and descriptive statistics. The thematic analysis was used to examine and derive basic themes from textual data generated by open-ended questions while descriptive statistics was used to analyze closed-ended questions of the interviews, using frequency tables and pie charts.

3.7 ETHICAL CONSIDERATIONS

During data gathering, the study adequately complied with all professional/ethical conventions cherished in research works. It was objective, fair, free from integrity issues such as plagiarism, and was credibly respectful of intellectual property rights and environmental regulations. Besides, the respondents' rights were well respected. None of their private details were captured and were informed in advance about the intent and the content of the interviews they were to participate in, there were never surprises.

3.8 DATA COLLECTION PROCEDURE

The data was collected from the respondents, starting from September 2012 up to March 2013. Interviews were conducted both in English and Somali language to accommodate the illiterate respondents. The researcher visited Mandera market on several occasions to observe in real-time main activities undertaken and toured outpost ranches to meet the herders in their natural environment.

3.9 CHAPTER SUMMARY

In this chapter data collection instruments, research design, sampling methods, and instrument reliability and validity were discussed. The raw data collected was analyzed and interpreted in the next chapter.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 INTRODUCTION

This chapter presents analysis and interpretation of the collected data. The data was collected in response to the problems highlighted in chapter one of this thesis. The data was analyzed and presented according to the research questions of the study. The aim of the study was to assess the information needs of livestock farmers in Mandera County in order to come up with an online Web portal that serves their needs and the research questions were to:

1. What are the information needs of Mandera livestock farmers?
2. What are the main channels employed to disseminate information to Mandera livestock farmers.
3. How do the existing information systems specifically serve the needs of Mandera livestock farmers and how effective are they if any?
4. Which software analysis and design tools and techniques are most suitable for developing a web portal for livestock farmers in Mandera?
5. Has the proposed web portal been successfully implemented and operated?

The chapter is organized into six sections comprising introduction, response rate, information needs of livestock farmers, information channels, existing livestock information systems and chapter summary.

4.1 RESPONSE RATE

Only 88 respondents were successfully interviewed as six herders and four cattle traders failed to turn up for the interview, giving us a response rate of 88%. Alongside with the interviews, non-participant observations were used to record live transactions at livestock markets, particularly focusing on type, body condition, gender and age of species, and payment methods used as well as surveying information posters and sick animals.

4.2 INFORMATION NEEDS OF MANDERA LIVESTOCK FARMERS

Research Question one addressed the information needs of Mandera livestock farmers. 88 respondents representing various groups of livestock farmers were required to state their key information requirements. The findings were as follows:

4.2.1 INFORMATION TYPES NEEDED BY THE RESPONDENTS

The study discovered that four areas of information were heavily demanded by the respondents. They included metrological information, veterinary information, market information and information on lost and found animals as presented in figure 4.0.

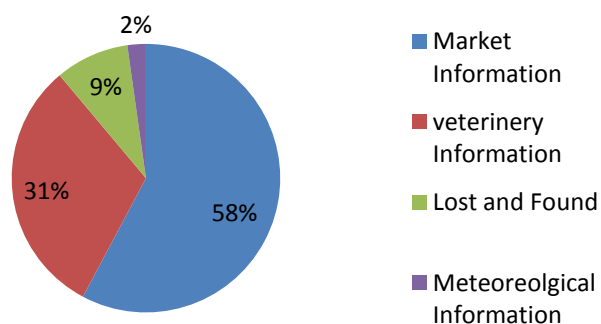


Figure 4.0: Key Areas of Information Needed By Respondents

As shown in figure 4.0, out of a total of 45 respondents interviewed, 58% of the respondents said market information is the most important of all the information pieces to them, while least important was meteorological information at 2%.

Animal markets are immensely important to livestock producers; the acts of buying and selling to fetch incomes for families and for restocking and destocking run all year round representing over 80% of livestock related activities and involve large cross-section of livestock keepers, and that makes it number one priority. This can be deduced from the following response:

“ suuqa xoolawa aad aay muhimpahay. Waa mel oo aan lacag aan kugatun or, cunto iyo feeska skolka aan kahaleeneyo. Beeca xoolaha hadi si waqti loo helo zaaid aay muhimpahay. ” (R1)

“Animal market is very much important to us. It is a place where we get the cash to enable us buy food, clothes and pay school fees. Knowing the price of an animal in timely manner is more important to us than anything else. ”

Frequent outbreaks of epidemics and animal infections that sometimes cause mass deaths of herds and devastating droughts that result in many herds becoming emaciated and bony, may be responsible for ranking veterinary information number two as can be deduced from the following response:

“ cuduro maar walba hoolawa nagadameeynayu waxaan rabna in noolashago maxaa keenayo cuduro iyo waaxa udaawa ah. ” (R2).

“These diseases that wipe out our herds every now and then, we need it so much if we can be told when they are likely to occur and their right medications.”

Although weather information is ideally very important to herders, weather forecasts that fail to materialize in semi-arid areas, coupled with the given fact that many forecasts are vague, all of these are responsible for making the weather accounts least important to local farmers. The respondents used expressions such as a Whiteman’s lie, hard to understand and ‘too little too late’ to express this.

In terms of respondents’ groups, metrological information, veterinary information, market information and information on lost and found animals were highly valued by the herders while the traders were only interested in market and veterinary information. Livestock officers were favorable users of weather reports, vet findings and drug information. This is presented in table 4.0.

Table 4.0: Respondents’ Preference for Particular Information

RESPONDENT	FAVORITE INFORMATION
Herders	Metrological Information, Veterinary Information, Market Information, Lost And Found Animals
Traders	Market Information , Veterinary Information
Livestock Officers	Meteorological reports, Veterinary and Drug Information

4.2.2 INFORMATION NEEDED DURING ANIMAL SALE

The study observed that seven key variables were critical to the process of selling an animal. They included price, gender, age of the animal, date of sale, time of sale, place of sale and the season. Pricing the animal depended on whether the animal was a male, a female or a calf, each of these had a different price. Visual assessment was used to determine animal's age and gender as shown in figures 4.1 and 4.2, weighing was hardly practiced.



Figure 4.1: business at Mandera livestock market

Figure 4.2: selling and buying at Mandera market

As seen from figures 4.1 and 4.2, there was no weighing of animals on scales to determine their kilograms; only visual judgment was used to complete the transaction.

4.2.3 LIVESTOCK SUPPORT SERVICES

Livestock officers interviewed indicated that Mandera County has two departments that deal with livestock care and production; the livestock production department and the veterinary department, each has a sub county officer in the six sub counties that make up the larger Mandera County. They further described the mandate of the livestock production department as conducting regular livestock census, livestock care in terms of fodder and water provision during droughts, livestock marketing and offering financial compensation for animals stolen or killed in clan conflicts, and that of its sister veterinary department as

managing infections and outbreaks, reporting new infections and treating the infected animals.

4.3 INFORMATION CHANNELS

Research Question two addressed the main information channels used by livestock farmers in Mandera. 88 respondents representing various groups of livestock farmers were required to state main channels of information dissemination they use. The findings show that six main sources of information were available to the respondents. They included a local FM, friends, public *barazas*, county information desks, news dailies and online social sites. The findings further show no use of animal web portals by the respondents.

Out of these information channels, friends were the most favorite channel to the respondents, according to 46.7% of them and the least used channel was the dailies standing at 2.2%. The local FM and county information desks were average, scoring 28.9% and 11.1% respectively as shown in table 4.1.

Table 4.1: Information Channels Used By the Respondents

	Information Channels	#	%
1	Friends	21	46.7%
2	Local FM	13	28.9%
3	Information Desks	5	11.1%
4	Barazas	3	6.7%
5	Social Media	2	4.4%
6	Dailies	1	2.2%
	Total	45	100%

The findings showing friends as the most preferred source of information can be explained by the fact that friends are plenty available, easily accessible and are users of popular vernacular, making the flow of oral information faster and more penetrative while for the local FM called star FM it is due to local Somali language it uses and convenience and ease of listening to its programs irrespective of remoteness of the listeners' locations. Public *barazas*, the dailies and the social sites ranked low on grounds of language barrier, low literacy levels of the respondent population and erratic nature of their supplies.

4.4 EXISTING LIVESTOCK INFORMATION SYSTEMS AND PORTALS

Research Question three addressed other livestock information systems and portals operating in Mandera. The respondents were required to state livestock-based portals or systems they use to get information. The findings revealed that there were no any livestock information systems or web portals exclusively serving Mandera livestock farmers. This was further corroborated by the results of online searches on e-government portals and NGO websites that returned negative. However, regional and national information portals and systems serving either an entire region like East Africa, or an individual county like Kenya, Ethiopia or Tanzania were found. They included the Kenya National Livestock Market Information System (NLMIS), Livestock Information Network and Knowledge System (LINKS) and IGAD Information Portal (1.0.1). The respondents confirmed they never used them.

4.5 CHAPTER SUMMARY

This chapter has described how the collected data was analyzed and interpreted according to the research questions and segmented as information needs of the respondents, information channels, and existing animal information systems and portals. Data summaries

obtained from this chapter were further analyzed in the next chapter, using a software system analysis and design approach.

CHAPTER FIVE

SYSTEM ANALYSIS, DESIGN AND IMPLEMENTATION

5.0 INTRODUCTION

This chapter deals with system analysis, design and testing in response to research questions four and five.

Chapter four detailed information highly needed by the respondents as market information, meteorological information, veterinary information and information on lost and found animals (figure 4.0). It further enumerated key information elements required in a single animal transaction as price, gender and age of the animal, date of sale, time of sale, place of sale and the season (4.2.2).

These information types and elements collected and analyzed in chapter four were used to provide content for the proposed portal, after they have been subjected to system analysis and design. The activities of systems analysis, design and implementation has been informed and guided by the systems development life cycle (SDLC). SDLC is a proven methodology for developing software systems. According to Valacich and Dennis (2012), SDLC comprises of four key steps: planning and selection, analysis, design and implementation. Planning and selection is about identifying problems and selecting the right course of action. This phase has already been resolved in chapter one and chapter two of the study. Systems analysis is composed of two activities: requirements gathering and requirements analysis. Requirements are analyzed both quantitatively using descriptive statistics and software-specifically using analytical tools.

Requirements gathering have been dealt with in chapter three of the study and qualitative requirements analysis resolved in chapter four of the study. Software-specific analysis, design and implementation shall be handled in this chapter as shown in table 5.0.

Table 5.0: showing distribution of SDLC activities across the study chapters

SDLC STAGE	RESPECTIVE CHAPTERS	
1. Planning and selection	1 , 2	
2. Analysis:	Requirements gathering	3
	Qualitative analysis	4
	Technical analysis	5
3. Design	5	
4. Implementation	5	

This chapter is organized into four sections comprising introduction, system analysis and design, system testing and chapter summary.

5.1 SYSTEM ANALYSIS AND DESIGN

Research question four addressed modeling data for system analysis and design. To realize this, a number of analytical tools and design models were used as shown in sections 5.1 A and 5.1B.

5.1 A: SYSTEM ANALYSIS

Systems Analysis is a systems development life cycle (SDLC) phase comprising requirements determination - the gathering of information about current systems and replacement systems- and requirements structuring - techniques for structuring the information discovered during requirements determination (Valacich, 2012; Dennis, 2012).

In systems analysis, a number of analytical tools are used. They include use cases, data flow diagrams (DFD), flowcharts and decision tables (Valacich, 2012; Dennis, 2012).

This study has used use cases and DFD level 0 to structure user requirements. The choice of these tools over others was informed by the fact that they are easier to use and are more effective in modeling user requirements.

First, major components of the web portal are described, and then followed by use cases and the context-level DFD.

5.1a.1 PORTAL OVERVIEW

Mandera web portal is composed of a MySQL database, a web application and a mobile application. The database is used to store details of user profiles, user comments, login, camels, goats, sheep, donkey and cows while the web app and mobile application provide means for registering users ,authorizing log ins, uploading and downloading files, updating tables, managing user views , generating graphs, and retrieving records from the database.

5.1a.2 USER REQUIREMENTS ANALYSIS

The users of the portal are categorized into a number of user classes determined by access privileges enjoyed or their occupations.

Grouping by access rights yields two user groups - ordinary users and administrators- while grouping by occupation yields five users, namely: herder/trader, web master, weather system, vet/livestock officer and GOK/NGO.

Two use cases and a context diagram (DFD) were used to model the requirement of these users.

The end users can execute the following tasks on the portal:

- ✓ Register himself/herself
- ✓ Login after registering
- ✓ Leave a comment
- ✓ Download information files
- ✓ Browse the portal for information
- ✓ View and save analytical graphs
- ✓ Log out

Administrators on the other hand have the following tasks and privileges:

- ✓ Register users
- ✓ Log in to enter administrator view
- ✓ Update database tables
- ✓ Upload files
- ✓ Leave comments
- ✓ Update Prices

✓ Logout

5.1a.2a USE CASES

According to Dennis (2012), a Use Case is a means of expressing user requirements; it represents how a system interacts with its environment by illustrating the activities that are performed by the users of the system and the system's responses.

Figures 5.0 and 5.1 are two use cases representing the end user's and administrator's requirements respectively.

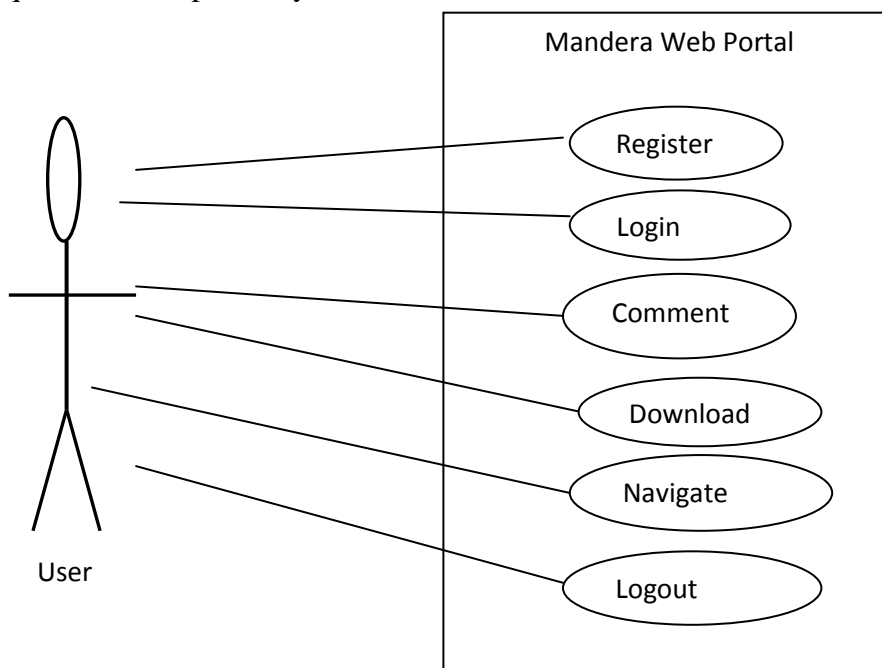


Figure 5.0: End User Use Cases

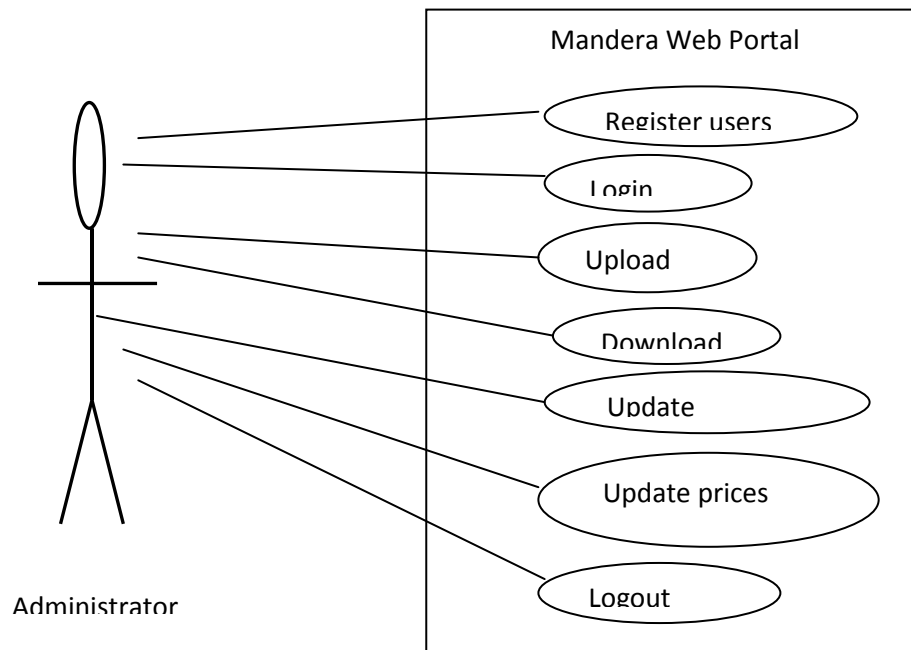


Figure 5.1: Administrator Use Cases

5.1a.2b DATA FLOW DIAGRAMS (DFDS)

A DFD is a graphical tool that allows system analysts to show flow of data in an information system; it shows the main inputs and outputs of the system and the system main users (Dennis, 2012 and Valacich, 2012). There are two types of DFDs: context level DFD (level 0) and exploded DFDs.

A context diagram is composed of external entities, the system and data flows. Figure 5.2 represents a DFD level 0(context diagram) for the portal showing the five occupational users.

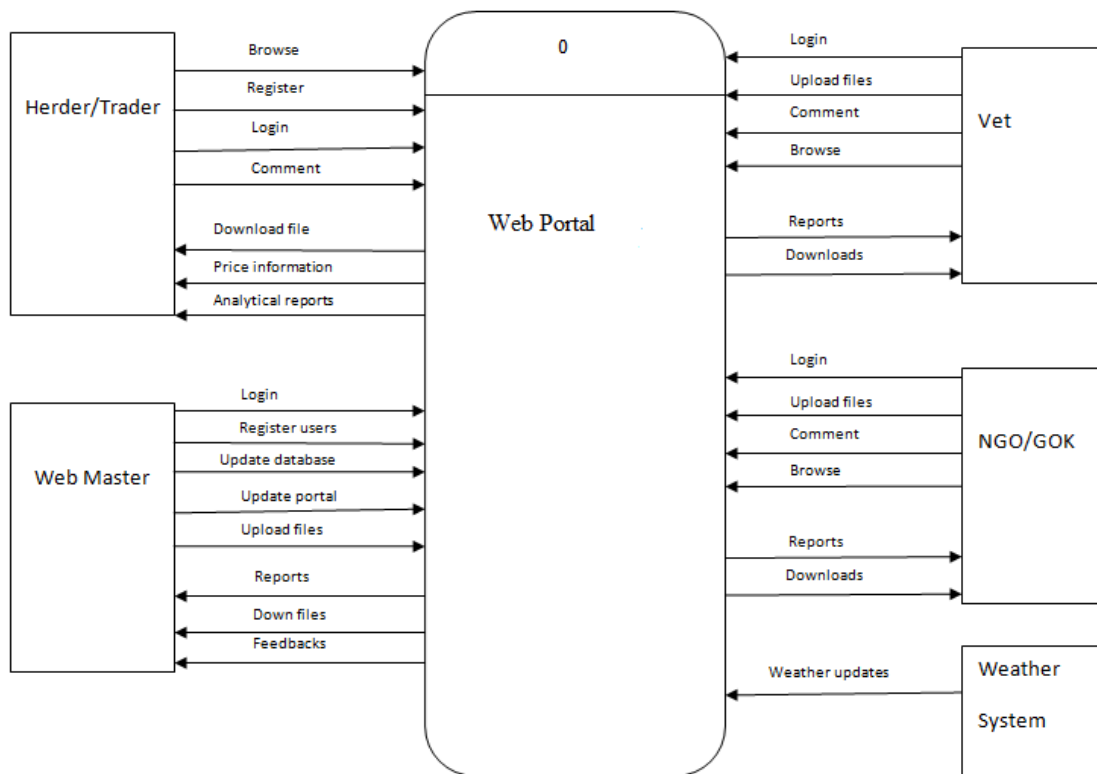


Figure 5.2: Context Diagram for Mander Portal

5.1 B: SYSTEM DESIGN

Dennis (2012) defines system design as the determination of the overall system architecture—consisting of a set of physical processing components, hardware, software, people, and the communication among them—that will satisfy the system’s essential requirements. According to Valacich and Dennis, system design activities include architecture design, user interface design and database design.

Hence, in this section, a description of how the three design activities: the web application design, the database design and user interface design (UID) was effectively used to design Mandra web portal is given.

5.1b.1 WEB APPLICATION DESIGN

In web application design, system architecture has to be fully described and its components specified.

The Mandra portal has a 3-tier architecture composed of the view (tier 1), the controller layer (tier 2) and the model layer (tier 3) called the MVC design pattern.

The view layer is dedicated to displaying and rendering data to the user. For Mandra portal, tier 1(view layer) is represented by JSP, Tiles and CSS.

Tier 2(the controller layer) receives user inputs, parses it to the Model and formats the output for the View. ActionServlets and Strut actions represent the portal's tier 2.

The Model (tier 3) comprises java beans and plain java objects (POJOs) used for querying, persisting and retrieving data from databases.

Figure 5.3 shows Mandra Portal's architecture.

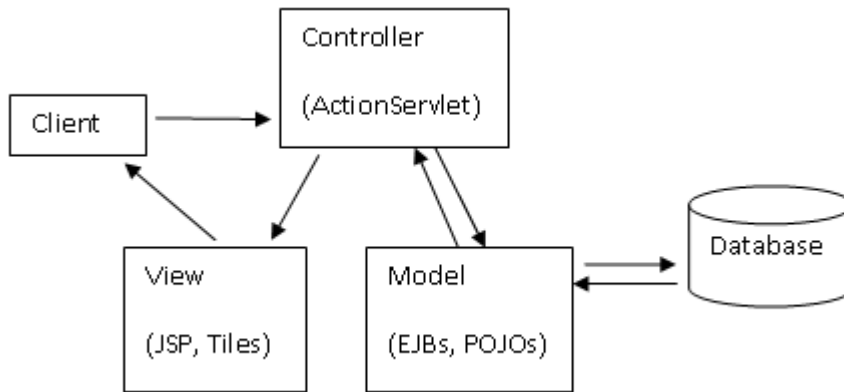


Figure 5.3: Architecture for Mander Portal

5.1b.2 DATABASE DESIGN

For database design, Entity Relationship (ER) diagram, normalized tables and views were used. In total, eight normalized tables and thirty six views were used.

Entity relationship diagram is a graphical representation of database tables. The main components of ER are entities, the relationships that can exist among them, and the constraints.

Figure 5.4 is an ER diagram for the portal showing 9 database tables, their columns and relationships among tables.

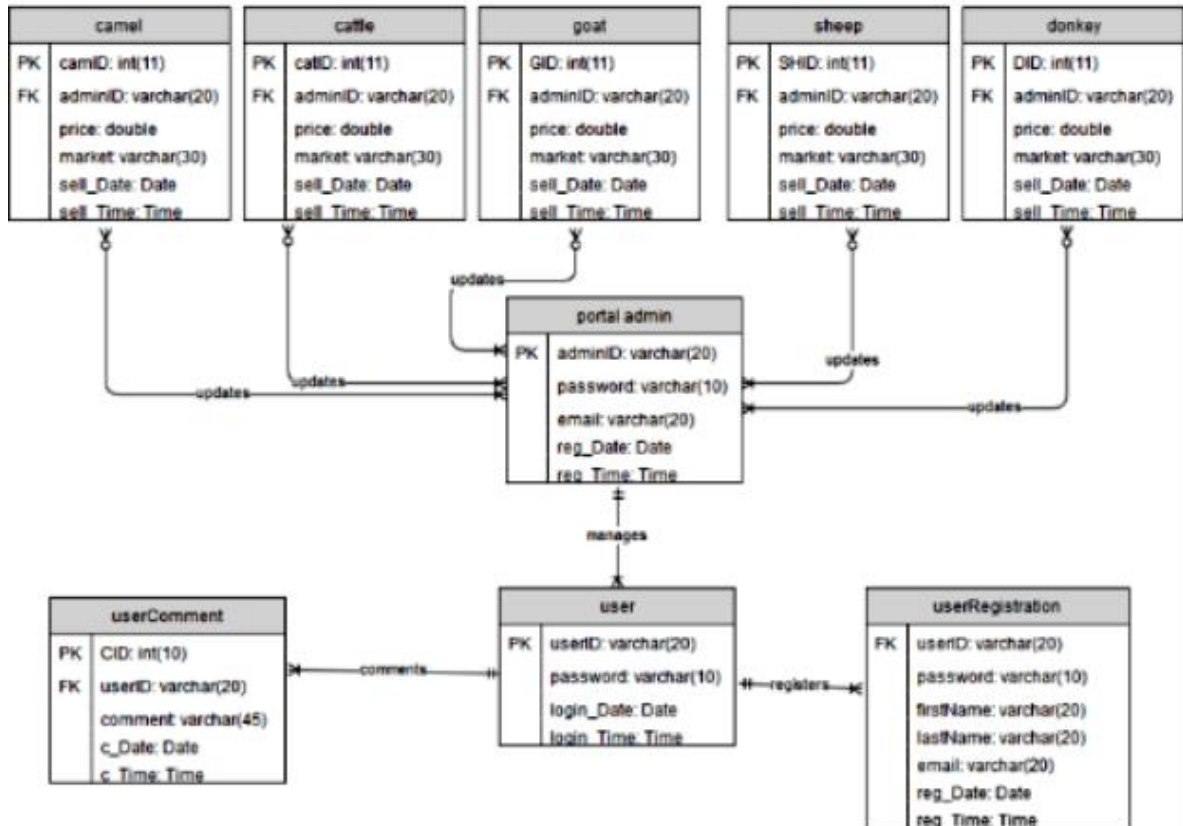


Figure 5.4: ER Diagram for Mandra Portal

All the tables were normalized up to third normal forms. Normalization is a process of systematically examining database tables for anomalies and removing detected anomalies by way of splitting tables into smaller tables. Main categories of anomalies are update, insertion and deletion anomalies. Normalization is implemented in levels called normal forms.

Each table of the portal had a primary key uniquely identifying it, was ensured freedom from repeating groups and from partial and transitive dependencies, and thus satisfied 1NF, 2NF, and 3NF rules. The resultant tables produced by the normalization process were interlinked via foreign keys.

1NF requires a table to have a primary key, atomic attributes and be free from multi-valued attributes, achieved via atomicization and decomposition of multi-valued columns. The 2NF and the 3NF deal with functional dependencies namely: partial dependency where an attribute in a table is dependent on another key that is not a primary key and transitive dependency where an attribute is determined by a non-key attribute in the table. Normalization to a 2NF eliminates partial dependency whereas 3NF eliminates transitive dependency, both employing a table split technique.

5.1b.3 USER INTERFACE (UI) DESIGN

A user interface is the way users interact with their computers, tablets and Smart phones; it comprises the screen menus and icons, keyboard shortcuts, mouse and gesture movements, command language and online help, as well as physical buttons, voice and natural language recognition, and all input devices, such as a mouse, keyboard, touch screen, remote control and game controller (SOA, 2016).

User interfaces are either GUI, character-based or web interfaces.

For convenient browsing, the portal is packed with an array of visual and textual elements that make it extremely user-friendly including well-labeled, easy-to-follow web forms, drop-down menus, prompt boxes, familiar images, appropriate colors, meaningful buttons, tabular reports, analytical charts, well-layered web pages and grouping of information pieces under clear headings.

5.2 SYSTEM IMPLEMENTATION

Research question five addressed implementation and operation of the proposed web portal. To achieve this, the web portal was developed, tested and documented. Implementation consists of three activities: coding, testing and documentation. For documentation, detailed user manuals for the portal have been provided in appendix 1. This section describes the coding and testing of the portal.

5.2.1 CODING

The portal was coded in two versions: the web version and mobile version. Java, Java server pages (JSP), struts 1.3, tomcat and MySQL were used to develop the web version of the portal while the mobile version was developed using J2ME, JSP, Struts 1.3, Light Weight User Interface Toolkit(LWUIT) and MySQL. MySQL was for managing the portal's database, tomcat for compiling and running action Servlets and struts as a framework for implementing MVC architecture.

The choice for Java language over other languages was informed by factors like ease of coding, security and Java's robust back-end technologies and frameworks.

The screenshots for the portal's web version and mobile version are figures 5.5-5.16 and figures 5.17 – 5.25 respectively.

The portal consists of a number of important modules and their sub-modules. The table 5.2 gives a detailed list of these modules and sub-modules.

Table 5.2: modules and sub-modules of Mandera portal

MAIN MODULE	PURPOSE	SUB-MODULES
1. Live market	- Shows price of an animal in a given market	- Camel - Donkey - Cattle - Goat - sheep
2. Trends	- Provides market performance indices	- Camel - Donkey - Cattle - Goat - sheep
3. Documents	- sharing of important files	- Four main folders: - Livelihoods - Policy - Trends - Animal health
4. Register	- Register users	-
5. Login	- User login	-
6. Comment	- User comments	-
7. Weather	- display Mandera weather	-
8. Data inputs	- Update prices	- Camel - Donkey - Cattle - Goat - sheep
9. Uploads	- uploading files	-

5.2.2 TESTING

Bentley (2015) defines Software testing as a process of verifying and validating a software application or program to ensure that it meets the business and technical requirements that guided its design and development, and works as expected.

Two testing strategies – functional testing and integration testing - were used. The choice of the strategies over others was informed by factors such as effectiveness, efficiency and ease of use of the strategies.

In functional testing, each module is tested alone in an attempt to discover any errors that may exist in the module's code while in integration testing, modules or functions are combined together and tested collectively as a related group (Dennis and Valicich, 2012).

Functional testing was used to singularly test all features of the portal such as user registration, login, generate a graph on fly etc, while integration testing was used to jointly test a group of related modules i.e. uploading a file to the server and downloading the same file to see whether the two were working or register a user, then login and post a comment by the same user to see whether the three were mutually co-working.

To test the portal for bugs and failures, the following parts/features of the portal were examined:

- ✓ The portal view in browsers
- ✓ Form input validation

- ✓ User views- admin and ordinary user
- ✓ Update/display price forms
- ✓ Hyperlinks
- ✓ Uploads and downloads
- ✓ Generated graphs
- ✓ Mobile application

5.2.2a THE PORTAL IN BROWSERS

The portal was tested in different browsers and found to be working very fine in known browsers. Figure 5.5 shows the results in Mozilla Firefox.



Figure 5.5: Portal View in Firefox

5.2.2b FORM INPUT VALIDATION

All forms are well validated using JavaScript and struts validation in case JavaScript is disabled. Two forms – login and register– are tested as follows.

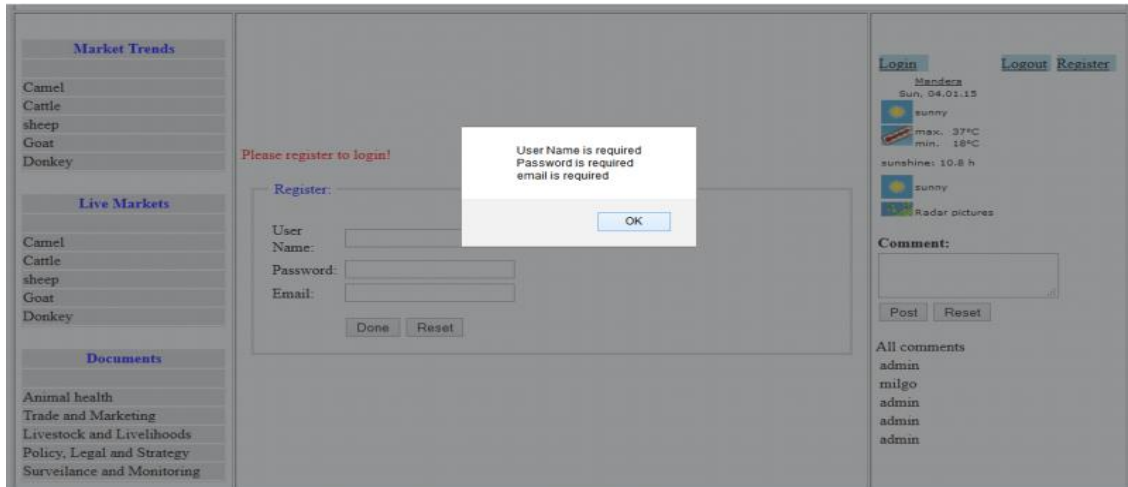


Figure 5.6: Register Form Validation 1

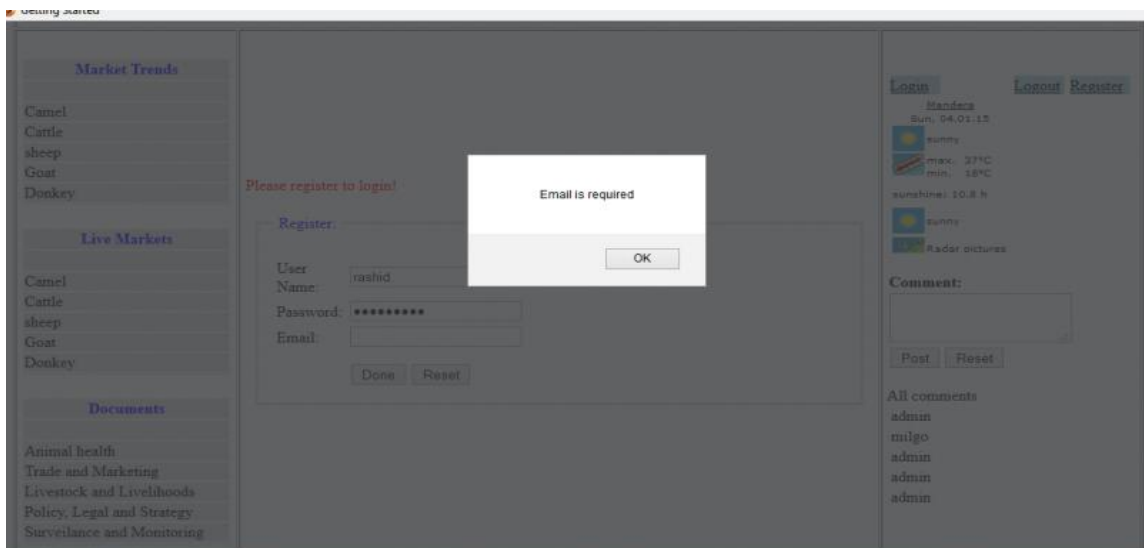


Figure 5.7: Register Form Validation 2

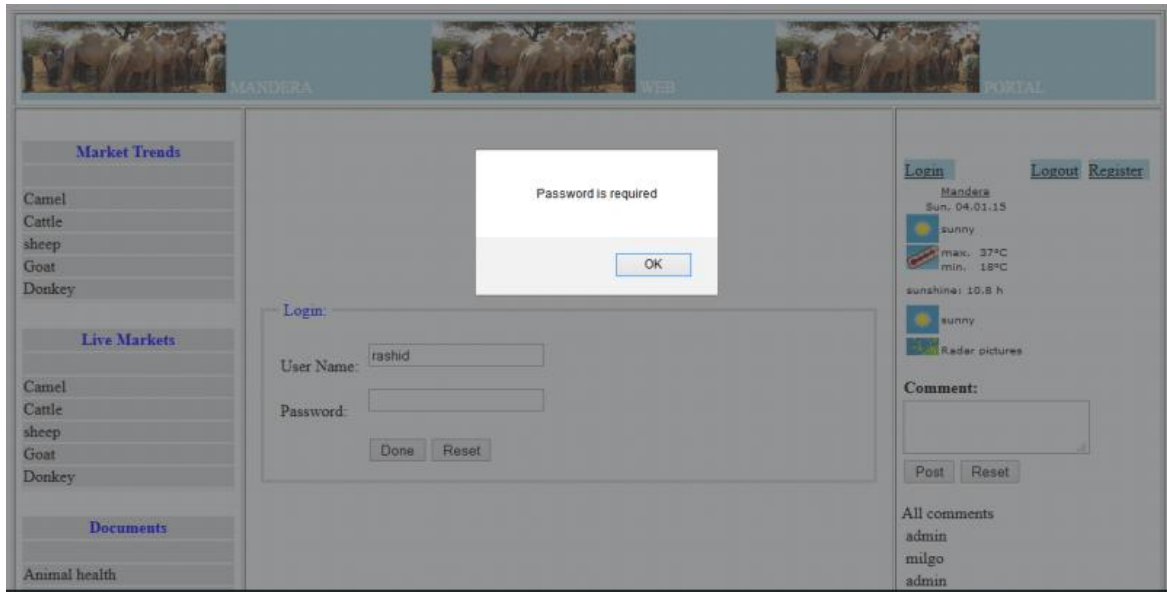


Figure 5.8: Login Validation

5.2.2c ADMIN AND USER VIEWS

The two classes of users have different rights when it comes to which page to view and what action to perform. Figures 5.9 and 5.10 show the two view results.

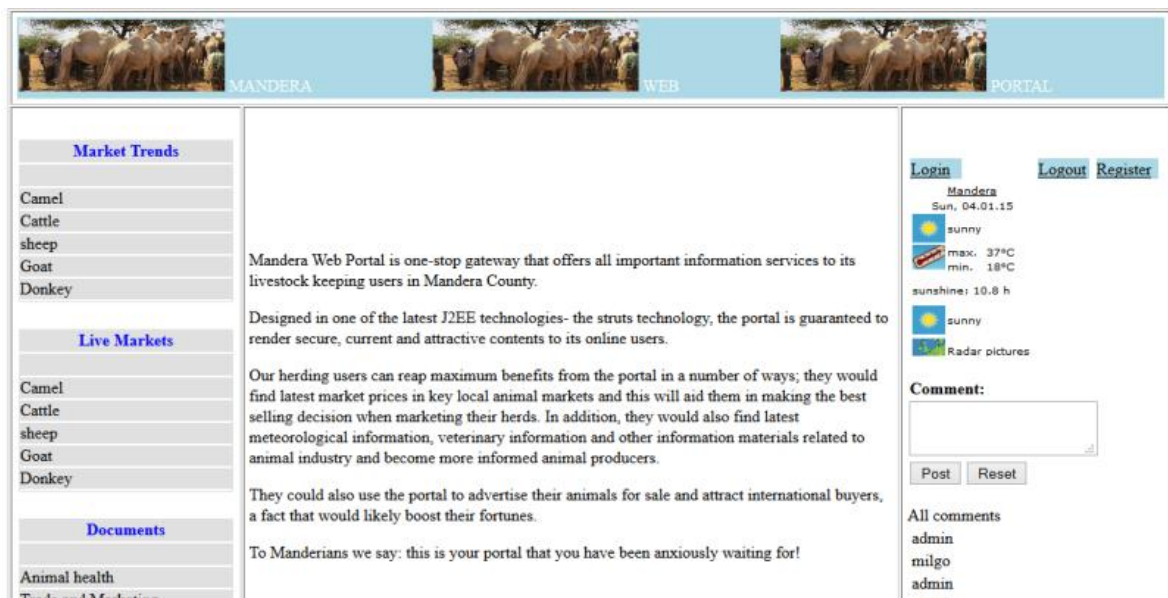


Figure 5.9: Ordinary User View

Figure 5.10: Administrator View

5.2.2d PRICE FORMS

Price update forms are used to instantly update price database tables for the users to get market updates on time.

Figure 5.11: Cattle Price before Update

Market Trends

- Camel
- Cattle
- sheep
- Goat
- Donkey

Data Inputs

- Camel
- Cattle
- sheep
- Goat
- Donkey

Uploads

- upload

Documents

- Animal health
- Trade and Marketing
- Livestock and Livelihoods

Cattle Price:

Type:

Price:

Market:

Mandera
Sun, 04.01.15

sunny
max. 37°C
min. 18°C
sunshine: 10.8 h

sunny
 Radar pictures

Comment:

admin
ghil

admin
working

milgo
home

admin

Figure 5.12: Updating Cattle Price

MANDERA WEB PORTAL

Market Trends

- Camel
- Cattle
- sheep
- Goat
- Donkey

Live Markets

- Camel
- Cattle
- sheep
- Goat
- Donkey

Documents

- Animal health

Today at Mandera Market,

650000/= 50000/= 6000/=

This is how cattle transactions went across the markets as of today, Sun Jan 04 23:32:48 EAT 2015

Type	Date	Price	Market
Calf	2015-01-04	6000	Mandera
Bull	2015-01-04	650000	Mandera
Cow	2015-01-04	50000	Mandera
Cow	2014-10-06	50000	Mandera

Login **Logout** **Register**

Mandera
Sun, 04.01.15

sunny
max. 37°C
min. 18°C
sunshine: 10.8 h

sunny
 Radar pictures

Comment:

All comments
admin
milgo

Figure 5.13: Cattle Price after the Update

5.2.2e TESTING UPLOADS AND DOWNLOADS

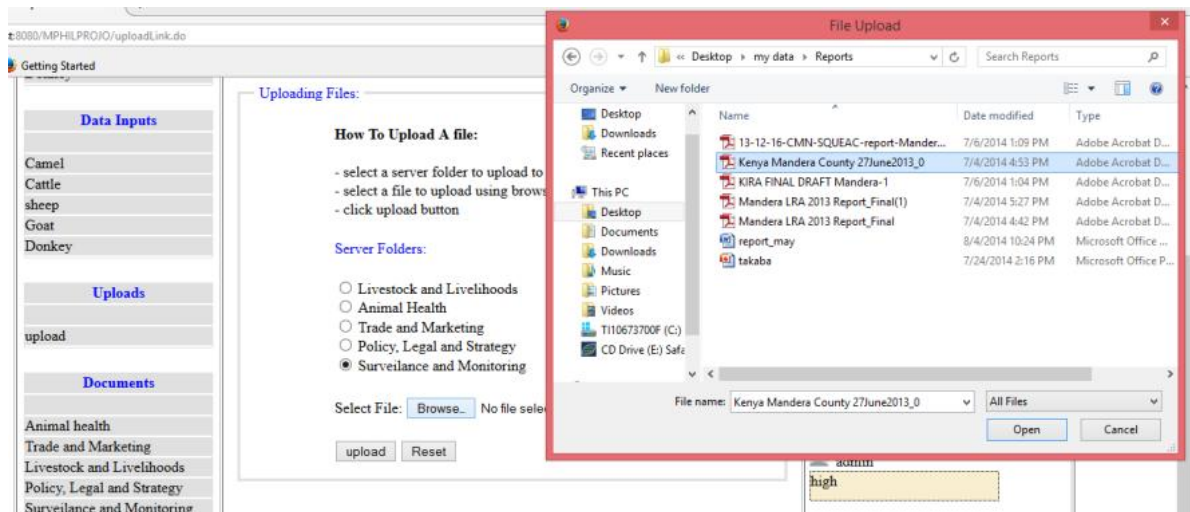


Figure 5.14: Upload in Progress

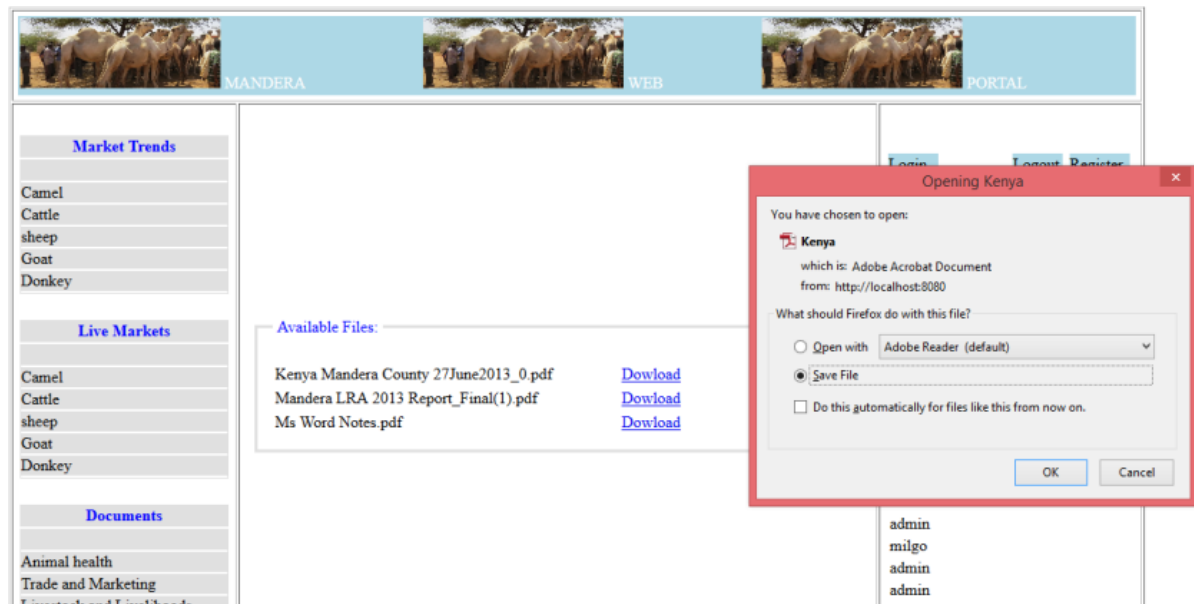


Figure 5.15: Download in Progress

5.2.2f: GRAPH GENERATION

Analytical graphs about market performance are to be generated automatically on fly.

Figure 5.16 shows Cattle Market Performance Chart indicating monthly volume and prices of cattle across all local markets.

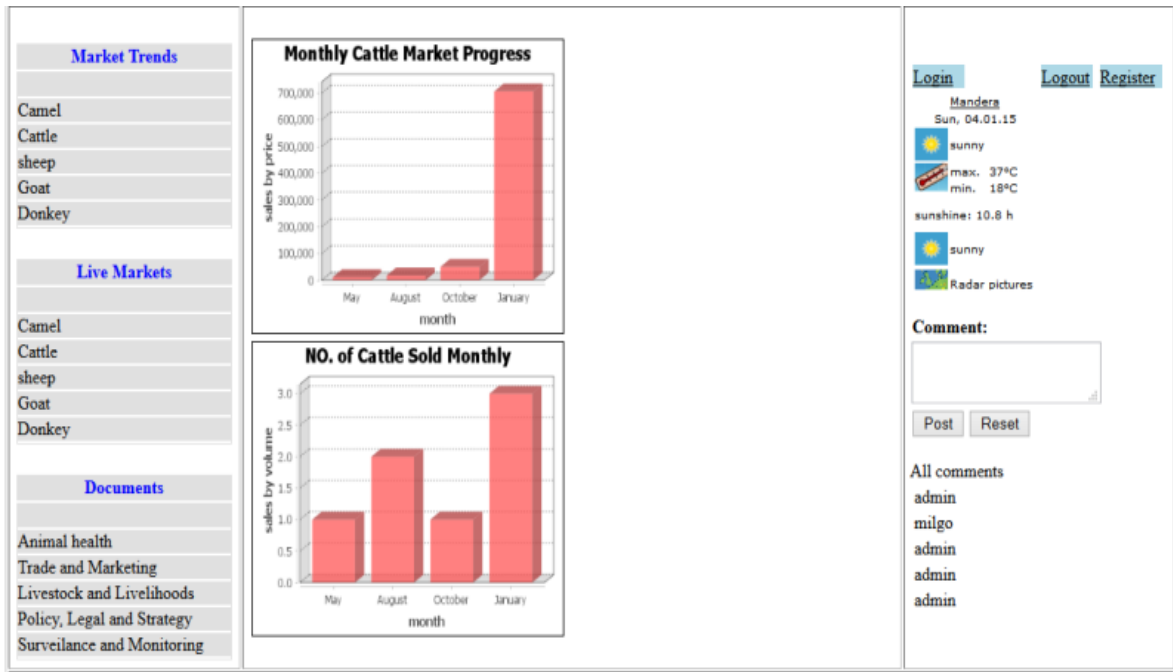


Figure 5.16: Cattle Market Performance

5.2.2g: MOBILE APPLICATION

a. LOGIN AND REGISTRATION



Figure 5.17: Mobile Null Login



Figure 5.18: Register with Existing User ID



Figure 5.19: Unregistered User Login *Figure 5.20: Cattle Price Display*

b. HERDER/TRADER VIEW

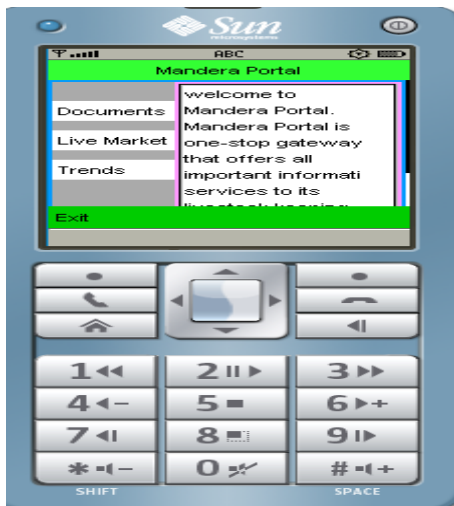


Figure 5.22: Home Page for Ordinary User *Figure 5.23: Animal Market*

c. ADMINSTRATOR VIEW*Figure 5.23: Admin Page**Figure 5.24: Price Update Form*

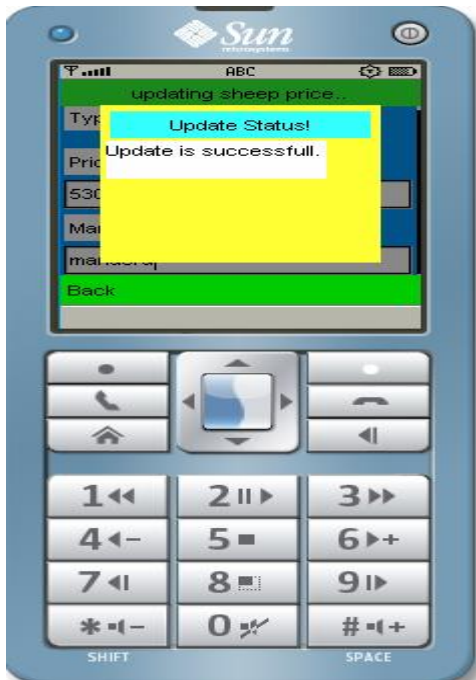


Figure 5.25: Update Status Dialog

5.3 CHAPTER SUMMARY

This chapter has dwelled on activities of system analysis, design and testing of Mandera web portal, demonstrating that the portal is working fine. User manuals for the portal are available in appendix 1.

CHAPTER SIX

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.0 INTRODUCTION

This chapter presents the summary of the findings, conclusion, recommendations and suggestions for future research.

The aim of the study was to assess the information needs of livestock producers in Mandera County in order to come up with an online portal that serves their needs. To realize this, a field work of collecting data from the respondents was carried out using interviews and observation method. The target population initially comprised of all the adults in Mandera County. But for reasons pertaining to time and resource constraints, only a sample of 100 persons comprising herders, livestock merchants and livestock officers was drawn to represent the entire population. The raw data collected was then analyzed both quantitatively using descriptive statistics to arrive at key findings and technically using two use cases, a top level DFD and an entity relationship diagram for software development. The proposed portal called Mandera Web Portal was then designed and developed using JSP, CSS, JavaScript, MySql database, Tomcat engine and a struts framework. Additionally, J2ME and LWUIT library were used to complete its mobile version. Finally, integration and functional tests were run to remove bugs and failures and to ensure that the portal was working fine.

6.1 SUMMARY OF THE FINDINGS

The study was anchored on five objectives. These included to:

1. Investigate the information needs of livestock farmers in Mandera county;

2. Establish existing main channels of disseminating information to Mandera livestock farmers;
3. Survey existing livestock-based information systems and portals serving Mandera livestock farmers;
4. Model the collected data for software analysis and design; and
5. Develop a web portal that will address the information needs of Mandera livestock farmers.

6.1.1 INFORMATION NEEDS OF LIVESTOCK FARMERS IN MANDERA COUNTY

The first objective was to investigate the information needs of livestock farmers in Mandera County. To achieve this, the respondents were required to indicate their information needs. The findings showed that there were four predominant areas of information needed amongst the livestock farmers: market information, veterinary information, information on lost and found animals, and metrological information in that order of priority (figure 4.3). Further, findings from the observation reveal seven information elements needed to execute an animal sale. They included price, gender/age of the animal, time of sale, place of sale and the season (4.2.2).

6.1.2 MAIN CHANNELS OF INFORMATION DISSEMINATION FOR LIVESTOCK FARMERS IN MANDERA COUNTY

The second objective was to establish existing channels of disseminating information to livestock farmers in Mandera. To achieve this, the respondents were required to indicate the

information channels they frequently use to get information they need. The findings showed that there were six main sources of information dissemination used by the respondents: friends, a local FM, county information desks, public *barazas*, social media and news dailies in that order of priority (table 4.4).

6.1.3 LIVESTOCK INFORMATION SYSTEMS AND PORTALS SERVING LIVESTOCK FARMERS IN MANDERA COUNTY

The third objective was to survey existing livestock-based information systems and portals serving Mandera livestock farmers. To achieve this, the respondents were asked to identify any livestock information systems and portals that they knew of or ever used in Mandera County. The findings showed that there were no any livestock-based portals or systems running in Mandera (4.4). This fact was further corroborated by the results of online searches conducted on government e-services portals and area NGO websites. However, regional and national information portals and systems serving either an entire region like East Africa, or an individual county like Kenya, Ethiopia or Tanzania were found. They included the Kenya National Livestock Market Information System (NLMIS), Livestock Information Network and Knowledge System (LINKS) and IGAD Information Portal (1.0.1).

6.1.4 DATA MODELING FOR SOFTWARE ANALYSIS AND DESIGN

The fourth objective was to model the collected data for software analysis and design. To achieve this, two use cases (figures 5.0 and 5.1) and a context diagram (figure 5.2) were used to analyze the user requirements while an MVC model (figure 5.3) and an entity

relationship diagram (figure 5.4) were used to describe design for the portal's web application and database respectively.

6.1.5 DEVELOPING WEB PORTAL FOR LIVESTOCK FARMERS IN MANDERA

The fifth objective was to develop a web portal that will address the information needs of Mandera livestock farmers. To achieve this, Java , JSP, struts 1.3 and MySQL database were used to develop, test and run the web version of the portal (figures 5.5 - 5.16) while J2ME, struts 1.3, and MySQL were used to develop and run the mobile version of the portal (figures 5.17 - 5.25).

6.1.6 VALIDATION OF ASSUMPTIONS

The study had two assumptions. The first assumption predicted in-existence of local livestock management systems (MIS) specifically designed to serve Mandera farmers. However, the study did not find any livestock information system or a portal exclusively serving Mandera farmers (4.4) or even jointly with other counties and hence, the assumption is invalid, implying a pressing need for a new portal. The second assumption was about connectivity of many parts of Mandera County to at least one network. The study established that there are three mobile networks operating in Mandera - Safaricom, Airtel, and Orange. Further, the study established that Safaricom is available in all main towns of the thirty wards of Mandera while Airtel is only operating in three constituencies out of the six constituencies of Mandera. Orange is limited to Mandera town only. Based on this observation, assumption two is valid in its connectivity claim; a large number Manderans are connected to at least one or more networks, providing further ground for new portal development.

6.2 CONCLUSION

Timely information is critical to the advancement and progress of livestock farming. Livestock farmers in Mandera have varied and complex information needs on a wide range of livestock-related areas. However, existing channels of information such as barazas, radios and oral means are either too ineffective or too limited in scope to address their needs; a better channel was urgently needed. Hence, there was need for advanced channels like web portals to address these needs. The study had developed and implemented Mandera web portal to serve pastoralists in Mandera.

6.3 RECOMMENDATIONS

Recommendation 1

Findings of research questions one and two showed that livestock farmers in Mandera have multiple information needs and that information channels available to serve their information needs were old and ineffective. To solve this, the study recommends to the ministry of agriculture, livestock and fisheries and concerned NGOs to adopt the following:

- Use of modern, advanced channels of information such as online portals, radio frequency identification devices (RFIDs) and mobile phones
- Satellite vegetation monitoring to be conducted more frequently in Mandera and the images availed to the local farmers in order to help them get better information on grazing grounds and make better decisions on where to take their herds during droughts.

- Biotechnology services to be availed in Mandera so that the local livestock farmers can access and improve their animal yields.

Recommendation 2

Findings of research question three revealed that no information portals or livestock-based information systems exclusively serving local livestock farmers were found operating in Mandera at the time of data collection. However, regional livestock information portals designed to serve wider East Africa and Horn of Africa do exist in Kenya, but Mandera farmers did not see them as being of use to them. Hence, the study recommends development and operationalization of a robust web portal for Mandera livestock farmers that has the capability to solve their information needs.

6.1 SUGGESTIONS FOR FUTURE WORK

The current version of Mandera web portal, although it has the capacity to satisfactorily serve its intended users, still needs some extension and more component building. I particularly suggest two important improvements namely: RFID-based livestock tracking component, and internet payments system for online animal transactions. Livestock tracking systems harness RFID technologies to identify and track animal movements from point A to point B along the supply chain, and through that enhance linkages and reduce wastage. Online payment systems, on the other hand, provide safer and more convenient channels for over-the Internet payments and cash transfers, thereby enabling more purchases, and boosting gross profit margins for livestock minders.

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APPENDICES

APPENDIX 1: USER GUIDE

INTRODUCTION

Mandera web portal is an online web application hosted on J2EE servers 24/7 and all that is required to access it is internet connectivity and a modern web browser or a mobile.

This Guide provides a step-by-step tutorial on how to access and use the portal with ease and convenience. The guide is segmented into two parts based on the mode of access – via browser or through a phone. Also, each part is further divided into two sections- one for ordinary users and the other for privileged users. Ordinary users include herders and traders while privileged users are web master, NGO /government, and veterinary officers.

1.1: ACCESS VIA BROWSER

1.1.1 SECTION A: HERDER/FARMER

Accessing the portal

To access the portal:

1. Open the browser
2. Type this web address: <http://localhost:8080/ManderaPortal/>
3. click go

Signing up/login

To sign up:

1. Click register
2. Enter the details. * means a required field
3. Click Submit

To login:

1. Click login
2. Enter user name and password
3. Click submit

To comment, **note:** you must be logged in to comment:

1. Type your comments in the comment box
2. Click post

Surfing the portal

The portal first page is divided into four columns- left, body, right, header and footer. The left column has three sections subheaded markets trends, live markets, and documents as shown in figure 6.1.

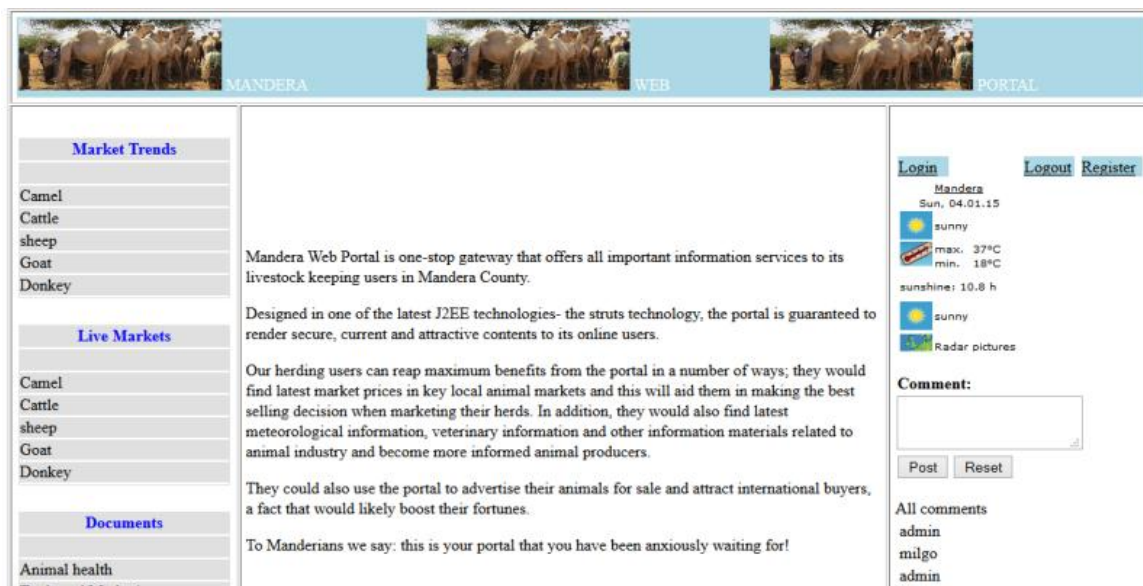


Figure 6.1 : left menu sections for user view

- a. **Market trends:** provides latestest livestock market analysis-monthly and yearly-and analytical charts.
- b. **Live markets:** presents price updates across all the markets and anmimal price list for the past months.
- c. **Documents:** contains downloadable information files, expert reports and findings on various livestock-related topics such as animal health, trade/marketing, liveslihoods, strategy and monitoring.

To read/dowload information materials:

1. Click appropriate title under documents section i.e animal health, strategy etc.
2. Identify the file to choose
3. Click download link infront of the file
4. Click Open to read it online or click save to save it on your computer.

To get latest price information:

1. Click the relevant title under live markets section i.e camel, cattle etc.

To get latest market analysis and reports:

1. Click the desired title under market trends section:
2. Click the chart to print it.

To get important links or contacts:

1. Click links or contats in the footer's section

1.1.2 SECTION B: ADMINSTRATORS

Accessing the portal

To access the portal:

1. Open the browser
2. Type this web address: <http://localhost:8080/ManderaPortal/>
3. click go

Login to exit normal user view

the first view you get is a normal user view, login to go to administrator view:

1. Click login
2. Enter user name and password
3. Click submit

Registering administrators

To register a user:

1. Click register
2. Enter the details. * means a required field
3. Click Submit

To comment:

1. Type your comments in the comment box
2. Click post

Updating the portal

The portal is divided into four columns- left, body, right, header and footer. the left column, has four sections headed markets trends, data inputs, uploads and documents. See figure 6.2.

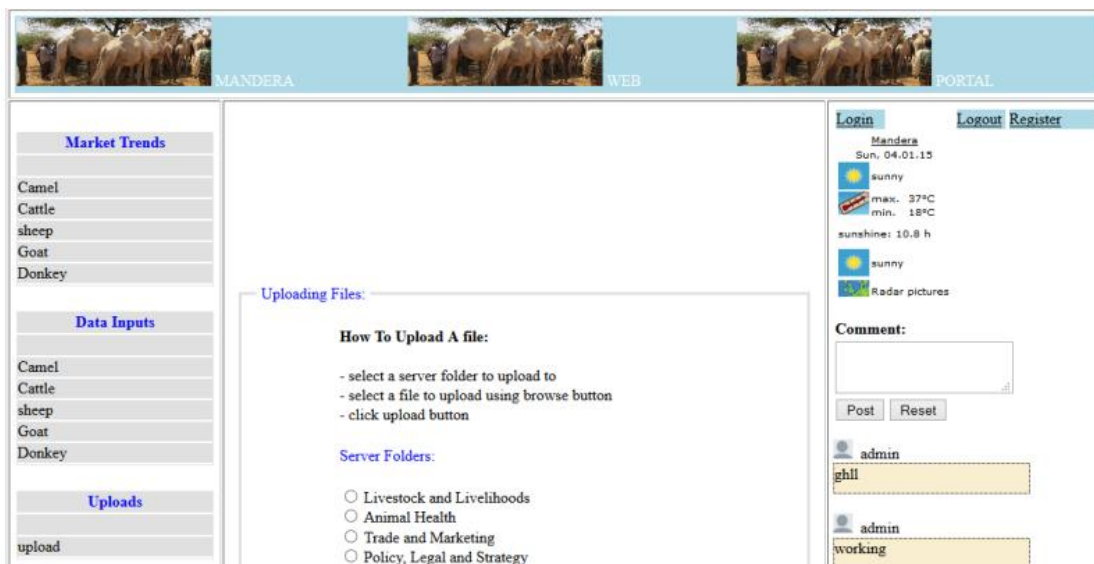


Figure 6.2: left menu sections for admin view

- a. **Market trends:** provides latestest livestock market analysis-monthly and yearly-and analytical charts.
- b. **Data inputs:** provides forms for updating the prices
- c. **Uploads:** for uploading files
- d. **Documents:** contains downloadable information files, expert reports and findings on various livestock-related topics such as animal health, trade/marketing, livelihoods, strategy and monitoring.

To upload materials:

1. Click upload under uploads section.
2. Select a server folder to upload to
3. Click browse button to select a file to upload
4. Click upload.

To update animal prices:

1. Click the relevant title under data inputs setion i.e camel, cattle etc.
2. Choose animal type from the menu
3. enter price
4. Enter market
5. Click update

To access the database directly:

1. Open query browser
2. Type root for user

3. Type root for password

To get latest market analysis and reports:

1. Click the desired title under market trends section:
2. Click the chart to print it.

To get important links or contacts:

1. Click links or contacts in the footer's section

To read/download information materials:

1. Click appropriate title under documents section i.e animal health, strategy etc.
2. Identify the file to choose
3. Click download link in front of the file
4. Click Open to read it online or click save to save it on your computer

1.2: ACCESS THROUGH A PHONE

To access the portal:

1. Type this web address: <http://localhost:8080/ManderaPortal/>
2. Download mandera portal.jar file
3. Open and install it
4. Open the application
5. On the login page, click menu -> register to register
6. Click exit to go to login page
7. Enter user ID and password then click menu -> login

8. See figure 6.3



Figure 6.3: login page

1.2.1: SECTION A: HERDERS/TRADERS

After login, the screen below appears.

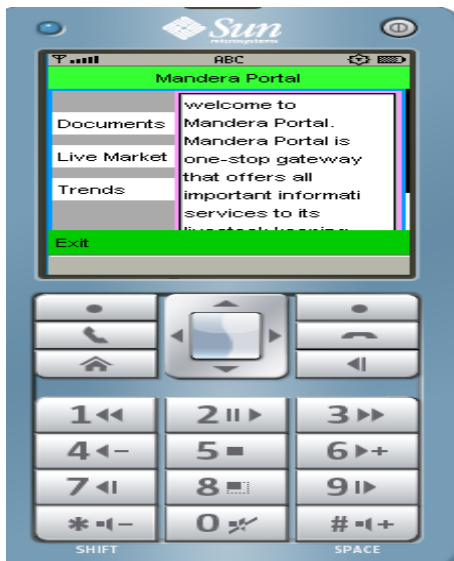


Figure 6.4: herder view

To get analytical charts:

1. Click on trends
2. Click on animal category i.e. cattle, camel etc
3. View the chart and click back

To get livestock price updates:

1. Click live market
2. Click on livestock category i.e. cattle, camel etc
3. View and click back

To download and read information files:

1. Click documents
2. Click file category i.e. animal health, policy/strategy etc
3. Open the file to read using your phone's Text Viewer application

1.2.2: SECTION B: ADMINISTRATORS

To update the database for new prices:

1. Click update
2. Choose animal category
3. Fill in the price form
4. Click submit
5. After getting "update is successful" message, click to back
6. Continue with rest of updates
7. See figure 6.5 and 6.6

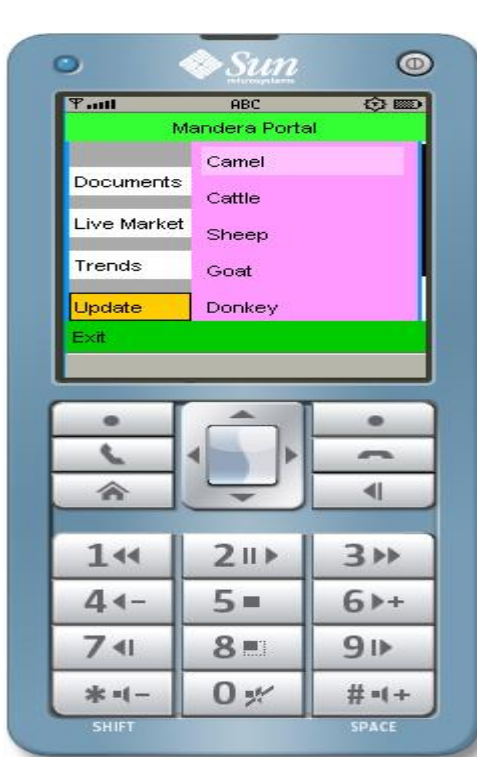


Figure 6.5: Administrator Main Page



Figure 6.6: Prices update form

*****END OF THE GUIDE*****

APPENDIX 2: PROJECT PLAN

Table 3: Time/Budget Estimates

Activity	weeks	Costs
1. selection of title	2	-
2. writing research proposal	16	5,000
3. data collection, and analysis	14	4,200
4. User inter faces(forms) design	4	1,500
5. Output design (reports and charts)	4	1,500
6. Database design(tables and views)	4	1,500
7. Front end design (view and content pages, JavaScript validation, graphics , Tiles and CSS)	16	8,400
8. Backend design (action forms, action classes)	18	8,400
9. Deployment and testing	5	1,500
10. Documentation	2	3,000
Total	85	35,000

APPENDIX 3: STRUCTURED INTERVIEWS**PART A: ALL RESPONDENTS**

1. Which of these roles best describe you?

- Herder
- Cattle trader
- Livestock officer

2. Which of the following areas of information do you need most?

- market
- meteorological
- lost and found animals
- veterinary
- water points
- others

3. State your key information requirements

- 1)
- 2)
- 3)
- 4)
- 5)

4. What are the main information channels you use to get information?

PART B: HERDERS

1. What are the major problems you face in your pastoral occupation?
2. What are the main causes responsible for these?
3. What do you think should be done to improve the situation?
4. Which areas do you take the herds to during drought spells?
5. What kinds of emergency services from NGO and the government during drought seasons?

PART C: CATTLE TRADERS

1. What are the main problems you face in cattle trade?
2. What, do you think, are the possible causes of these problems?
3. Describe how the sale of animals takes place at the market i.e. major deals, main actors, documents involved etc.
4. How do you usually determine the prices of animals?
5. Where are your loyal buyers found?
6. Which measures do you think are appropriate to make cattle business more viable?
7. When are your peak seasons for this business?
8. Approximately, by what margin does transport eat into your accruing profits?
9. Which species have the highest market demand?

PART D: VETERINARY OFFICERS

1. What type of animal care services do you provide for Mandera farmers?
2. Describe the impact of these services on livestock sector in Mandera
3. What do you think should be done to improve the conditions further?

4. Where are the main centers for your services in the county?
5. How is the local demand for your services?
6. What are the main challenges that you encounter in providing these critical services?
7. Which diseases are most common in Mandera County?

APPENDIX 4: OBSERVATION CHECKLIST

Items to observe:

- I. Information posters: contents of posters placed at markets, cattle treatment centers and butcheries, indicating things like prices, announcements etc.
- II. Market events: the act of selling and buying, parameters considered when buying/selling an animal, mode of payments, documents used etc.
- III. Sick animals, emaciated animals and their prices.