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REPORT ON DATA SHARING WORKSHOP

EARLY WARNING SYSTEMS FOR IMPROVED HUMAN HEALTH AND RESILIENCE TO CLIMATE – SENSITIVE VECTOR BORNE DISEASES IN KENYA

MARCH 8TH 2016 – MARCH 12TH 2016

QUEENS GARDEN HOTEL, ELDORET

PREAMBLE

Jaramogi Oginga Odinga University of Science and Technology in collaboration with the University of Nairobi is jointly implementing a research project entitled: *Early Warning Systems for improved Human health and Resilience to Climate –Sensitive vector borne disease in dryland areas of Kenya*, which is based in Baringo County and is currently in its third year of successful implementation since inception in 2014.

The project team organized a data sharing workshop between 8th and 12th March 2016 at the Queens Garden Hotel in Eldoret Town, Uasin Gishu County to deliberate on data management, data sharing and research uptake activities and to develop a communication strategy aimed at facilitating community and stakeholder feedback on research findings.

In his opening remarks, the Principal Investigator, Prof. Benson Estambale outlined the objectives of the workshop with an emphasis on the need to review key outputs of each component; define the preliminary findings and prepare papers and manuscripts for publication. Additionally, the team was encouraged to share experiences and challenges encountered so far even as they developed an overall action plan for the 2016/2017 during the no-cost extension period.

The Assistant County Commissioner, Mr. Andrew Guvuredi officially opened the data sharing workshop on behalf of Mr. Peter Okwanyo (the Baringo County Commissioner). In his speech, the County Commissioner lauded the efforts of the research team and urged the team to actively engage the local administration in determining intervention strategies for improved resilience by the community to vector-borne diseases.

A total of 33 participants attended the workshop drawn from the research team, PhD and MSc students and project staff. The workshop was also attended by representatives from Baringo County who included the County Director of Medical Services, County Director of Veterinary Services, County Medical Laboratory Technologist, Laboratory Technologist at Marigat Field Station, national radio journalist and M&E representative from Right Track Africa.

The progress made by the various components was notably remarkable and they were currently on manuscript preparation and research uptake activities- save for eco-hydrology and health economics aspects that were recently (January 2016) brought on

board. The need to hasten the process of manuscript preparation for publication of papers as part of the key project outputs was emphasized.
The workshop also sought to explore data sets collected by the different project components that could be collated to develop an early warning system; which is the key output for this project.

To promote the utilization of the developed strategies by the stakeholders, the workshop aimed at developing an effective communication strategy to disseminate key messages for action by the relevant target audiences. This would be implemented through capacity building activities within the study area in fulfillment of the project objectives.

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1.0. BACKGROUND

Climate change is a global concern that continues to elicit controversy the world over. Questions abound on who is to blame, what are the causes, what is the impact on health and socio - economic spheres and how best can these effects be mitigated.

As the blame game continues, climate change is likely to continue influencing the incidence and prevalence of Vector Borne Diseases (VBDs) in the tropics. For instance, the WHO reports that in 2015, approximately 3.2 billion people – nearly half of the world's population – were at risk of malaria, with the sub-Saharan Africa carrying a disproportionately higher share of malaria cases and deaths. On the other hand, outbreaks of RVF have been reported in Africa since 1911 when the first outbreak occurred in Naivasha, Kenya. Most outbreaks being associated with heavy rains. RVF affects both humans and livestock and is easily transmissible to humans through direct contact with blood, milk, meat and/or other body fluids of infected animals. It can also be transmitted through a bite of an infected mosquito.

The fact that RVF is characterized by serious economic losses and loss of lives raises extensive interest in studying this particular vector borne disease. It is against this backdrop that this project chose to focus on malaria and rift valley fever by seeking to answer the following questions:

1. What are the factors contributing to local populations vulnerability to these VBDs?
2. How do these communities respond to these outbreaks?
3. What indigenous knowledge is known concerning these diseases?
4. Can the indigenous knowledge be used together with other known factors to help predict outbreaks?

A conceptual framework (Figure 1) depicting the interaction between climatic factors and other factors that pre-dispose communities to vector borne diseases was developed to guide the various components in developing tools that would be required to implement the project objectives and aid in the subsequent development of an early warning system.

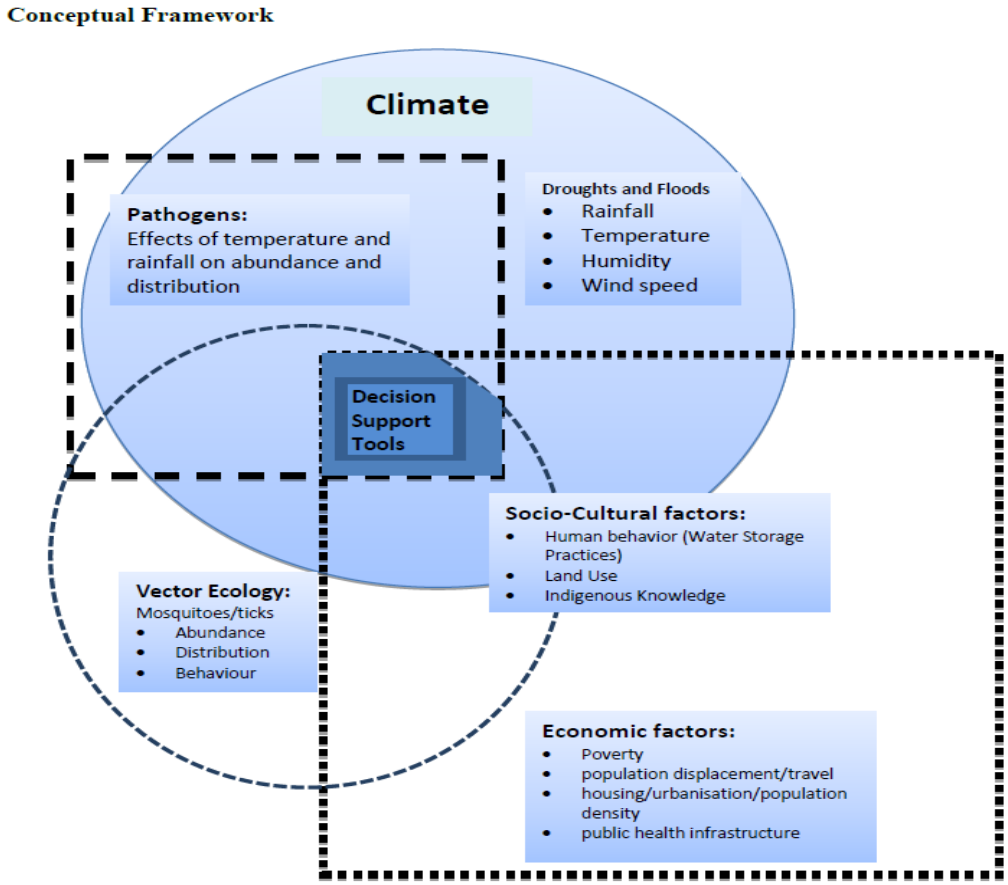

Figure 1. Conceptual Framework

1.1. Project Objectives and Responsible Components

To effectively achieve the project objectives, three PhD fellows were recruited in the project under three key components *i.e.* Entomology, Anthropology and Spatial modeling. In addition, five Msc. students and an additional PhD student were also enrolled in the study at different times for relatively shorter durations to tackle other components of the study including virology, parasitological, health economics and eco-hydrology components. The project objectives and the responsible components are as outlined in Figure 2 below.

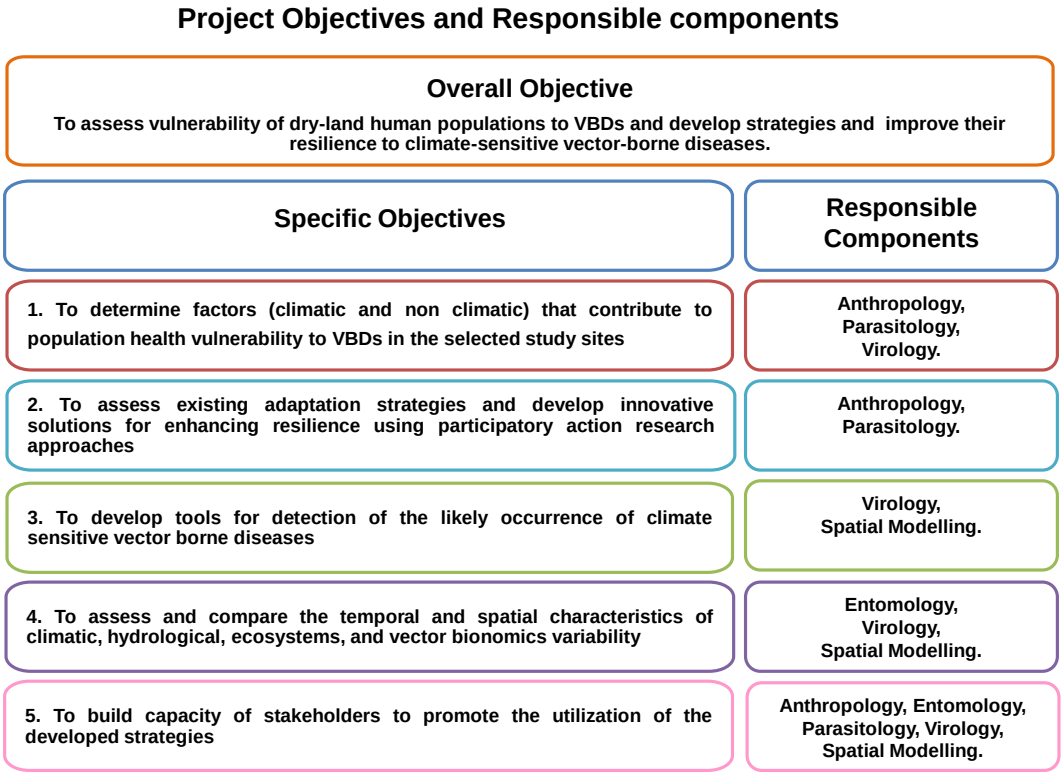

Figure 2. Overall project objectives and the responsible components

2.0. WORKSHOP OBJECTIVES

The workshop objectives were:

1. Review the key outputs per component;
2. Discuss the preliminary findings and publications ;
3. Review the integrated research uptake strategies developed;
4. Develop a communication strategy;
5. Share experiences and challenges encountered; and
6. Develop an overall action plan for the 2016/2017 period.

3.0. PRESENTATIONS BY VARIOUS COMPONENTS

Each components was given sufficient time to make their presentations. The aim of the presentations was to inform participants the progress made as well as establishing the kind of data sets that can be shared between the various components. The presentations were critiqued and suggestions made on improving them.

Figure 1. A section of workshop participants listening to a presentation

3.1. ANTHROPOLOGY COMPONENT

Ms Edna Mutua (PhD student) gave a presentation titled: *"Community Adaptation to Malaria and Rift Valley Fever in Baringo County"* whose objectives were to:

(i) Establish community knowledge of the relationship between climate variability, malaria and RVF in Baringo,

(ii) Determine the link between socio-cultural practices and vulnerability to malaria and RVF among communities in Baringo,

(iii) Describe the effect of resource factors to community vulnerability to malaria and RVF in Baringo, and

(iv) Establish community strategies for coping with malaria and RVF in Baringo.

Preliminary findings indicate that although climate change occurs naturally, it has been accelerated by anthropogenic activities, thus increasing the frequency of extreme weather events whose consequences include vector borne diseases including malaria and RVF. Communities whose livelihoods depend on climate sensitive resources are most vulnerable to adverse effects and therefore their adaptation is key to protecting themselves.

The recovery from adverse effects of climate change depends on their adaptive capacity, which can however be hampered by inappropriate intentions, actor limitations, under or overutilization of resources and use of inappropriate strategies among others.

Malaria is reportedly an endemic disease in Baringo County, while RVF occurred in 2007 resulting in 5 human deaths, 85 human cases and livestock losses. Though biomedical ways of controlling and managing malaria and RVF are available, the two diseases remain a serious threat to the local community which therefore calls for further investigations into people's interaction with these diseases and their vectors.

The PhD fellow - anthropology indicated that the place of human behaviour in disease control and management is often overlooked despite communities being key determinants of their own health outcomes. This results in ineffective control and management of diseases, increased health burdens at household and national levels and failure to meet national and international goals on sustainable development. This study therefore sought to investigate how the people's way of life increases or decreases vulnerability to malaria and RVF in Baringo County.

Methodology

This was a cross-sectional study in which both qualitative (FGDs and KIIs) and quantitative (KAP, Market survey and Abattoirs) data sets were collected across the 4 zones. Retrospective health records data from 2004-2014 were also collected.

Key Milestones

The component has completed most of its field activities indicated below:

- KAP survey of 560 respondents is complete.
- A market survey of 210 respondents is complete.
- Abattoirs study (observation of occupational exposures) has been completed.
- A total of 66 Focus Group Discussions (FGDs) on malaria (20), RVF (26) and community characteristics (20) has been completed.
- Medicinal plant collection and identification has been complemented.
- Health records from 13 of the 14 health facilities earmarked for the exercise has been completed
- A draft manuscript titled: *Lay management of malaria in Baringo County, Kenya*" has been developed and is undergoing internal review before submission.
- A comprehensive communication strategy for dissemination of key messages by the anthropology team was also developed and refined at the workshop.

Remaining/on-going tasks

- Transcription of remaining KII and FGDs on RVF is on-going

- Data analysis and preparation of more manuscript is on-going
- Thesis development will commence once all the FGDs and KII have been transcribed and data analyzed.

Occupational Exposure: Abattoirs' and Slaughter Slabs

3.2. ENTOMOLOGY COMPONENT

Ms Isabella Moraa (PhD student) gave a general introduction of the entomology component. Participants were informed that RVF and malaria pose a serious threat to human populations and their livestock through the different vector species found in Baringo.

3.2.1. Presentation by Dancan Kobia (MSc. student)

Dancan Kobia gave a presentation titled "*Diversity and Distribution of Immature Malaria and Rift Valley Fever Vectors along an Altitudinal Gradient in Baringo County, Kenya*", whose objectives were to:

(i) Determine the diversity and distribution of malaria and RVF mosquito vector species larvae along the altitudinal gradient, and

(ii) Evaluate habitat suitability for Malaria and RVF vector breeding based on water quality, vegetation and presence of other organisms in a habitat.

Climate change is known to cause shifts in the distribution ranges of climate sensitive insect vectors such as mosquitoes and climatic factors that define vector distribution

range vary along altitudinal gradients, implying that altitude can indirectly define the occurrence and distribution of vectors.

Mr. Kobia further reported that the control of adult mosquito stages is currently proving difficult due to behavioral adaptations such as change in biting patterns by the adult mosquitoes. With such changes, it would be reasonable to focus more on control of aquatic stages, which are less mobile. The fact that the distribution of vectors is affected by various environmental factors, targeting immature stages can be effective provided good knowledge of their diversity and distribution in aquatic habitats along altitudinal gradient is known. The study region (parts of Baringo county) provided a good ground for such a study due to its unique and accessible altitudinal diversity.

Methodology

A total of sixteen ecological sites were purposively selected and sampled for larvae every two weeks for three months (between 6th June 2014 and 28th August 2014). From each site, larvae were sampled using 350ml dippers and a pipette (for small habitats) and taken for morphological identification using appropriate keys at Marigat DVBD laboratory. Habitat form, vegetation, water quality and presence of other organisms were also recorded alongside the mosquito larvae sampled.

Key Milestones

1. The student has completed field work/data collection for this study.
2. Identification of vectors, data entry, cleaning and analysis has also been completed.
3. The student completed his studies and graduated with an MSc. after using part of the collected data for his project dissertation.
4. Development of a communication strategy for dissemination of key messages to the stakeholders has been completed.
5. Preparation of a draft manuscript titled: *Effect of altitudinal variation on the distribution immature malaria and Rift Valley vectors in Baringo County, Kenya* is complete and the manuscript is undergoing internal review before submission.

Remaining task

- The actual dissemination of research findings and messages will commence once preparations by the entire team are completed.

3.2.2. Presentation by Calvin Loye (Msc. student)

Calvin Loye made a *pres*entation titled: "*Characterization of mosquito larval habitats and assessment of their relative contribution to adult mosquito population in Baringo County, Kenya*", whose objectives were to:

(i) Determine the physico-chemical properties of mosquito larval habitats in riverine and highland zones in Baringo County, Kenya and

(ii) Establish the relative contribution of characterized larval habitats to the adult mosquito populations in riverine and highland zones in Baringo County, Kenya.

In his presentation, Calvin informed participants that pre-adult mosquitoes inhabit a variety of habitats with different physico-chemical characteristic which affects their larval populations. Vector control approaches targeting the immature stages are important in the management of vector borne diseases. Characterization of larval habitats based on physico-chemical factors is therefore of importance as it would help understand the dynamics of larvae and adult populations as well as help in identification of the most prolific breeding sites.

Methodology

A total of six mosquito breeding habitats were identified and sampled in each of the two (riverine and highland) ecological zones within the study area. A range of physico-chemical properties were measured and biotic factors such as vegetation types and presence of predators noted at each larval sampling point. Larvae collection was done using a 350 ml dipper at a rate of 10 to 15 dips per site, with early instars being reared to late instars. For adult mosquitoes, four houses were recruited in the vicinity of each ecological habitat for indoor adult mosquito collection. Both outdoor and indoor mosquito collections were carried out monthly for six months using the CDC light traps and the PSC method, respectively. Indoor mosquito collection was done between 6.00 am and 8.30 am, while outdoor mosquito collection was carried out between 6.00pm and 6.00am.

Key Milestones

1. The Msc student has completed sample collection/field activities.
2. Preliminary analysis of larvae data against physico-chemical parameters has been completed.
3. A communication strategy for dissemination of key findings for the entomology component has been developed.

Remaining/ongoing task

- Cleaning and analysis of adult mosquito data is on-going.
- Manuscript preparation for submission to a suitable journal once all the data is analysed.
- Completion of the thesis for submission to the SBS will be done once data analysis is completed.

Local County Administrators from Left: Dr. Micah Langa't, Mr. Mark Rotich and Dr. Gerishom Abakalwa follow the workshop proceedings

3.2.3. Presentation by Isabella Moraa (PhD)

Isabella Moraa gave a presentation titled: "*Impact of Seasonal Variability on Malaria and Rift Valley Fever Vector Bionomics and Infection Status in Baringo, Kenya*", whose objectives were to:

(i) Investigate how variability in temperature & rainfall influences RVF/malaria vector diversity and habitat preference,

(ii) Assess the effects of variations in temperature and rainfall on RVF and malaria vector densities,

(iii) Evaluate the impact of variability in temperature and rainfall on infection status of malaria vectors.

In her findings, the development of aquatic stages of mosquitoes and habitat productivity are affected by temperature and rainfall with high temperatures likely to shorten developmental time required from egg to adult and vice versa, while moderate rainfall can lead to high larval production; though when in excess, it may destroy habitats and flush out larvae. These climatic factors affect vector densities and distribution.

Baringo County is reportedly highly heterogeneous in topography & altitude and partly semi arid. The current study covers larvae and adult mosquito sampling on a wider area including different altitudinal gradients. The study also seeks to investigate association between climatic factors and vector species densities along altitudinal transect and house type preference for indoor resting.

Methodology

This is a longitudinal study in which vector collection (both larvae and adults) is carried out on a monthly basis since June 2014. Immature mosquitoes are sampled using standard mosquito dipper (350ml) and a pipette (for smaller habitats). Ten to 20 dips are made per sampling site but a pipette is used directly when a habitat is too small. For adult mosquito sampling, different houses were selected based on materials used for the roof and wall. A total of 96 houses were consented but on average, about 80-85 houses are sprayed every month. Additional information that is recorded every month include: number of people sleeping in the house, use of nets, size of eaves, presence and proximity to animal shed. The PSC method is used for indoor adult collection that is carried out between 6.00 am and 8.45 am, while a CDC light trap is used for outdoor adult collection, normally conducted between 6pm and 6am. The collected vectors are identified under a dissecting microscope using appropriate taxonomic keys.

Key Milestones

1. Non–entomological data (Climate/meteorological data) has been downloaded – (covering 15 years), and these include:
    1. Mean monthly rainfall for all sites/zones of the study
    2. Mean monthly temperatures for all sites/zones of the study
    3. Land cover (NDVI)
    4. Evapotranspiration (ET)
2. Monthly mosquito larvae has been sampled for the last 18 months
3. Monthly adult mosquitoes have been collected for 14 months so far.
4. Preliminary analysis of the already collected data has been conducted
5. A manuscript titled: "*Diversity & Distribution of RVF & Malaria Transmitting Mosquitoes in Baringo*" is ready and has been reviewed by all co-authors and is therefore ready for submission.

Remaining/ongoing tasks

- Detection of sporozoites in *Anopheles* mosquitoes through salivary gland dissection has only just started.
- Enzyme Linked Immunosorbent Assay *(ELISA)* is yet to start.
- Identification of *An. gambiae* complex to sub species level by PCR is yet to start.

- A total of three additional manuscripts are being prepared for submission, and they are titled as follows:
    1. "Seasonal variability of RVF & Malaria vector densities in Baringo County"
    2. "House type influence on indoor resting mosquito densities at selected study sites in Baringo County, Kenya"
    3. "Impact of seasonal changes on infection status of malaria vectors: a case study of Baringo County, Kenya"

Photo-Journalist Godfrey Binaisha recording the workshop proceedings

3.3 MODELING COMPONENT

The modeling PhD student (Mr. Alfred Ochieng') gave a presentation titled: "*Ecological Niche Modeling of Rift Valley Fever Virus Vectors in Baringo under Climate Change Scenarios*" whose objectives were to:

(i) Evaluate the effect of climate change on RVF vector distribution in Baringo.
(ii) To develop a risk map for spatial prediction of RVF outbreaks in Baringo based on vector distribution.

Participants were informed that climate change refers to statistically identifiable changes in the mean and/or variability of climate properties that persists over an extended period of time, typically decades or longer. These changes are due to both natural variability and human activity. Observed climatic changes include changes in temperature and precipitation resulting in changes in soil moisture, increases in sea level and more extreme weather events like floods and droughts. Many prevalent human diseases are linked to climate fluctuations due to flooding, heat waves, altered transmission of infectious diseases and malnutrition from crop failures.

Several RVF outbreaks have been reported in animals and humans in Africa and the Arabian Peninsula. Over 30 species of *Aedes* and *Culex* mosquitoes have been reported as vectors of RVF. Four species namely *Culex poicilipes*, *Culex quinquifasciatus*, *Mansonia africana* and *Mansonia uniformis* have been confirmed to carry the RVFV in Baringo County. The geographic distributions of RVF vectors can be predicted based on the environmental conditions of sites of their known occurrence.

Key Milestones

- Climate and hydrological data sets have been downloaded and these include:
    1. Max and Min temperature (spatial averages) for the period 2004-2014
    2. Rainfall (spatial averages) for the period 2004 – 2015
    3. Partial data on rainfall (observed) for the period 2004 – 2015
    4. Partial gauge heights (GH) for the period 2004 – 2014
    5. NDVI and Dem
- Local climate and hydrological data sets have been obtained
- A manuscript entitled "*Ecological Niche Modeling of Spatial and Temporal Patterns of Rift Valley Fever in Baringo, Kenya*" has been developed and is undergoing internal review.
- Most of the vector data required for the model has been collected (monthly) by the entomology team

Remaining tasks

- Preparation of the thesis will commence once all data sets have been obtained.
- Additional manuscripts will be written once all data sets have been obtained.
- An Early Warning System (EWS) will be developed once all components have completed data collection and the data analyzed.

3.4. VIROLOGY COMPONENT

The virology Msc student (Dr. Evans Juma) presented on the "*The Inter-epidemic sero-epidemiological survey of Rift Valley Fever in livestock and humans in Baringo County, Kenya*".

The objectives of this part of the study were:

(i) To determine the sero-prevalence of RVF in humans and animals during the inter-epidemic period in Baringo County and,

(ii) To determine the Knowledge, Attitudes and Practices (KAP) of livestock keepers in Baringo County on RVF and its risk factors.

The presentation entailed a short background information on RVF virus, its transmission in different seasons, epidemiology, previous major outbreaks and its effects on humans and livestock. A map of the epidemiology of RVF in Africa was also shared with participants. Participants were informed that RVF was first reported in Kenya in 1931 in Naivasha, and since then, many outbreaks have occurred; the major ones (1997 and 2007) being associated with *El Nino rains*. The 2007 RVF outbreak was reported in new areas in Kenya among them Kitui, Tharaka, Meru Mwingi, Embu, Mbeere, Taita taveta, Kirinyaga, Murang'a, Baringo and Samburu. The highest animal morbidity was however reported in Garissa and Baringo; justifying this study.

Key Milestones

1) Three rounds (seasonal snap shots) of serum sample collection from livestock and human has been conducted.
2) Analysis of animal serum samples collected so far for RVF antibodies analysis has been done
3) KIIs and FGDs among livestock keepers and other stakeholders in the livestock sector have been conducted.
4) Transcription of FGDs and KII has been completed.
5) Preliminary analysis of available data sets has been performed to establish trends.
6) A total of 130 out of 200 KAP questionnaires have been administered. A communication strategy has been developed by the team for information dissemination.

Remaining / on-going task

- The last round of serum sample collection from humans and livestock is on-going.
- The remaining 70 out of 200 KAP survey questionnaires will be administered later.
- A manuscript titled: "*Inter epidemic Sero-epidemiological Survey of Rift Valley Fever in Livestock in Baringo County, Kenya"* is in progress and will be finalized once serum sample collection from an additional 200 animals is collected and analysed.
- Other additional manuscripts will be developed once all the data sets have been generated and analysis done.

3.5. PARASITOLOGY COMPONENT

The Msc. student (Collins Omondi) gave a presentation entitled: "*Prevalence of Plasmodium falciparum Infection among Primary School Children in Baringo County, Kenya*".
The objectives were:

i. To compare malaria prevalence among primary school children within the four zones of the study area;
ii. To determine incidence of *P. falciparum* infection among primary school children in Baringo County;
iii. To determine the sensitivity and specificity of SD and Care Start RDT kits in the diagnosis of *Plasmodium* spp. infections among primary school children in Baringo County;
iv. To determine the decadal (2004-2014) seasonal trends of malaria in Baringo County.

He gave background information on the importance of malaria as a vector-borne parasitic disease reporting that globally, 214 million cases resulted in 438,000 deaths in 2015, with 88% of these deaths occurring in the sub-Saharan Africa where young children were most affected (WHO, 2015). In Kenya, about 80% of the total population is at risk of contracting malaria. It emerged that malaria transmission pattern was quite diverse in Kenya and therefore understanding the patterns of malaria transmission was important when designing control interventions.

Key Milestones

1) Four rounds of RDT testing exercise on pupils from 15 primary schools within the study area has been completed
2) Data entry, cleaning and analysis of the collected data has been done.
3) A draft manuscript titled: "*Incidence of plasmodium spp. infections among primary school children in Baringo County, Kenya*" has been developed and is undergoing internal review before submission to a suitable journal.

Remaining /on-going tasks

- The Msc. student has embarked on thesis write-up for submission to graduate school of Kenyatta University.
- Slide identification under a microscope is on-going
- An additional manuscript will be developed once all data sets including microscopy has been obtained.

3.6. ECO-HYDROLOGY COMPONENT

The PhD fellow (Jacinter Amadi) who is tasked with the eco-hydrological aspects gave a presentation titled: "*Eco-Hydrological Variability and its Influence on Malaria Risk in Baringo County, Kenya"* whose objectives are to:

i. Assess the influence of seasonal climate variability on eco-hydrological structures in Baringo County
ii. Establish the relationship between various components of the eco-hydrological system and malaria vector abundance in Baringo County, and
iii. Develop eco-hydrology based strategies to mitigate malaria risks in Baringo County.

Malaria is reportedly the most important tropical infectious disease, with a complex of correlated factors. She further reported that while the effect of climatic factors on malaria vectors and pathogen is known, little emphasis has been directed to the effect of ecological and hydrological systems on vectors, thus understanding this relationship can inform on future impacts on malaria dynamics in the face of a changing climate. This formed the basis for this study.

Methodology

This is a longitudinal study in which climate and hydrological data is being obtained from various sources while vectors are being collected from permanent and temporary

sites, on a monthly basis. Both macro vs micro sites being sampled to give detailed mosquito distribution and species diversity. At each sampling site, slow dip technique was used to collect immature vectors for identification. Clinical data from health facilities located in the lowland and riverine zones is also being extracted. Focus group discussions and KII will also be conducted and triangulated to help come up with community based malaria control strategies.

Key Milestones

1) A 2 month vector (mosquito larvae) data has been collected and the exercise is expected to continue up to December 2016.
2) Extraction of health record data from a total of 13 out of 14 health facilities earmarked for the exercise has been completed.
3) Climate and hydrological data sets that have been obtained include:

    i. Maximum and Minimum temperature (spatial averages) for the period 2004-2014
    ii. Rainfall (spatial averages) for the period 2004 – 2015
    iii. Partial data on rainfall (observed) for the period 2004 – 2015
    iv. Partial gauge heights (GH) for the period 2004 – 2014
    v. NDVI and Dem

Remaining/on-going tasks

- Some climatic and hydrological data sets (Temperature (observed), Atmospheric humidity, soil structure and infiltration and water table) are yet to be obtained.
- Data extraction and entry from the final health facility (Kiserian Dispensary) is on-going.

4.0. DATA MANAGEMENT

The data management strategy for the EHCD project was presented by Mr. Edwin Kipruto - the Data Manager. Participants were informed that the project has standard operating procedures which address data ownership, collection, storage, protection, retention, analysis, sharing and reporting. It was further reported that various statistical tools are currently being used to manipulate and analyze data from the different project components. The statistical software mentioned are given in Table 1 below:

Table 1. Statistical Software for analyzing different data sets

	Component	Statistical Software
1	Entomology	R vers 3.2.1,Canoco ver 5 and Past
2	Anthropology	NVivo 5.1,Cspro ver 6, IBM SPSS ver 22 and STATA 12
3	Parasitology	IBM SPSS ver 22 and STATA ver 12
4	Virology	IBM SPSS ver 22, R ver 3.2.1 and NVivo 5.1
5	Modelling and Hydrology	R vers 3.2.1, Maxent, Qgis, Arcmap, Grass, Saga

4.1. Data Connection

All the available data sets (as at the time of the workshop) from each of the project components were presented to workshop participants for purposes of establishing the point of interaction/connection. However, the data manager informed the participants that various analyses are required before data connection can be achieved. Some of the analyses required included: Risk analysis, vulnerability assessment, species modelling, seasonal climate forecasting, hydrological modelling among others. The data connection framework as presented by the data manager was deliberated upon by workshop participants at great lengths. Various suggestions given towards refining the framework to achieve the overall goal of coming up with an early warning system.

Outcomes	OUTCOMES VS COMPONENT INDICATORS			
	Climate	Entomology	Anthropology	Virology
Exposure risk (RVF & Malaria)	Rainfall, Temperature, EVI, NDVI, Soil Properties, Altitude	Vector density, species composition, species distribution	Health records, House type, water storage, Knowledge of disease and transmission dynamics	Seroprevalence longitudinal data
Seroprevalence (malaria & RVF)	Rainfall, Temperature, EVI, NDVI, Soil Properties, Altitude	Vector density, species composition, species distribution	Knowledge and disease transmission, health records, house type, water storage	Seroprevalence longitudinal data
Malaria incidence	Rainfall, Temperature, EVI, NDVI, Soil Properties, Altitude	Vector density, species composition, species distribution	House type, water storage, knowledge of disease and transmission, health records,	

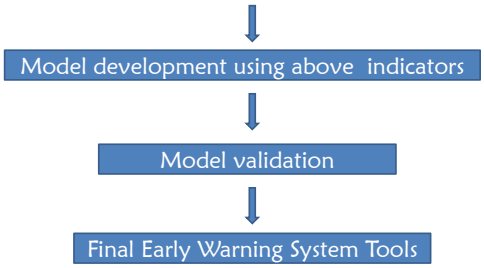

Figure 3. Framework for the development of an early warning system

5.0 COMMUNICATION STRATEGY

Participants deliberated on the most effective communication strategy that would be used for dissemination of key messages arising from key findings of the various components. and the overall research project.

Each of the research components was expected to identify a maximum of three key messages to be incorporated in the communication strategy. These key messages were to be directed partly to the local community and to inform policy formulation. The key findings per component were used to inform the key messages to be delivered to the target audience. The target audience was used to determine the kind of tools to be used in the dissemination as well as the type of message to be disseminated. The project team came up with a final communication strategy incorporating all the project components as shown in Appendix I.

6.0 LOCAL SUPPORT &INVOLVEMENT

In cognizance of the critical role that the local administration has played in the successful implementation of this study, the project team invited a section of the local administration and community gatekeepers to the attend the five day workshop.

The key stakeholders invited to this crucial data sharing workshop included: The Baringo County Commissioner Mr. Peter Okwanyo who was represented by Mr. Andrew Gavuredi, the Baringo County Director of Medical Services (Dr. Gerishon Abakalwa), Baringo County Veterinary Officer (Dr. Micah Langat), Laboratory in-charge Baringo County (Mr. Haron Bowen), Chief Technologist, Marigat DVBD Laboratory (Mr. Mark Rotich), Monitoring & Evaluation (M& E) Expert (Ms. Sarafina Wanja) who was supporting the team on behalf of Mr Julius Nyangaga and Mr. Joshua Chesire, Journalist with a local media house (Kenya Broadcasting Corporation).

From Right: Project PI (Prof. Estambale), Prof. Oyieke (Supervisor, Entomology)Prof. Amimo (Supervisor, Modeling) and Co-PI Prof. Nyamongo address the local press dubbed Baringo County News during the workshop.

The Baringo County Commissioner of Baringo in a speech read on his behalf by Mr. Andrew Gavuredi observed that the project's success depended, to a great extent, on local support from all stakeholders in Baringo County. The involvement of the local community and officers from the county government in the project activities was key since their efforts would be instrumental in the implementation of the communication strategy. The Commissioner reassured the team that Baringo County government would continue providing the required assistance to the project to enable it achieve its objectives.

The Director of Medical Services of Baringo County Dr. Gerishon Abakalwa explained that support should be two way; i.e. from the research team to the county and from the county to the research team. He further stressed the need to create an enabling environment for mutual benefit by both the county and the research team. Under health information for instance, the Director reminded the team that through data mining, the research team has been able to assess the data quality thus strengthening the health information system in health facilities within the county. He also pointed out that this information could also be used for advocacy, resource mobilization and resource allocation.

APPENDIX I.
COMMUNICATION STRATEGY

Early Warning Systems for Improved Human Population Health and Resilience to Climate–Sensitive Vector Borne Diseases in Dry land Areas of Kenya

(Project ID No: B20278)

1. BACKGROUND

The Early Warning Systems for Improved Human Population Health and Resilience to Climate – Sensitive Vector Borne Diseases in Dryland Areas of Kenya (EHCD) project aims at determining the potential effect of climate change on vector borne diseases (VBDs) by unraveling the role played by environmental, ecological and climatic factors on the spread of two climate sensitive VBDs namely; Malaria and Rift Valley Fever (RVF). The project is expected to develop decision support tools for use as early warning mechanisms to help monitor outbreaks in the event of increased rainfall occurring as part of climate change in Baringo County. For over two years intensive field work has been conducted to collect data on knowledge and practices of local communities to VBDs in the context of climate change. Malaria occurrence data has been collected from school children and historical data has been extracted from selected health facilities in the County. Climate data has also been extracted from the relevant weather stations within and outside the County. Continuous entomological surveillance has been on-going, while information on knowledge, attitude and practice as well as sero-prevalence data on RVF have been collected. The purpose of this strategy is to identify mechanisms of communicating the research findings to the lay community, policy makers, county and central governments officials and other stakeholders in order to improve on health and resilience of the local populations of Baringo County in Kenya.

2. OBJECTIVES

To provide effective communication to the local and scientific communities as well as policy makers in order to raise awareness and understanding of the impact of climate change on vector borne diseases and recommend mechanisms of protection through changes in attitude and behaviour supported by evidence-based and focused policies and strategies.

Specific objectives:

i) To increase awareness of the target audience on climate sensitive vector borne diseases occurring in Baringo County, Kenya.
ii) To encourage community participation by providing feedback on research outcomes.
iii) To share practical actions and strategies for mitigating risks to VBDs based on the research findings
iv) To strengthen research partnerships for improved project planning and evaluation.

3. TARGET AUDIENCES

- County Government of Baringo
- County Department of Veterinary Services (CDVS)
- County Department of Health (CDH)
- County Department of Education (CDE)
- Community Owned Resources Persons (CORPS)
    i. Religious leaders
    ii. Community elders(opinion leaders/gatekeepers)
- School going children
- Research community

4. KEY MESSAGES

Modelling component

1. Climate change models, projections and scenarios are key sources of information that show a likely increase of vector density and occurrence of rift valley fever and malaria in Baringo County of Kenya.

Virology component

2. Livestock in the lowlands are at a higher risk of rift valley fever infection than those from other areas of the County.
3. Low knowledge on transmission mechanisms of RVF increases the risk of infection in the event of an outbreak

Parasitology component

4. Intensified surveillance and community-wide interventions against malaria, particularly with regard to prevention, diagnosis and treatment, will mitigate malaria risk in the County.

Entomology component

5. The community and livestock living in the lowland and riverine areas of Baringo County are at a much higher risk of malaria and RVF due to high vector densities.
6. There is need to sensitise the local inhabitants to actively participate in integrated vector management.

Anthropology component

7. There is need to improve uptake of good malaria control and management practices
8. Avoiding risky behaviours is key in the control and management of RVF

5. PROCESS IMPLEMENTATION

KEY MESSAGES	ACTIVITIES	TARGET AUDIENCE	MEANS OF DISSEMINATION	RESPONSIBLE COMPONENT
1. **Climate change models, projections and scenarios are key sources of information that show a likely increase of vector density and occurrence of rift valley fever and malaria in Baringo County of Kenya.**	• Sensitization of stakeholders on the importance of decision making tools for disease prediction.	• County Government	• Meetings, bulletins, flyers	• MODELLING
	• RVF vaccination exercises should focus on all areas predicted as being suitable habitats for the vectors.	• Veterinary services • Local community • Administration	• Meetings, brochures Posters/flyers, billboards, local fm radio stations, video clips	
	• Sensitization on the risk of RVF	• Veterinary services • County administrators • Researchers, local communities Schools, health care workers	• Meetings, Brochures, Posters/flyers • Billboards • Radio • Video clips	
2. **Livestock in the lowlands are at a higher risk of rift valley fever infection than those from other areas of the County.**	• Demonstration of risk maps to show risk areas for resource allocation and exposure reduction actions.	• County Government • Veterinary services • Local community	• Meetings • Bulletins • Flyers	• VIROLOGY • COMMUNICATION
3. **Low knowledge on transmission mechanisms of RVF increases the risk of infection in the event of an outbreak**	• Public sensitization on transmission pathways of RVF and how to avoid them.	• Veterinary services • Administrators • Researchers • Local communities • Schools • Health institutions	• Meetings • Brochures • Posters/flyers • Billboards • FM radio stations • Video clips	
4. **Intensified surveillance and community-wide interventions against malaria, particularly with regard to prevention, diagnosis and treatment, will mitigate malaria risk in the County.**	• Mass school- and community-based screening and treatment; • Provision of bed nets • Demonstration on malaria prevention and management	• School children	• Brochures, Posters • Termly visits to schools • Sports days	• PARASITOLOGY
		• Local community • Dept of Health • Dept of Education	• Local public meetings • Posters, brochures • Seminars, conferences • Publications	

KEY MESSAGES	ACTIVITIES	TARGET AUDIENCE	MEANS OF DISSEMINATION	RESPONSIBLE COMPONENT
5. The community and livestock living in the lowland and riverine areas of Baringo County are at a much higher risk of malaria and RVF due to high vector densities. **6. There is need to sensitise the local inhabitants to actively participate in integrated vector management.**	Demonstration of risk of transmission of RVF and malaria in the County Demonstration of integrated vector management in Baringo County	• Local community	• Local public meetings • Infotainment (eg roadshows) • Booklets, posters, • Calendars, T-shirts, caps, lessos/kangas, branded jerricans, training on proper use of bed nets	• ENTOMOLOGY
		• Local Administration	• Local public meetings • Calendars, posters, booklets • T-shirts, caps	
		• County Government	• Emails& website uploads • Twitter • Facebook • Posters, Reports	
		• Research community	• Conferences/seminars/ workshops • Publications/Booklets • VBD platform • Email and website	
		• Facilitators/ Implementers	• Conferences/ seminars • VBD platform /Emails • Twitter /Facebook • Posters	

KEY MESSAGES	ACTIVITIES	TARGET AUDIENCE	MEANS OF DISSEMINATION	COMPONENT/ RESPONSIBILITY
7. There is need to improve uptake of good malaria control and management practices	• Oral explanation • Designing of appropriate IEC materials	• Community	• Brochures • Posters	• ANTHROPOLOGY
		• School children	• Videos • Cartoon Posters	
		• County health ministry	• Policy brief	
8. Avoiding risky behaviours is key in the control and management of RVF	• Designing appropriate IEC materials	• Community	• Brochures • Posters mainly comprised of infographics • Billboards	
	• Designing appropriate IEC materials	• Community	• Brochures • Posters with infographics • Billboards	
		• The veterinary department	• Policy brief	
9. Key messages as identified by all components	• Manuscript preparation	• Scientific community	• Scientific journals • Conferences • Seminars	• ALL COMPONENTS
	• Preparation of Policy briefs	• Policy makers	• Policy documents	

Approval

This strategy was approved by:	Principal Investigator : Prof. Benson Estambale
on:	
at/in presence of:	
Further information/Contact details	

APPENDIX II.
EHCD COMPLETED AND PROPOSED MANUSCRIPTS

Component	Proposed titles	Corresponding Author	Status and Timeline for completion	Proposed Journal
ANTHROPOLOGY	Lay Management and Control of Malaria in Baringo County, Kenya.	Mutua Edna	Full Manuscript available undergoing internal review	*Malaria Journal*
	RVF knowledge, vulnerability and risk assessment of RVF in Baringo County	Mutua Edna	Under development	
	Ethno-medical practices for malaria in Baringo County	Mutua Edna	Under development	
	Malaria prevention and control in Baringo County	Mutua Edna	Under development	
ENTOMOLOGY	Diversity and Distribution of RVF and Malaria Transmitting Mosquitoes in Baringo, Kenya	Dr. Ong'amo	Outline available for further development	*Parasites and vectors*
	Seasonal variability of Malaria and Rift Valley Fever vector densities in Baringo County, Kenya	Ondiba Moraa	Draft Manuscript available, further analysis required	*Journal of Vector Ecology/Journal of Medical Entomology*
	House type influence on indoor resting mosquito densities at selected study sites in Baringo County, Kenya	Ondiba Moraa	Outline available for further development	*Am. J. Trop. Med. Hyg./Journal of Vector Ecology*
	Impact of seasonal changes on infection status of malaria vectors: a case study of Baringo County, Kenya	Ondiba Moraa	Outline available for further development	*Malaria Journal/ Parasites and Vectors*
VIROLOGY (Sero-Epidemiology)	Interepidemic Seroepidemiological Survey of Rift Valley Fever in Livestock in Baringo County, Kenya	Juma Evans	Abstract ready, Manuscript is being developed and more analysis to be done, will be ready by April 2016,	PLOS NTDS, Parasite and Vectors
	Knowledge, Attitudes and Practices on Rift Valley Fever among Livestock Keepers of Baringo County, Kenya	Juma Evans	Full manuscript ready but some sections (Results) are being revised. To be ready by June	PLOS NTDS, Parasite and Vectors
	Interepidemic Seroepidemiological Survey of Rift Valley Fever in Humans in Baringo	Juma Evans	Kits for analysis not ready.	PLOS NTDS, Parasite and Vectors

	County, Kenya			
SPATIAL MODELING & HYDROLOGY	Ecological niche modeling of Rift Valley fever virus vectors in Baringo under climate change scenarios.	Alfred Ochieng	Full manuscript available undergoing internal review	*Infection Ecology and Epidemiology*
	A retrospective analysis of climatic and environmental factors in relation to RVF outbreaks in Baringo County	Alfred Ochieng	Full manuscript to be ready by **June 2015.**	
	Sustainability of vegetation to climate variability in Baringo: implications to population health variability	Jacinter Amadi		
PARASITOLOGY	Incidence of *Plasmodium* spp. infections among primary school children in Baringo County, Kenya	Omondi Calvin	Full manuscript available undergoing internal review	
EPIDEMIOLOGY	Seasonal and temporal trends of malaria cases in Baringo County, Kenya	Kipruto Edwin	Abstract available, further analysis required	

Appendix III.
List of Workshop Participants

S/No.	Name	Role in Project	Institution
1.	Prof. Benson Estambale	Principal Investigator	JOOUST
2.	Prof. Isaac Nyamongo	Co-PI	UoN
3.	Prof. Dan Olago	Researcher	UoN
4.	Dr. Christopher Oludhe	Lead – Modeling component	UoN
5.	Dr. Julius Oyugi	Lead – Virology component	UoN
6.	Dr. George Ong'amo	Lead – Entomology component	UoN
7.	Dr. Mark Nanyingi	Researcher	UoN/Colorado Uni.
8.	Prof. Florence Oyieke	Supervisor - Entomology	UoN
9.	Prof. Fred Amimo	Supervisor - Modeling	JOOUST
10.	Dr. Daniel Onguru	Parasitology component	JOOUST
11.	Dr. Gerishom Abakalwa	County Director of Health Services	Min. of Health, Baringo
12.	Mr. Andrew Gavuredi	Asst. County Commissioner, Baringo	National Government
13.	Sarafina Wanja	Monitoring & Evaluation expert	Right Track Africa
14.	Dr. Micah Langat	County Veterinary Officer	Vet Dep. Baringo county
15.	Mr. Haron Bowen	County Medical Lab Technologist	Min. of Health, Baringo
16.	Mr. Mark Rotich	Laboratory in charge - Marigat	Min. of Health, Baringo
17.	Fredrick Oluoch	Project Administrator	JOOUST
18.	Douglas Anyona	Project Coordinator	JOOUST
19.	Marion Nyapola	Project Secretary	JOOUST
20.	Wilkister Baraza	Project Accountant	JOOUST
21.	Alfred Ochieng	PhD Fellow - Modeling	JOOUST
22.	Edna Mutua	PhD Fellow - Anthropology	UoN
23.	Isabella Moraa	PhD Fellow - Entomology	UoN
24.	Jacinter Amadi	PhD Fellow – Eco-hydrology	UoN
25.	Godfrey Binaisha	Photo –Journalist:	JOOUST
26.	Joshua Chesire	Journalist - Kenya Broadcasting Corporation	Baringo County
27.	Dancan Kobia	Msc. Student - Entomology	UoN
28.	Evans Juma	Msc. Student - Virology	UoN
29.	Collins Omondi	Msc. Student - Parasitology	Kenyatta University
30.	Calvin Loye	Msc Student - Entomology	UoN

31.	Edwin Kipruto	Data Manager	JOOUST
32.	Macrae Mbalanya	Research Assistant	JOOUST
33.	Juliet Jepkosgei	Research Assistant	JOOUST
34.	Erick Agure	Project Driver	JOOUST
35.	Samson Odero	Driver	JOOUST
36.	Mark Ochieng'	Driver	JOOUST