International Livestock Research Institute

Workshop report

Participatory modelling of pastoral and irrigated cropland ecosystems to describe linkages between environmental changes and local stakeholders' health and well-being

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Contents

Project background

The *Dynamic Drivers of Disease in Africa: livestock/wildlife, health and well-being* project evaluates the effects of climate and land use changes on the occurrence and transmission of emerging infectious diseases, namely, Rift Valley fever (RVF) in Kenya, Lassa fever in Sierra Leone, trypanosomiasis in Zambia and Zimbabwe and *Henipavirus* infection in Ghana. The International Livestock Research Institute (ILRI) is implementing the Rift Valley fever case study in collaboration with the Division of Disease Surveillance and Response, the Kenya Medical Research Institute (KEMRI), the University of Nairobi, and the Department of Veterinary Services. The case study uses two ecosystems with contrasting land use patterns as the main economic activity: agriculture and nomadic pastoralism. The hypotheses of the case study are:

- The creation of new permanent water masses through irrigation alters vector biodiversity and abundance, populations of livestock and humans and frequency of interactions between hosts and vectors, driving Rift Valley fever emergence and transmission.
- The occurrence of Rift Valley fever in these novel and relatively intensive systems has impacts on health, well-being and economy that differ quantitatively and qualitatively from impacts in minimally altered ecosystems.

The case study has five research themes identified in the main project document:

- Local system contexts and interactions
- Disease-ecosystem interactions
- Multi-scale drivers
- Social, economic and environmental values
- Political economy of knowledge and policy

Summary

A workshop involving selected pastoralists, veterinarians, range management experts, medical personnel, natural resource management specialists and other stakeholders of the *Dynamic Drivers of Disease in Africa: livestock/wildlife, health and well-being* project (Annex 1) was convened at the Nomads Hotel, Garissa on 4–5 March 2015. The objectives of the workshop were (i) to disseminate the project's preliminary results, (ii) to develop participatory models showing linkages between ecological factors/processes/changes, disease occurrence and stakeholders' well-being within the project's study sites and (iii) to validate scenarios that had been developed in the project partners' meeting held in Naivasha in June 2014.

The participatory models were developed through a step-wise process that involved (i) identification of the primary stakeholders in the target ecosystems (pastoral and irrigated ecosystems), (ii) identification of the primary factors that influence livelihoods and well-being of these stakeholders, (iii) development of a well-being matrix to identify stakeholders that would be most affected by any given factor and (iv) identification of linkages between each of the factors identified above and livelihood options and well-being of the primary stakeholders. This method has been described by the Ecosystem Services for Poverty Alleviation P-Mowtick project. Future socio-economic scenarios that had been developed by the project were also validated. This objective was also addressed in a two-step process. First, the participants were asked to identify changes that had occurred in these areas over the past 10 years. Subsequently, they were asked to predict changes that would happen in the next 10–15 years and external shocks that might prevent these changes from occurring.

The workshop identified a long list of primary stakeholders and factors that had the greatest influence on livelihoods. Large well-being matrices with primary stakeholders on the Y-axis and factors on the X-axis were therefore developed. To help reduce the challenges of filling out all the factor-stakeholder interactions, up to five stakeholders that were perceived to have the highest sensitivity to a factor were identified and the effects of these factors characterized by (i) the nature of the effect, whether positive or negative and (ii) the magnitude of the effect, whether low, moderate or high. This analysis identified stakeholders who would lose or gain whenever changes occurred in their ecosystems. Droughts and conflicts, for instance, were perceived to negatively affect both pastoralists and farmers but non-governmental organizations and politicians would benefit by capitalizing on these challenges to raise their profiles.

The participatory models developed clustered factors into three main classes: (i) those that had primary or direct effects on the selected livelihoods (livestock/crop farming), (ii) those that had both primary and secondary effects and (iii) the multi-scale drivers whose effects transcended multiple ecosystems. Pathways from livelihood options to health and well-being were also described, as well as the feedback mechanisms through which a successful attainment of desired well-being states would influence selected primary and/or secondary factors. For example, successful attainment of the desired livelihood was thought to lead to an improvement in literacy levels and hence a reduction in conflicts. The participatory model developed for the irrigated system also identified ways in which improvement of water management/drainage systems would improve water utilization and reduce incidence of vector-borne diseases.

With regards to historical changes that had occurred in the study sites, participants from Ijara Sub-county (pastoral ecosystem) identified urbanization with the development of small businesses and permanent settlements, improvement of education standards and access to health care services, reduction in the number of camels due to ticks and tsetse infestation and expansion of crop farming with some areas being set aside for irrigation. Those from Bura (irrigated ecosystem) identified increased incidence of poverty as population increases, reduced access to credit facilities and land for cultivation, increase in education levels, increase in the number of businesses and increase in the number of permanent settlements. Future scenarios identified in the pastoral site included increase in population densities due to immigration, increase in urbanization and

permanent settlements, climate and environmental changes and expansion of crop farming due to construction of new irrigation schemes in the area. In the irrigated area, scenarios identified were: an increase in the human population density and development of more permanent settlements, expansion of irrigation schemes, climate change leading to floods and droughts, deforestation, increase in poverty and reduction in land availability. Shocks that were likely to interfere with these changes are: conflicts, disease outbreaks and better policies from the county government with political goodwill to succeed. These observations therefore matched well with those that had been developed in the project partners' meeting.

The participatory models developed will be validated through key informant interviews and qualitative parameters representing the nature and strengths of the linkages described in the model generated using Fuzzy distributions. These relationships will then be coded in Microsoft Excel using IF statements. A completed model could be useful for conducting qualitative assessments on interventions, such as using improved technologies for managing water in irrigated systems.

Workshop sessions

Session 1: Introduction and presentation of the objectives of the workshop

Participants introduced themselves to the group after which the objectives of the workshop were introduced. The objectives were (i) to share initial results from the project, (ii) to develop a systems model to identify factors that directly influence the well-being of stakeholders in irrigated and pastoral ecosystems and (ii) to validate socio-economic scenarios that had been developed in the project partners' meeting held in Naivasha Kenya in June 2014. The workshop guidelines and agenda were also developed with the participants in a participatory process. Importantly, results that were to be disseminated were presented late on Day 1 to avoid influencing stakeholder perceptions on the drivers of the systems that were to be analysed.

Session 2: Identification of the primary stakeholders in the target ecological systems (irrigation and pastoral systems)

This session focussed on the identification of key stakeholders from the pastoral and irrigated systems being used by the project. Participants were given cards and asked to give one stakeholder per card. The session was conducted in plenary and once the participants had completed the exercise, cards were pasted on two boards: one for the irrigated system and the other for pastoral system. The suggested stakeholders were clustered if they served similar functions or had multiple names.

Stakeholders identified in the pastoral system were herders/pastoralists, local non-governmental organizations, the Kenya Wildlife Service, the Kenya Meat Commission, the National Irrigation Board, the Water Resources Management Authority, ranchers, local and national governments, the Ministry of Health, transporters, the World Health Organization, research institutes, milk/livestock traders, banks/financial institutions, butchers, consumers, agrovets/input suppliers, veterinarians, the Ministry of Agriculture and multinational investors.

Stakeholders identified in the irrigated systems (Bura and Hola) included bankers/financial institutions, market agents/traders, the National Irrigation Board, the Water Resources Management Authority, the Kenya Seed Company, the National Cereals Produce Board, agropastoralists, agro-shops, agro-chemical companies, consumers, food processors, water engineers, the Ministry of Agriculture, the Ministry of Health, farmers, transporters, the Kenya Plant Health Inspectorate Service, research institutes, extension officers, the World Food Program, the Food and Agriculture Organization of the United Nations, non-governmental organizations, legislators/politicians and development boards.

Session 3: Identification of factors that directly influence the well-being of the primary stakeholders

Factors that influence livelihoods of the various stakeholders mentioned were identified in a plenary session. Stakeholders in the pastoral system were perceived to be affected by drought, sharia banking, conflicts, uncontrolled grazing, diseases, shortage of labour, increased taxation, free grazing, water point availability, availability of pasture, inadequate veterinary services, market competition, inadequate advocacy, cross-breeding, illiteracy, lack of disease-free zones, livestock-wildlife interaction, inefficient markets, erratic rains, inbreeding, livestock theft, and poor road infrastructure.

Factors that were thought to affect stakeholders from the irrigated system were poor storage facilities, conflicts, crop diseases, political interference, high interest rates, poor seed quality, water supply, poor infrastructure, lack of markets, seed availability, climate variability, value addition, land use policy, investment in infrastructure and efficient water use technologies.

Session 4: Formulation of the stakeholder – well-being matrix

A matrix combining the stakeholders identified (Y axis) and the factors that influence their livelihoods (X axis) was used to identify stakeholders that were highly sensitive to each of the factors identified. A plus sign indicated that a factor had positive effects on a stakeholder's livelihood while a negative sign indicated the opposite effect. The degree of effect was illustrated by the number of signs used: three indicated high, two moderate and one low. Insignificant effects were ignored and respective cells left blank. Separate matrices for pastoral and irrigated systems were developed. Figure 1 illustrates a matrix for the pastoral ecosystem. Some factors were assumed to have both positive and negative effects.

Figure 1: Well-being matrix.

Session 5: Formulation of participatory/system models

Factors that affect the well-being of the primary stakeholders (used in the well-being matrix) were written on a white board and relationships between each of the factors created. In addition, linkages between these factors and the key livelihood activities — crop and livestock production in irrigated (Figure 2) and pastoral (Figure 3) systems, respectively — were also determined. The latter exercise helped to identify primary and secondary factors that affected each livelihood activity and whether these factors had positive or negative effects.

The models were also extended to show how antecedent multi-scale drivers such as population, poverty, urbanization and land use policies and climate change influenced the local factors, as well as how each livelihood activity contributed to the health and well-being of farmers and pastoralists. Linkages that would enhance disease occurrence and transmission were also identified. For the irrigated system, availability of water and drainage systems was thought to have a positive effect on crop production but a negative effect on disease regulation. For the pastoral system, linkages that were associated with disease occurrence were availability of watering points and grazing sites.

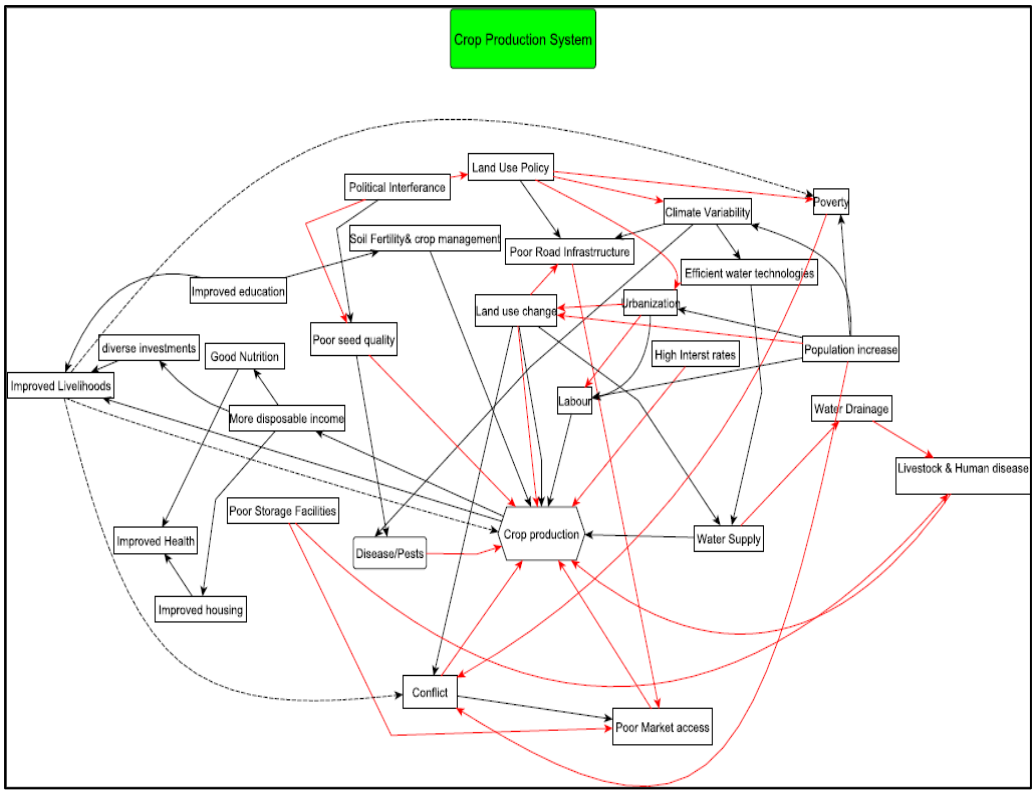

Figure 2: System model for the irrigated system.

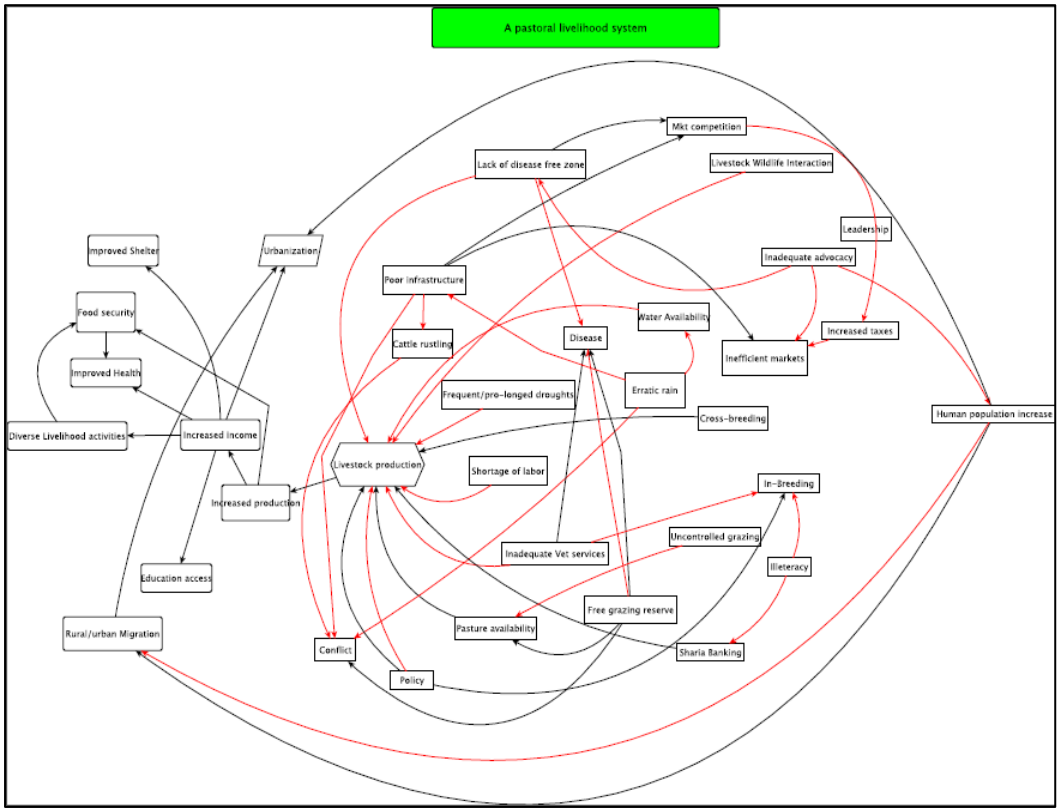

Figure 3: System model for the pastoral system.

Multi-scale drivers were perceived to have multiple effects depending on the factor being considered. A rise in human population density was associated with increased labour availability, demand for food and development of roads, schools and other types of infrastructure that would boost agricultural production. An increase in population was, however, negatively associated with development of permanent settlements which would lead to deforestation and soil erosion. This would reduce land area available for crop production and livestock grazing. Pastoralists would move to new areas for pasture. High population would also put more pressure on water supply systems, increasing conflicts between farmers as well as with wildlife. High population and conflicts would also promote other vices such as cattle rustling as a result of high demand for livestock products.

Poverty was associated with availability of cheap labour but the rich would benefit more. Poverty was, however, associated with a number of negative effects including perpetuation of illiteracy and hence reduced access to and use of information on improved crop and livestock production. Poverty was also thought to contribute to conflicts, thefts and other vices that would negatively affect agricultural production.

The participants indicated that urbanization would attract development of various infrastructure and institutions, thereby improving access to markets. Urbanization was associated with increased access to financial institutions, education facilities, improved literacy levels and improved infrastructure. One of the identified negative effects of urbanization was a rise in poverty levels due to high standards of living in urban centres. Urbanization would lead to destruction of vegetation and biodiversity through occupation of virgin land. Wildlife, for instance, would be pushed out of their normal ecological niches while new insects and pests would emerge. This would lead to emergence of new diseases in both livestock and humans, compromising agricultural production (due to crop and livestock pests and diseases as well as reduced labour as a result of human infections). Unplanned urbanization was also associated with poor sanitation and health facilities, overcrowding and increased incidence of infectious diseases.

Enactment of effective policies, including those on land use, establishment of livestock markets and disease control (vaccination, quarantine, creation of disease-free zones and controlled grazing), would boost livestock production. However, laws on taxation – especially at the county level – were perceived as being a hindrance to livestock production by eating into farmers' profits. Leadership and governance would directly impact on the various factors that influence production because they would provide guidance, enforcement and implementation of policies and adherence to laws and policies. More specifically, leadership and governance would support communities in setting up dry season grazing lands and watering points, thus reducing the chances of conflicts between farmers and pastoralists.

Session 6: Presentation of preliminary results – Part 1

Two presentations on findings from ecological and entomological analyses were given by Mohammed Said and Rosemary Sang. The first showed land use changes that have occurred in Bura since the 1970s and the second showed the types of mosquitoes that have been sampled in irrigated areas in Bura.

Session 7: Validation of socio-economic scenarios and shocks

The project had identified four socio-economic scenarios and shocks for the study area at a previous meeting held in Naivasha in June 2014. These were (i) maintenance of the status quo ('business as usual'), (ii) rapid climate change, (iii) expansion of agriculture under irrigation and (iv) development of One Health systems. The workshop was therefore used to validate these scenarios given that they had been identified by the project scientists without the involvement of the local stakeholders. Participants were first asked to identify changes that have occurred in their areas in the last 10 years.

Participants from Ijara and Sangailu identified the following changes:

- Increase in urbanization, small businesses and permanent settlement
- Increase in education, especially for the girl child
- Increase in hospital infrastructure
- Reduction in the number of camels due to ticks and tsetse infestation
- Increase in crop farming, with some areas being set aside for irrigation

Historical changes that were perceived to have occurred in Bura were:

- Increased incidence of poverty as population increases, access to credit facilities declines and land available for cultivation declines
- Increase in education levels
- Increase in the number of businesses
- Increase in the number of permanent settlements

Following this, the participants were asked to describe changes that are likely to happen in the next 10–15 years. Participants from Ijara/Sangailu identified:

- Increase in the population densities due to immigration for (a) the Lamu Port and South Sudan Ethiopia Transport Corridor project and (b) irrigation in Ijara
- Increase in urbanization and permanent settlements and hence businesses e.g. around Lake Kiilu
- Climate and environmental changes. Changes in vegetation would be attributed to irrigation and charcoal burning. There is cross-border trade in charcoal across Boni Forest.
- Increase in crop farming due to plans to increase irrigation by the National Irrigation Board in Bodhai

External shocks that might prevent achievements of these targets were identified as insecurity, lack of adequate funding for some of the infrastructural developments including irrigation schemes, policy changes arising county government interest in land use change leading to more effective policies and massive climate and environmental changes such as floods associated with El Niño and reduction in underground water (aquifers).

Changes expected in the next 10–15 years identified by the participants from Bura included:

- Increase in population density and permanent settlements
- Expansion of irrigation schemes
- Climate change leading to floods and droughts
- Deforestation
- Increase in poverty and reduction in land availability
- Increased farming outside the scheme

Shocks that are likely to interfere with these changes are conflicts, disease outbreaks and better policies from the county government with political goodwill to succeed.

From these observations, it can be concluded that the scenarios developed by the project team aligns well with those from the local stakeholders. The stakeholders also identified more shocks that best fit the circumstances they are conversant with.

Session 8: Presentation of preliminary results - Part 2

Two additional presentations on the results generated by the project were given. One of the presentations covered participatory work implemented with the communities while the other presented livestock and human sampling activities and preliminary results of the serological screening.

Way forward

The participatory models developed will be validated through key informant interviews and qualitative parameters representing the nature and strengths of the linkages described in the model generated using Fuzzy distributions. These relationships will then be coded in Microsoft Excel using IF statements. A completed model could be useful for conducting qualitative assessments on interventions, such as using improved technologies for managing water in irrigated systems.

Annex 1: List of participants

No.	Name	Designation	Institution/region	Gender (M/F)
1	Abdi Isaak	Pastoralist	Ijara	M
2	Anderson Njau	Veterinarian	Tana River	M
3	Athman Mwatondo	Medical epidemiologist	Zoonotic Disease Unit, Nairobi	M
4	Bernard Bett	Veterinarian	ILRI	M
5	David Wanyonyi	Livestock production officer	Ijara	M
6	Enoch Ontiri	Ecologist	ILRI	M
7	Haji Bahar	Pastoralist	Sangailu	M
8	Hassan Abdi	Clinical officer	Garissa	M
9	Hassan Hussein	Laboratory technologist	Garissa	M
10	Idris Guyo	Farmer	Tana River	M
11	Joseph Mwaura	Researcher, natural resources management	Kenya Agricultural and Livestock Research Organization, Garissa	M
12	Mark Odhiambo Obonyo	Veterinarian	Ministry of Agriculture, Livestock and Fisheries, Nairobi	M
13	Mohammed Abdi	Pastoralist	Garissa	M
14	Naomi Mukuhi Waihenya	Farmer	Bura	F
15	Oscar Koech	Range manager	University of Nairobi	M
16	Pius Kasusya	Environmentalist	National Environment Management Authority, Garissa	M
17	Rosekellen Njiru	Admin assistant	ILRI	F
18	Rosemary Sang	Entomologist/arbovirologist	KEMRI	F
19	Mohammed Said	Ecologist	ILRI	M
20	Salome Bukachi	Anthropologist	University of Nairobi	F

Agenda

Time	Activity	Moderator
Day 1		
08.00 – 08.30	Registration	
08.30 – 09.00	Introduction	Bernard Bett
	Objectives of the workshop	
	Guidelines	
	Logistics	
09.00 – 10.00	Identification of stakeholders in the study sites	Salome Bukachi
10.00 – 10.15	Break	
10.15 – 12.45	Identification of factors affecting livelihoods of the stakeholders	Salome Bukachi
	Stakeholder – factor matrix	
12.45 – 16.30	Systems modelling	Salome Bukachi
16.30 – 17.00	Presentations on preliminary results on the project: Ecological analyses	Mohammed Said
	Presentations on preliminary results on the project: Entomology	Rosemary Sang
Day 2		
09.00 – 10.00	Review of participatory models	Bernard Bett
10.00 – 10.30	Break	
10.30 – 11.30	Scenarios	Bernard Bett
11.30 – 12.00	Presentations on the results of the project	Bernard Bett/ Salome Bukachi
12.00 – 12.30	Closing ceremony	Bernard Bett