Providing/Developing/Setting up Regional Livestock Market Information System (LMIS) at IGAD Center for Pastoral Areas and Livestock Development (ICPALD), Nairobi

Final Report

Prepared for Intergovernmental Authority on Development

Center for Pastoral Areas and Livestock

Development

From

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September 2019

Introduction

The International Governmental Authority on Development (IGAD) currently coordinates the Regional Pastoral Livelihoods Resilience Project (RPLRP) that currently operational in Ethiopia, Kenya and Uganda. The objectives of RPLRP are to enhance livelihood resilience of pastoral and agro-pastoral communities in cross-border areas that are prone to drought and improve their capacity to respond promptly and effectively to an eligible crisis or emergency. RPLRP has five main components which are: 1) Natural Resources Management; 2) Market Access and Trade; 3) Livelihood Support; 4) Pastoral Risk Management; and 5) Project Management and Institutional Support. In each of the 3 countries, RPLRP is managed through the government ministries and activities associated with the components listed above are being implemented in the targeted counties/districts. As part of this effort, one of the activities related to the Market Access and Trade component is the development of a livestock market information system to provide a means for timely livestock market information system to be reported digitally, and then made available it to the public and stakeholders for use in decision making. The livestock market information system will be designed to allow data collected from primary, secondary, and terminal livestock markets from the three countries to be entered into the system at the country level via short messaging service (SMS) messages from cellular telephones. Pastoralists, livestock traders, and other interested stakeholders can then request the price and volume information for specific markets using SMS and Internet. In addition, another goal is to link the systems from each of the countries to form a regional livestock market information system to support and enhance cross-border trade and enterprise development.

In July 2018, Texas A&M AgriLife Research (TALR) entered into an agreement with IGAD to support development and deployment of software in the project countries to support national livestock market information systems (NLMIS). It was agreed to as part of this effort, that TALR would conduct training workshops for NLMIS system administrators on installation of the system and maintaining the system over time. In addition, sessions for training of trainers would be conducted in each of the countries to build capacity for training market monitors on field data collection and in quality control for data. During the period from August 2018 to November 2018, the initial training events were conducted in each of the countries. During February and March 2019, backstopping and refresher trainings were held in each country. In July 2019, additional follow-up training, information transfer, and project closeout meetings were conducted in each of the LMIS countries. Summaries of the events are described below.

System Administrator Training – August 2018

The NLMIS System Administrators Training was held in Nairobi, Kenya on 22th -25th August 2018. In attendance were system administrators from Ethiopia (Bethelhem Tigistesellassie, Desta Almaz Chernet), Kenya (Mugambi Githinji, Pius Cheruiyot), and Uganda (Vanessa Namayanja, Amos Mpungu, along with IT professionals from IGAD (Oliver Salehe, Jemal Mensur). The objectives of the training were as follows:

- Learn about the procedures for installing the livestock market information system (LMIS)software onto Windows servers.

- Provide hands-on training for installing the software, connecting the modem, and testing the communications with SMS.
- Provide an overview of the LMIS coding and LMIS database structure, relationships, tools for backup and restore of database.
- Demonstrate the LMIS Administration web pages for data entry to populate the LMIS database for use and for updating.
- Discuss best practices for data quality control, data corrections, and develop framework for a plan to establish quality control procedures and documentation.
- Discuss harmonization of codes for regional LMIS.

The intended outcomes of the training were: 1) administrators should understand how to install the different components of the LMIS software onto a Windows Server; 2) have an understanding of the LMIS database structure, relationships, and coding; 3) be able to backup and restore the LMIS database; and 4) have a basic protocol for quality control of LMIS data sent to the server from the markets.

The first day of training began with general overview of the livestock market information system software. The main goals of the were described which included integrating the system into the current livestock market data streams, taking advantage of the digital technologies to transfer data rapidly from the field, and to improve and expand the analytical, reporting, and geographical relevance of the market data.

The trainees were then walked through the LMIS methodology. A graphic of the general framework of the system's information and dataflow was described. Points in the data flow where quality control issues could be evaluated and corrected were discussed. The SMS modules for parsing data and how the various parts of the SMS string were decoded and stored in the database were conferred. The trainees were then provided with a schematic of the livestock market information system database structure that included a listing of database tables, primary keys, foreign keys and table relationships. Linkages between the tables were discussed and look-up functions for turning codes into text for markets, animal kinds, breeds, ages and grades were shown. The need for harmonization of codes among countries was also discussed for improving the merging of data for the regional market information system.

The trainees were provided with hands-on training for installing the LMIS software onto a server, using their laptops as a proxy. First, the trainees were shown how to install the PostgreSQL database software that is needed for storing the LMIS data. After installation of the database software, the trainees were shown how to restore the LMIS database and how the database could be backed up once restored or for periodic back-up on another system. After database installation, demonstrations were provided for installing the Java software and Apache Tomcat web server packages. Once the web server was installed, the trainees were provided with the steps for installing the LMIS web and LMIS administration software applications. These installations were tested, and information given on how to troubleshoot problems in case the software would not load or if the web page had errors. The trainees were then walked through the process of installing the drivers for connecting the modem and testing the communications with SMS messaging.

Database tables, relationships among tables, and data entry into the database tables were discussed. The LMIS administration tool was introduced and each of the modules of the tool were demonstrated. Data entry for languages, countries, animal kinds, breeds, age groups, sex of animal, and grades were conferred, as well as information provided on the structure of these items that were in previous versions of the LMIS in Kenya and Ethiopia. Development of unique codes for markets and users were discussed and the linkages that need be made between markets and users so that data sent from markets could be entered into the database via SMS.

An overview of the LMIS website was then given. Dr. Angerer demonstrated to the team how the main page of the LMIS could be used to get quick summaries of the market data. He showed how the market data on the Google map could be used to view market data changes, and how the market summary table could be used to get quick reports on market conditions. He also discussed the options for changing the language and the currency for the website. The LMIS menu items were then demonstrated. The usage of the Livestock Market Trend, Volume Trend, Market Chain, and Livestock Volume Composition tools was shown. The team then discussed the development of market reports and the interfaces for producing market reports for livestock and livestock products were demonstrated. Lastly, the email and SMS subscription options for push messages was demonstrated.

To close out the training for the system administrators, quality control measures for data collection and reporting were discussed. Dr. Angerer showed the group how to set the anomaly detection functions within the LMIS Administration software so that daily reports could be produced highlighting data that was sent to the server that exceed specified thresholds for change in price or volume. The goals of a quality control program for the LMIS were given. These included: 1) development of a plan and procedure for maintaining quality of LMIS data from point of collection to a query by LMIS stakeholders; 2) measures to insure that data from the LMIS are as accurate and timely as possible; and 3) development of a culture among the LMIS team to produce a quality product and to implement quality control procedures to insure the highest quality and most accurate market data. The development of the quality control manual that describes the roles and responsibilities of each group involved in sending in or reviewing data was also discussed. An example quality control manual was also provided to the team.

The training was concluded on 25th August 2018. Each of the teams was provided with a cellular modem to use in setting up the server in their respective country. Documents and PowerPoint slides were provided to the participants. The documents and presentations can be accessed here: https://www.dropbox.com/s/nov9y8rfkq85yxh/LMIS_sys_admin_docs.zip?dl=0

Ethiopia LMIS Installation and Training of Trainer Training – August 2018

Dr. Angerer traveled to Addis Ababa, Ethiopia on August 27, 2018 to work with the system administrators with the Ministry of Agriculture and Natural Resource (MoANR) to install the LMIS software on the new server housed and the Ministry. He first met with Sertse Sebuh, the Ethiopia RPLRP National Coordinator, to discuss the outcome of the system administrator training in Nairobi and

to discuss the plan for installation of the software and the training that would be held later in the week for trainers. He then met with Dr. Sebuh and the other members of the Ethiopia LMIS team to discuss the plans for the week.

For the installation of the LMIS software, Dr. Sebuh had made arrangements to transfer the old server that was housed at the International Livestock Research Institute (ILRI) to MoANR. The LMIS data were removed from the old system and prepared for upload to the new system. Dr. Angerer and the LMIS system administrators (Bethelhem Tigistesellassie, Desta Almaz Chernet, Mehari Negash) installed the software onto the server located in the secured server room at MoANR. After the software as installed, the data from the old server was restored onto the new server. The modem software was installed on the system and the modem was tested. Initially, the SIM card in the modem would not register with the cellular, and the connection would be lost immediately. The problem with the connection of the modem was determined to be related to the SIM card. Since the SIM card being used was from the modem used on the old server, the SIM card was at least 7 years old. Therefore, it was suggested by Dr. Angerer that the system administrators contact Ethiopia Telecom and replace the SIM card with a new version that could easily switch between 4G, 3G, and 2G protocols. For the interim, the team was able to provide a temporary SIM card from one of the Ministry's employees and this was used to test whether the modem and system were working correctly. When the modem was tested with a different, newer SIM card, the system was able to connect to the SMS modem.

After the software implementation and testing was completed, Dr. Angerer provided the team with additional training on the use of the LMIS Administration component. The age classes, animal kinds, breeds, grades, and other characteristic data for Ethiopia were reviewed. The user list and market list were also reviewed. A database dump of names and markets were provided to the administrators for review to remove people from the "active" state to "non-active" in the user data table. Dr. Angerer also demonstrated how to link users to specific markets so that the users could send in data to the system via SMS. Dr. Angerer downloaded the updated tables to include in the "Training of Trainers" PowerPoint presentations.

On Wednesday, August 30, Dr. Angerer traveled with the MoANR team to Adama to conduct the Training of Trainer Sessions for personnel who would be training market monitors on how to collect market information in the various livestock producing regions of Ethiopia. The objectives of the training were to: 1) provide an overview and demonstration of the livestock market information system (LMIS)software that will be used for Ethiopia livestock markets; 2) discuss and provide training on the market information system coding system for sending market data to LMIS server; 3) practice sending data to the server and discuss troubleshooting problems with messages; 4) discuss best practices for data quality control and data corrections, and 5) discuss harmonization of LMIS codes for aggregation to regional LMIS.

Approximately 50 people attended the training. During the first day, the first three objectives were met. Participants were provided training on the coding system and were given the opportunity to practice sending data to the LMIS server. If trainees had issues with coding or in sending data, these problems

were discussed as a group and resolved. On the second day of training, the group traveled to a camel market (Figure 1) and a livestock fattening operation (Figure 2) outside of Adama to practice livestock grading protocols and to discuss data collection procedures. The group also visited two cattle markets, but these were inaccessible due to heavy rainfall the previous day.

On the third day of training, the trainees were convened to discuss quality control procedures for the LMIS data. This training focused on the process and protocols that need to be implemented to ensure that the LMIS data collected are of the highest quality and free of errors. Dr. Angerer discussed the development of a quality control document that would provide a plan and procedure for maintaining quality of livestock market information system data from point of collection to query of the data by LMIS stakeholders. It would define the roles and responsibilities of each person or group involved in data collection and storage and would describe actions for correcting erroneous data.

The Ethiopia LMIS team and Dr. Angerer provided a timeline for implementation of the data collection at markets and for completion of training of trainers and quality control manuals. Immediate next steps that were discussed included: 1) Identification of markets that will be collecting data; 2) Identification of market monitors who will collect data at each market; 3) providing national IT personnel with list of markets and market monitors for each market; 4) conducting training of market monitors and provide datasheets for data collection; and 5) begin data collection and evaluation of data accuracy. Steps that would need to be implemented during the next 6 months included: 1) production of monthly bulletins/reports of price and volume; 2) market monitors, market supervisors, and regional supervisors to provide feedback on system and website; 3) provide information on markets that would be included in the regional LMIS; 4) identification of any quality control issues; 5) development of a quality control manual; and 6) update and finalize the training manuals.

Dr. Angerer and the LMIS national team returned to Addis on August 31. Dr. Angerer worked with the national IT team on September 1 to provide guidance on adding markets and market monitors to the system and to ensure that the LMIS software was working properly on the server. The group also discussed provisioning of a public IP address so that the LMIS website could be made public.

A copy of the PowerPoints used for the Ethiopia training can be accessed here:
https://www.dropbox.com/s/y1xm8lya75t104r/Ethiopia_LMIS_powerpoints.zip?dl=0

Kenya LMIS Installation and Training of Trainer Training – October 2018

Dr. Angerer traveled to Nairobi, Kenya on October 30, 2018 to install the LMIS software on servers at the Kenya Ministry of Agriculture, Livestock, Fisheries, and Irrigation (MoALFI) and to conduct training of trainers for LMIS implementation. Dr. Angerer first met with Maurice Ouma, the Kenya RPLRP Coordinator to discuss the agenda for the week and meetings that were planned, in addition to discussions on the software installation and the training.

Dr. Angerer then met with MoALFI IT staff (Mugambi Githinji and Pius Cheruiyot) to extract the data from the previous LMIS server and to prepare it for the new server. The LMIS software was then

Figure 1. Camels at a market near Adama. These camels were under a quarantine to ready them for export out of Ethiopia.

Figure 2. Cattle being fattened at a livestock fattening operation outside Adama.

installed on a server housed at MoALFI and the data from the old server was uploaded to the system. The modem software was installed on the system and the modem was tested. After the software

implementation and testing of the software were completed, Dr. Angerer provided IT staff who would be administering the system with a walk-through of the system administration. This included data entry procedures for editing or adding age classes, animal kinds, breeds, grades, and other characteristic data for Kenya system. Since much of this data had already been transferred from the old system, time was spent reviewing the data to ensure that it was still needed or if additional data needed to be added for the new system. The user list and market list were also reviewed. Dr. Angerer provided a demonstration on how to link users to specific markets so that the users could send in data to the system via SMS.

The LMIS software and server were tested to ensure that everything was working properly. The MoALFI IT staff procured a domain name and it was linked to the public IP of the system. The system was then brought online publicly and made available at the following web address: http:// http://www.lmiske.go.ke.

Training of Trainers for the Kenya markets was held on November 1 and 2 at the 67 Hotel in Machakos county. The Kenya LMIS team (Maurice Ouma, Harrison Mugo, Mugambi Githinji and Pius Cheruiyot Pius) and 50 trainees from counties across Kenya attended the training. The objectives of the training were: 1) provide an overview and demonstration of the livestock market information system (LMIS) software that will be used for Kenya livestock markets; 2) discuss and provide training on the market information system coding system for sending market data to LMIS server; 3) practice sending data to the server and discuss troubleshooting problems with messages; 4) discuss best practices for data quality control and data corrections, and 5) discuss harmonization of LMIS codes for aggregation to regional LMIS.

During the first day, the first three objectives were met. Participants were provided training on the coding system and were given the opportunity to practice sending data to the LMIS server. If trainees had issues with coding or in sending data, these problems were discussed as a group and resolved. On the second day of training, the trainees discussed quality control procedures for the LMIS data. The development of a quality control document that would provide a plan and procedure for maintaining quality of livestock market information system data from point of collection to query of the data by LMIS stakeholders was also discussed. This document would also define the roles and responsibilities of each person or group involved in data collection and storage and would describe actions for correcting erroneous data.

The Kenya LMIS team and Dr. Angerer provided a timeline for implementation of the data collection at markets and for completion of training of trainers and quality control manuals. Immediate next steps that were discussed included: 1) Identification of markets that will be collecting data; 2) Identification of market monitors who will collect data at each market; 3) providing national IT personnel with list of markets and market monitors for each market; 4) conducting training of market monitors and provide datasheets for data collection; and 5) begin data collection and evaluation of data accuracy. Steps that would need to be implemented during the next 6 months included: 1) production of monthly bulletins/reports of price and volume; 2) market monitors, market supervisors, and regional supervisors to provide feedback on system and website; 3) provide information on markets that would be included

in the regional LMIS; 4) identification of any quality control issues; 5) development of a quality control manual; and 6) update and finalize the training manuals.

The Training of Trainers session was completed, and participants were given a test on the topics and procedures covered during the training. The participants did well on the test, especially on the questions regarding livestock grading. The training ended on the afternoon of November 2.

A copy of the PowerPoints used for the Kenya training can be accessed here: https://www.dropbox.com/s/iib7m17efk1xajj/kenya_lmis_training_powerpoints.zip?dl=0

Uganda LMIS Installation and Training of Trainer Training – November 2018

Dr. Angerer traveled to Entebbe, Uganda on November 4, 2018. On November 5, he met with the Uganda LMIS team (Martin Kasyrie and Vanessa Namayanja) and IT staff (Amos Mpungu, Andrew Namilanga) to install the LMIS software on the server at the Uganda Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and to conduct training of trainers for LMIS implementation. The LMIS software was installed on a server housed in MAAIF's secure server room. The modem software was installed on the system and the modem was tested. After the software implementation and testing of the software was completed, Dr. Angerer met with IT staff who would be administering the system to demonstrate the system administration and to discuss what markets needed to be added to the system and what age classes, animal kinds, breeds, grades, and other characteristic data should be added to the Uganda system. It was decided that the age classes, animal kinds, breeds, and grades would match that used in Kenya to allow better harmonization at the regional level. Six markets from the Karamoja region were added to the system. The user list was also discussed, and it was decided that the initial list of users would be requested at the training of trainers training event. Dr. Angerer provided a demonstration on how to link users to specific markets so that the users could send in data to the system via SMS.

The LMIS software and server were tested to ensure that everything was working properly. The MoALFI IT staff procured a domain name and it was linked to the public IP of the system. The system was then brought online publicly and made available at the following web address: http://lmis.agriculture.go.ug/lmis.

The Uganda LMIS team (Martin Kasyrie, Vanessa Namayanja and Andrew Namilanga) and Dr. Angerer traveled to Soroti on November 7 to conduct the Training of Trainers for the Uganda LMIS. The training started on November 8 and approximately 45 people from the Karamoja region attended. The objectives of the training were to: 1) provide an overview and demonstration of the livestock market information system (LMIS) software that will be used for the livestock markets; 2) discuss and provide training on the market information system coding system for sending market data to LMIS server; 3) practice sending data to the server and discuss troubleshooting problems with messages; 4) discuss best practices for data quality control and data corrections, and 5) discuss harmonization of LMIS codes for aggregation to regional LMIS.

During the first day, the first four objectives were met. Participants were provided training on the coding system and were given the opportunity to practice sending data to the LMIS server. If trainees had issues with coding or in sending data, these problems were discussed as a group and resolved. Quality control procedures for the LMIS data were also discussed. This included the development of a quality control document that would provide a plan and procedure for maintaining quality of livestock market information system data and define the roles and responsibilities of each person or group involved in data collection and storage.

The following day the trainees, the LMIS team and Dr. Angerer traveled to a market outside of Soroti and livestock grading was conducted and discussed for the animals present at the market. Approaching buyers and collection of the price and volume information was also discussed.

The group returned to Soroti to close out the training. The participants were given a test on the topics covered during the training. The participants were also provided with a timeline for implementation of the data collection at markets, and for completion of training of trainers and quality control manuals. Immediate next steps that were discussed included: 1) Identification of the livestock markets that will be collecting data; 2) Identification of market monitors who will collect data at each livestock market; 3) providing national IT personnel with list of markets and market monitors for each market; 4) conducting training of market monitors and provide datasheets for data collection; and 5) begin data collection and evaluation of data accuracy. Steps that would need to be implemented during the next 6 months included: 1) production of monthly bulletins/reports of price and volume; 2) market monitors, market supervisors, and regional supervisors to provide feedback on system and website; 3) provide information on markets that would be included in the regional LMIS; 4) identification of any quality control issues; 5) development of a quality control manual; and 6) update and finalize the training manuals.

The training ended on the afternoon of November 8. The Uganda LMIS Team and Dr. Angerer returned to Entebbe.

A copy of the PowerPoints used for the Uganda training can be accessed here: https://www.dropbox.com/s/bhzi5f94897xa15/Uganda_livestock_market_information_system_TOT.zip?dl=0

Kenya Backstopping and Reinforcement Training – February 2019

Dr. Angerer traveled to Nairobi, Kenya on February 25, 2019 and met with the Kenya LMIS team (Maurice Ouma, Harrison Mugo, and Mugambi Githinji, and Pius Cheruiyot) to discuss the status of the LMIS system and to resolve any outstanding problems. Dr. Angerer provided the team with an overview of the additions that had been made to the LMIS system since the visit in October 2018. These included: 1) dual modem capabilities; 2) ability to change the logos and banner from LMIS Administrative page; 3) ability to change text content on front page; 4) ability to control public downloads – administrator download only; 5) linked language and currency defaults throughout website; 6) capabilities for state/province and county/districts for markets reports; 7) Fully encrypted passwords; 8) currency synchronization fixed; 9) ability to check modem status added and 10) improvements to market reports

formats. The LMIS team mentioned problems they were having with messages being sent from markets which were not showing up in the database. Dr. Angerer demonstrated how to access the server logs for incoming and outgoing messages and how to search for missing messages. It was discovered that for some of the messages that had been sent, the market monitor was not registered or linked with the market that he/she was sending data from. Dr. Angerer demonstrated to the team on how these could be corrected in the database and how messages that were rejected could be entered into the system via the batch mode capabilities. The group discussed issues with the website and administrative functions. The team provided a list of items for suggested fixes and enhancements that Dr. Angerer logged and provided to the programmer (Mousumi Deb) at Texas A&M AgriLife Research.

On the second day of the mission, Dr. Angerer traveled with Harrison Mugo and Mugambi Githinji to the Lodwar market. There, the group met with the market director and market monitors from the area (Figure 3) to discuss issues they were having with the data collection and sending data into the LMIS server. The majority of these issues were related to linking the appropriate market monitor to the appropriate market so that messages sent in would be accepted by the server. These issues were resolved on site and the market monitors verified that the system would accept data they were sending by resending messages that had been reject. The LMIS team also demonstrated some of the capabilities of the website and the ability of the system to generate market reports (Figure 4).

Figure 3. LMIS team and market monitors at the Lodwar market in Kenya.

Figure 4. Market monitors testing the SMS and LMIS software with the Kenya LMIS team at the Lodwar market in Kenya.

After demonstrating the system, the LMIS team toured the market facilities (Figure 5) and discussed with the market monitors about data collection. The market director explained that the Lodwar market was a daily market that received cattle, sheep, goats and camels. Although it is a daily market, one day of the week has the largest volume (Wednesday) and this is also the time that buyers come for regional transport of the livestock purchased at the market. After the tour of facilities, the group had lunch and Angerer, Mugo, and Githinji returned to Nairobi.

On the third day of the visit, Dr. Angerer met with Oliver Salehe from IGAD and worked with him to install the LMIS software for the Regional LMIS server at the IGAD offices in Nairobi. The system installation was completed. However, some issues were discovered with connection of the SMS modem related to the Virtual Machine software which will require some additional software to correct the problem. In addition, the regional server was not yet connected to a public IP address due to an impending move of the IGAD offices to another location in Nairobi. Once the move is completed, Dr. Angerer will work with Mr. Salehe to bring the system online.

Dr. Angerer met with Maurice Ouma to close out the backstopping mission. The selection of markets for the regional system was discussed and Mr. Ouma said that the Kenya team would meet to come up with the list. The quality control procedures manual was also discussed. Dr. Angerer provided an example document that could be used as a template for developing the Kenya document.

Figure 5. Examining the livestock and market facilities at the Lodwar market in Kenya.

Ethiopia Backstopping and Reinforcement Training – February/March 2019

Dr. Angerer traveled to Addis Ababa on February 28, 2019 and met with the Ethiopia LMIS team (Wondimagegnehu Shibru, Bethelhem Tigistesellassie, Mehari Negash) to discuss the status of the LMIS system and to resolve any outstanding problems. Dr. Angerer provided the team with an overview of the additions that had been made to the LMIS system since the visit in September 2018. Several of these were suggested by Ethiopia LMIS team. These included: 1) dual modem capabilities; 2) ability to change the logos and banner from LMIS Administrative page; 3) ability to change text content on front page; 4) ability to control public downloads – administrator download only; 5) linked language and currency defaults throughout website; 6) capabilities for state/province and county/districts for markets reports; 7) Fully encrypted passwords; 8) currency synchronization fixed; 9) ability to check modem status added and 10) improvements to market reports formats.

Mr. Shibru provided an overview of the progress that had been made and provided an update on the status of the program. He also stated that the Ministry was actively involved in developing a short number, bulk SMS system that would be used by several groups in the Ministry for distributing information. He stated that Dr. Angerer should meet with the IT contractor that was working on the bulk SMS system to discuss how to integrate it with the LMIS SMS messaging. Mr. Shibru also stated that a meeting had been arranged with the State Minister of Agriculture, Aynalem Nigussie, for Monday March 4 to provide an overview of the LMIS and to discuss progress.

The LMIS team indicated that issues related to problems with the modem SIM card had been resolved with the update to the modem software that Dr. Angerer had completed in early February 2019. Dr. Angerer worked with the team to go over any problems they were and having and to demonstrate some of the new features of the LMIS software. The IT team provided a list of issues that required attention and went through each of these with Dr. Angerer. The team then asked questions about fixing messages with errors and proper procedures for using the batch mode tool. The group discussed issues with the website and administrative functions. Dr. Angerer took notes on problems and suggested fixes/enhancements and these were combined with the list that the IT staff provided. These issues were sent to the programmer (Mousumi Deb) at Texas A&M AgriLife Research for incorporating into the next software update.

On Monday, March 4, Dr. Angerer met with the Ethiopia LMIS team and Oliver Salehe (IGAD IT) to go through the presentation that would be made later in the day for the State Minister of Agriculture. Suggested corrections were documented and included into the presentation. During the afternoon, the Dr. Angerer and the team met with Her Excellency Aynalem Nigussie, State Minister of Agriculture. The Ethiopia LMIS team was introduced along with member of the Advisory Committee that is providing oversight and suggestions for development of the Ethiopia LMIS. Dr. Angerer presented an overview of the LMIS system along with information on the progress to date in implementing the LMIS. Issues that have occurred with regard to data collection and availability of the system were also presented and discussed. Questions from the advisory committee to Dr. Angerer related to the issues with the SMS modem, as well as issue with the public availability of the LMIS server. It was agreed at the meeting that the LMIS team would develop a timeline of activities that needed to be completed in order for the State Minister to present the system to the public in late April in order to meet promises to the Prime Minister regarding deployment of the system. Wondimagegnehu Shibru indicated to the group that he would put this together and so that the work could be communicated to those involved and so that the deadline would be met.

On Tuesday, March 5, Dr. Angerer met with the Ethiopia LMIS team to discuss the timeline of activities and to transfer all documents and PowerPoints that had been developed to date to the Ethiopia team. The quality control manual development was also discussed and Dr. Angerer provided the team with a template document that could be used to start development and documentation of the quality control protocols and procedures.

A copy of the PowerPoint presentation given to the State Minister can be downloaded here: https://www.dropbox.com/s/n88rfa591wshod8/ET_livestock_market_information_system_update_03042019_small.pptx?dl=0

Uganda Backstopping and Reinforcement Training – March 2019

Dr. Angerer traveled to Entebbe, Uganda on March 5, 2019. On the morning of March 6, Dr. Angerer met Uganda LMIS team (Vanessa Namayanja, Amos Mpungu, Andrew Namilanga) and Oliver Salehe (IGAD IT) to travel to Soroti, Uganda to conduct refresher training for the LMIS to market trainers. Upon arrival in Soroti, the team met for a short time to discuss the training the following morning.

For the refresher training, approximately 40 people were in attendance (Figure 6). Dr. Angerer provided the team with an overview of the additions that had been made to the LMIS system since the visit in November 2018. Dr. Angerer then gave an overview of improvements that had been made to the LMIS system and demonstrated to the trainers some of the capabilities of the LMIS website. The floor was then opened to the trainees for them to ask specific questions about problems they were having with sending messages and using the system. The majority of problems were related to market monitors sending data for a market in which they were not registered in the system. The majority of the afternoon was spent adding market monitors names to the system and then linking these users to the correct markets. Discussions were also held about additional markets that needed to be added to the system. The new markets were agreed upon among the trainers and the LMIS team and these markets were added into the system along with the names of the associated market monitors. Dr. Angerer then showed the trainees on how to spot problems in messages and how these should be corrected.

Figure 6. Refresher training conducted for market trainers in Soroti, Uganda.

Time was spent discussing the quality control measures that needed to be implemented for ensuring that data was accurate and timely. The quality control manual development was also discussed and Dr. Angerer provided the team with a template document that could be used to start development and documentation of the quality control protocols and procedures. The LMIS team asked the trainees to work with their monitors to have data collection begin immediately and to send in any data that had not already been captured into the system. The training ended and the LMIS team, Dr Angerer, and Mr. Salehe returned to Entebbe.

Uganda Follow-up Trainings and Project Closeout, July 2019

Dr. Angerer met with Vanessa Namayanja, Amos Mpungu, Andrew Namilanga and Oliver Salehe (IGAD IT) from July 8 to July 10 for follow-up training on changes that had been made to the LMIS since the last visit in March 2019 and provided demonstrations of how to administer these on the system. These included:

- Updated components in the site settings to allow administrators to direct who can download information from the website (registered users or public), how volume is presented (averaged or summed), and placement of Google Analytics and Google Map keys.
- Demonstrated how to set up and administer daily, weekly, and monthly scheduled tasks to send emails or SMS messages for registered users, error reports for administrators, and daily syncing of data with the regional market information system at IGAD.
- Exhibited the website and modem statistics logging that allows administrators to gather information on how many users are requesting data and how many people are accessing the website.
- Demonstrated how to request the Google maps API key and where to include it in the LMIS Administration site setting page.
- Discussed how Google Drive could be used to provide daily database backups
- Trained administrations on how to install the task for uploading data to the Regional LMIS server and how new markets could be added to the query list.
- Viewed the error reports and discussed common errors and how to correct them.
- Provided additional backstopping on adding new markets and users.

Dr. Angerer also presented information and demonstrations on enhancements and updates to the LMIS home page and tools. He demonstrated how administrators could update the text and logos on the home page, and a new user login interface to facilitate being able to download data when the site is set up for user downloads. If the download capability in the site settings is set to allow public download, there is no need for users to log in. However, if only registered users are allowed to download the information, then the user login interface can be used to allow users to download market data as a spreadsheet. Capabilities for reporting data by administrative boundaries was demonstrated so that price data can be downloaded by county or district. Dr. Angerer demonstrated how the administrative hierarchy needed to be set up in the LMIS administration portal so that the relevant counties are linked to the individual markets. Once the hierarchy is established, market reports can be developed using the "Advanced Country, State, County Report" button in the Market Reports tool to view information at the different administrative levels. Capabilities for capturing export volumes for animals sold and exported were also demonstrated. The new code structure for adding in animals sold and exported was presented and Dr. Angerer showed how the code string should be written to capture this information. The Buy/Sell module was also discussed and demonstrated. The Uganda LMIS team was provided with a draft training document for the Buy/Sell module for their comments. The document will be included in the final versions of the LMIS manuals to be delivered at project end.

The group discussed quality control protocols and worked to develop a draft version of the LMIS Quality Control Manual. The group discussed the quality control process and the roles of each of the actors in the process beginning with the market monitor and ending with the Ministry National supervisor. The individual responsibilities of each actor were defined, and a flow chart was developed for users to quickly ascertain these responsibilities and the flow of digital data (SMS messages) and paper datasheets to the Ministry. The draft manual was provided to the Uganda team for review by the Ministry personnel working on the LMIS and the District Project coordinators.

During the last day, the project closeout was discussed. The Uganda team made several requests for improvements or changes to the LMIS prior to the project closeout. These included: 1) examine issues as to why modem turns off and messages are lost when modem turns off; 2) ability to upload images to the picture gallery and add captions to images; 3) create a batch SMS that could be sent to markets each Monday reminding market monitors to collect data; and 4) allow colors of the website to be changed so that they meet Ministry standards for color. Dr. Angerer stated that he would present these to the programmer and work to get them incorporated before the end of the project [Note: these items were completed in August 2019 and the latest versions uploaded to Uganda Server].

Ethiopia Follow-up Trainings and Project Closeout, July 2019

Dr. Angerer arrived in Addis Ababa Ethiopia on July 11 and met with the Ethiopia LMIS team (met with the Ethiopia LMIS team (Wondimagegnehu Shibru, Getnet Taye, Bethelhem Tigistesellassie, Mehari Negash) to discuss progress, conduct refresher training where needed, develop the quality control manual, and to discuss project closeout (Also in attendance was Oliver Salehe, IGAD IT). The LMIS administrators had recently reformatted the server and re-installed all of the LMIS software. Dr. Angerer worked with the team to ensure that the latest database was installed and that the system was working properly. The team was trained on backing up and restoring the database in case of a system crash. Follow-up training was initiated for the changes that had been made to the LMIS since the last visit in March 2019 and demonstrations provided on how to administer these components of the system. These components included:

- Updates to the site settings to allow administrators to direct who can download information from the website (registered users or public), how volume data are presented (averaged or summed), and placement of Google Analytics and Google Map keys.
- Demonstrations on how to set up and administer the daily, weekly, and monthly scheduled tasks to 1) send emails or SMS messages for registered users, 2) send error reports for administrators, and 3) the daily syncing of data with the regional market information system at IGAD.
- Administrators were shown how the website and modem statistics logs could be used to allow administrators to gather information on how many users are requesting data and how many people are accessing the website.
- Demonstrations on how to request the Google maps API key and where to include it in the LMIS Administration site settings page.
- Discussed how Google Drive could be used to provide daily database backups

- Trained administrations on how to install the task for uploading data to the Regional LMIS server and how new markets could be added to the market query list.
- Viewed the error reports and discussed common errors and how to correct them.
- Provided additional backstopping on adding new markets and users.

In the previous visit to Ethiopia in March 2019, the Ethiopia team requested that bulk SMS messaging be added to the LMIS system to take advantage of bulk SMS messaging capabilities and software that had been acquired by the Ministry. Texas A&M AgriLife received the specifications from the team and incorporated these into the LMIS software. During this visit, the version of the software with bulk SMS capabilities was installed on the Ethiopia server and tested for the first time. Several problems were discovered in the LMIS software's capability in properly capturing the SMS messages from the Ministry's bulk SMS software. Dr. Angerer work with the programmer at Texas A&M AgriLife to modify the code to properly read the messages and store the data on the LMIS server. This task was completed and a new version of the LMIS software was installed on the Ethiopia server. We continued to test the system with messaging from the field and the bulk SMS module in the LMIS software performed well.

Dr. Angerer presented to the LMIS team information and demonstrations of enhancements and updates to the LMIS home page and tools. He demonstrated 1) how administrators could update the text and logos on the home page, 2) a new user login interface to facilitate being able to download data when the site is set up for user downloads, and 3) capabilities for reporting data by administrative boundaries was demonstrated so that price data can be downloaded by administrative boundary . Dr. Angerer demonstrated how the administrative hierarchy needed to be set up in the LMIS administration portal so that the relevant woredas are linked to the individual markets. Once the hierarchy is established, market reports can be developed using the Advanced Reporting in the Market Reports tool to view information at the different administrative levels. Capabilities for capturing export volumes for animals sold and exported were also demonstrated. The new code structure for adding in animals sold and exported was discussed and Dr. Angerer showed how the code string should be written to capture this information. The Buy/Sell module was also discussed and demonstrated. The Ethiopia LMIS team was provided with a draft training document for the Buy/Sell module for their comments. The document will be included in the final versions of the LMIS manuals to be delivered at project end.

Dr. Angerer and the group discussed quality control protocols and worked to develop a draft version of the LMIS Quality Control Manual. The group discussed the quality control process and the roles of each of the actors in the process, beginning with the market monitor and ending with the National supervisor. The individual responsibilities of each actor were defined, and a flow chart was developed for users to quickly ascertain these responsibilities and the flow of digital data (SMS messages) and paper datasheets to the Ministry. The draft manual was provided to the Ethiopia team for review by the Ministry personnel working on the LMIS.

The Ethiopia Team requested that several corrections be made to the LMIS website and LMIS Administration portal. These included the following:

- The market report had errors in reporting Grade 1 and Grade 4 prices.

- Some messages with errors were missing from LMIS Admin log, but could be found in the modem log. Request that the LMIS Admin log show all messages.
- Problems with "Home" link not resolving to the home page.

These issues were given to the Texas A&M AgriLife programmer to resolve. [Note: As of September 9, 2019, all issues have been resolved]

Kenya Follow-up Trainings and Project Closeout, July 2019

On July 16, Dr. Angerer met with the Maurice Ouma, the Kenya RPLRP Coordinator to discuss progress on the LMIS. Dr. Ouma stated that since the previous visit in March 2019, that an official partnership had been formed between the Ministry and the Kenya Livestock Marketing Council (KLMC) to have KLMC assist with LMIS data collection at some markets across Kenya. He also stated that the backlog in appropriations for monitors had been brought to date and market data was being sent from 47 markets. He also stated that a partnership had been formed with ILRI to have them digitize the datasheets of market information that had been collected in past years and not entered into the system.

On July 18, Maurice Ouma, Abdikadir Mohamed (Kenya Livestock Marketing Council) and Dr. Angerer met with Principal Secretary of Livestock, Harry Kimtai, to provide an update on the status of the LMIS and data collection. Dr. Ouma provided the PS with a quick update on the system and discussed the partnership with KLMC. Dr. Angerer provided information on some of the additional features that had been added to the system since the inception of the contract with the ministry. The PS stated that he viewed this system as the national system for Kenya and that we should work toward national coverage for the market information. This would require development of a strategy for rolling out the system to new areas/markets. In discussing market exports, he stated that this aspect needs to be more formalized, but it is an important component of the system to be collecting this information. Lastly, the PS stated that a strategy needed to be developed to begin data collection on hides and skins because of the developing leather markets.

After meeting with the PS, Dr. Angerer met with the LMIS team from the Ministry (Ouma and Mugambi Githinji) and the team from the Kenya Livestock Marketing Council (Abdikadir Mohamed and Betty Obuya) to discuss progress on the LMIS, develop the quality control manual, and to discuss project closeout. Also in attendance was Aggrey Lutsinga, a software developer who is working with the Ministry and KLMC to develop a mobile application so that users can access the LMIS data. Mr. Lutsinga provided an overview of some of his past work on mobile applications and provided an update on the design of the system he is proposing to develop. The group discussed the mobile application and agreements were made that the mobile application could access the LMIS database. The group agreed that Dr. Angerer would work with Mugambi Githinji to provide access to the database software on the server.

Dr. Angerer presented to the LMIS team information and demonstrations of enhancements and updates to the LMIS home page and tools. He demonstrated 1) how administrators could update the text and logos on the home page, 2) a new user login interface to facilitate being able to download data when the site is set up for user downloads, and 3) capabilities for reporting data by administrative boundaries.

Dr. Angerer demonstrated how the administrative hierarchy needed to be set up in the LMIS administration portal so that the relevant woredas are linked to the individual markets. Once the hierarchy is established, market reports can be developed using the Advanced Reporting in the Market Reports tool to view information at the different administrative levels. Capabilities for capturing export volumes for animals sold and exported were also demonstrated. The new code structure for adding in animals sold and exported was discussed and Dr. Angerer showed how the code string should be written to capture this information. The Buy/Sell module was also discussed and demonstrated. The Kenya team was provided with a draft training document for the Buy/Sell module for their comments. The document will be included in the final versions of the LMIS manuals to be delivered at project end.

Dr. Angerer and the group discussed quality control protocols and worked to develop a draft version of the LMIS Quality Control Manual. The group discussed the quality control process and the roles of each of the actors in the process, beginning with the market monitor and ending with the National supervisor. The individual responsibilities of each actor were defined, and a flow chart was developed for users to quickly ascertain these responsibilities and the flow of digital data (SMS messages) and paper datasheets to the Ministry. The draft manual was provided to the Kenya team for review by the Ministry personnel working on the LMIS. The Kenya team also provided Dr. Angerer with a version of the LMIS Training of Trainers Manual that contained updates/comments from the Kenya team.

The Kenya Team requested that several corrections be made to the LMIS website and LMIS Administration portal. These included the following:

- The ability to quickly acquire the number of users who requested market data on a weekly basis.
- A listing of those markets and the market monitors who have not submitted data in the past 2 weeks.
- A report in the Administration page that provides the names of market monitors and the number of messages that they have sent in for the week.
- Put the latitude and longitude into pop up on the front page Google map

These issues were given to the Texas A&M AgriLife programmer to resolve. [Note: As of September 9, 2019, all issues have been resolved]

IGAD Server Updates and Project Closeout, July 2019

On July 17, Dr. Angerer went to the IGAD/ICPALD offices in Nairobi to update the Regional LMIS server with the latest version of the software and to install drivers to allow the modem to be used for SMS messaging. The software and modem were installed and tested; however, the port forwarding for the public IP address was not turned on by the Internet Service Provider (ISP). The website was tested internally and found to be working properly within the IGAD offices. Oliver Salehe stated that he would work with the ISP to have the ports opened for the public IP address. Dr. Angerer purchased domain names for the regional server at IGAD (www.igadlmis.com) and for the cloud-based version of the LMIS regional server (a Virtual Machine Hosted in New York; www.igadlmis.net).

The Way Forward and Recommendations

The LMIS software is functioning well in each of the countries and on the regional server. As of this writing, all of the requested updates/changes requested by the host countries have been incorporated into the software and the software has been updated on each countries' servers. Each of the countries has been provided with the updated versions of the LMIS Installation Manual, the LMIS Administration Manual, and the LMIS Training of Trainers and Quality Control Manual. A Google Drive has been established for each country and the regional server. Copies of the training manuals and the latest versions of all the software have been placed on the Google Drives. A link and access to the source code can be provided upon request.

Recommendations for Quality Control and Sustainability of Data Collection

- Continue backstopping and refresher training of market monitors, district officers, and district project coordinators to ensure that quality control roles and responsibilities are defined, and market monitors are collecting the data appropriately
- Each country should have someone dedicated to reviewing the server logs and message anomalies, as well as correcting data on a daily basis.
- Each country should make sure that there is a daily backup to the cloud or another server for the LMIS software and database backups. For each country, the LMIS server had Google Backup and Restore installed. However, this needs to be checked periodically to ensure items are being backed up.
- The Uganda and the Regional Server are hosted as Virtual Machines (VM). The VMs need to be monitored carefully to ensure that the USB connection for the modem is not cut off or that the VM shut down.
- Each country should work to maintain the user database to restrict access to the system by users who are no longer associated with LMIS data collection.
- The email and SMS subscriber tables and the modem logs should be monitored periodically to purge users from the system that have bad emails or phone numbers.

Texas A&M AgriLife will be available to assist the LMIS teams in each of these host countries as data collection and expands and continues. If bugs in the software are discovered, please report these to Dr. Angerer and he will work to get corrections made to the software.