

BUILDING AN INVESTMENT CASE FOR CO-MANAGEMENT OF ECOSYSTEMS, FOOD SYSTEMS & PUBLIC HEALTH IN AFRICA



A REPORT OF THE ECOSYSTEMS, FINANCE & HEALTH INCEPTION WORKSHOP

MARCH 19-22, NAMUNYAK CONSERVANCY, SAMBURU, KENYA



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Executive Summary

A significant proportion of human and animal disease is mediated by the environment. This is especially, but not only, the case in 21st century African landscapes, where hazards posed by climate and other forms of environmental change converge with food systems, social and economic conditions to determine where people fall sick. Managing these risks preemptively costs significantly less than the cost of response.

Framing management of communicable and non-communicable disease as a socioecological challenge has important implications for allocation of public health spending. The African health care sector is estimated to be worth US\$ 259 billion by 2030, with a financing gap of at least US \$66 billion annually. Increasing emphasis is being placed on human and animal health as a preventative expenditure. However, health financing tends to focus narrowly on individual diseases at the expense of more integrated solutions that place disease threats within the context of a broader environment-health nexus.

Opportunities to counter these threats by financing preemptive health system improvements *jointly* with ecosystem management and sustainable food production have yet to be explored using traditional or more innovative financial structures such as blended finance. Targeting interventions along pathways connecting ecosystem function to food systems, social systems and the health of rural and urban populations not only has the potential to allow for more effective and sustainable approaches to reducing disease risk, but also has societal impacts on ecosystem integrity (e.g. biodiversity), food and water security, equity and poverty alleviation that extend far beyond the diseases in question. Structuring health financing in this way is also economically and financially beneficial; in principle it

increases human and animal productivity, reduces the cost of health care to families and governments, and has the potential to reallocate risks associated with investments. Considering the health impacts of environment focussed interventions that have proved successful in generating finance (e.g. carbon credit schemes) could also add significant value to these investments.

This workshop gathered 40 leading experts from science, finance, governments, NGOs and communities **to explore the feasibility of building an investment case and de-risking mechanisms for co-management of ecosystems and public health in Africa.** The goal was to co-create a road map outlining steps that could be taken towards achieving this. Participants, whose work examines environmental change and public health from different perspectives, were drawn from 29 organizations from Africa and further afield.

The workshop's activities were framed around the following questions:

1. How is public health currently financed on the African continent?
2. Would joint financing of health systems, food production and sustainable ecosystem management be an attractive proposition to financing organizations?
3. Can a framework that captures the linkages between changing environmental and social systems, disease and economics be used to identify interventions that most effectively deliver health and sustainability benefits and financial returns on investment, within a given landscape?
4. What value proposition do these interventions hold for local stakeholders?



This workshop gathered 40 leading scientists, practitioners and financing experts to explore the feasibility of building an investment case for co-management of public health and ecosystems in Africa

5. What are the data gaps and other unknowns that need to be addressed in order for investors and decision makers to direct resources towards co-financing public health, ecosystem management, and sustainable food production?

The meeting was held on Namunyak Conservancy in Samburu, Kenya (1°00'34.3"N 37°23'05.3"E), from March 19th to 22nd, 2024. Namunyak, which is managed by local communities and the [Sarara Foundation](#), is a model for community conservation and landscape management. By holding the workshop here, the aim was to immerse participants in a landscape where co-management of health and the environment in African rangelands is already being put into practice, and to emphasize the importance of equity and community partnership. We also sought to foster genuine interactions and learning experiences between workshop participants and members of the local Samburu community during the workshop.

The workshop began with an open discussion around the broader meaning of health, and an opportunity for participants to review and provide feedback on the workshop's goals, objectives, and hypotheses. Participants were also encouraged to share their expectations and the tangible outcomes they would like to see generated from the workshop.

On day 2, participants worked in groups to evaluate and refine a conceptual model for the ecological,

social, and epidemiological pathways that give rise to human disease risk across landscapes (presented on page 12). This model was developed through a process of virtual pre-workshop participant engagement. Diverse perspectives strengthened this model and framed the economic impacts of managing disease risk alongside other ecosystem outputs (such as food and water security, as well as climate co-benefits, and equitable community benefits).

To test the conceptual model's suitability for identifying preemptive interventions linking ecosystems, food systems, and public health systems, groups were assigned one of three different landscape-disease systems. These were:

- A. Rodent-borne diseases in forested landscapes supporting small-holder agriculture,
- B. Mosquito-borne diseases in pastoral rangeland systems,
- C. Heat in rural, peri-urban and urban landscapes.

Anchored to these systems, each group spent one full day identifying integrated interventions, and considering the evidence that would be required to measure their impact, and understand the value proposition for local stakeholders. Ideas were exchanged with members of the local Samburu community, who were active participants in this exercise and shared insight from their own resilience-building strategies. A fourth group consisting of experts in natural resource economics, nature-based solution investments, development finance, and capital markets met separately to discuss how the financial risks, returns, and impacts

Hon. Pauline Lenguris MP - the Women's Representative for Samburu and member of the Kenyan Government's Parliamentary Committee on Health, addresses workshop participants



“

A one-year roadmap towards the development of a pan-African initiative called “Ecosystems, Finance & Health” was discussed, drawing unanimous support from participants

of interventions could be measured, and to map how public health & ecosystem management is currently financed in Africa. Each group’s co-management plans were then ‘pitched’ to the group of financing experts, which created awareness about different financing mechanisms and the extent to which these could be leveraged to blend financial support for interventions.

In the evening, participants were treated to a show of traditional Samburu song and dance, and a briefing on the constellations, first from the point of view of the Samburu and then of the ancient Greeks. Our hosts explained the environmental challenges they face, and their need to be included as full participants in solutions. The Samburu women also provided context on the important role played in an otherwise traditionally male dominated society, and the importance of gender sensitivity was later infused into workshop discussions.

The final day was opened by Hon. Pauline Lenguris Member of Parliament, the Woman’s Representative for Samburu and a Member of the Kenyan Government’s Parliamentary Committee on Health. Her excellency stressed the health challenges faced by her constituents, and the importance of empowering communities

(particularly women who are agents of change) as custodians of the environment. She also offered the Government’s full support to the outcomes of this workshop.

Participants then came together to create work streams through which a community of practice dedicated to building an investment case for co-management of ecosystems, food systems and public health systems in Africa could be developed. These included: synthesizing evidence gaps and mapping these to tangible workshop outputs (e.g., scientific papers, policy briefs and communication materials); identifying and engaging key stakeholders and financing mechanisms; and defining an adaptive structure, guiding principles, and timeline to carry these activities forward.

A one-year roadmap towards the development of a pan-African initiative called “Ecosystems, Finance & Health” was discussed, drawing unanimous support from participants. It was agreed that the lead organizers will be responsible for spearheading co-creation of this initiative, with the buy-in of workshop participants.

Samburu residents of Namunyak Conservancy, who played an integral role in the workshop’s discussions, listen to proceedings



Workshop highlights

Day 1: 18 March 2024 - Opening

The first day was dedicated to welcoming participants and developing a shared understanding of workshop's goals, objectives and outputs.

Welcome Remarks

Welcoming participants to the forum, **James Hassell** and **Joseph Kamau**, the workshop's lead organizers, noted that there is limited investment in measures to address the upstream drivers of ill health in humans and animals. This is despite an increasing appreciation for the role that changing climate, pressures on agricultural systems and social systems play in generating burdens of disease. They noted that on the one-hand, such complexity can render conventional medical and veterinary interventions less effective for controlling disease. However, if key epidemiological processes can be identified and disrupted along pathways linking climate, ecosystems, food systems and health, then a wider array of possible preemptive interventions could be unlocked.

Hassell outlined the potential investment case for operationalizing more holistic approaches to disease control; financing of ecosystem, food system and public health system improvements could generate economic returns through healthcare cost savings, taxable economic output, and other ecosystem service outputs, whilst also de-risking these investments. For investors to direct resources in this way, they would need to identify interventions with the greatest potential to improve human health, advance sustainable development goals, and have a risk profile that matches their goals/tolerance.

The workshop was formally opened by **Mathew Muturi** from the Kenyan Government's Zoonotic Disease Unit. Participants were then welcomed by **Robert Lemayian** and **Nurse Dorcas** on behalf of the Namunyak Wildlife Conservancy, its inhabitants, and the Sarara Foundation. They expressed how appreciative the community were that Namunyak was chosen as a destination for the workshop, and drew parallels between the workshop's focus on health and the environment which are also core values of Samburu culture. Dorcas explained how the Sarara Foundation's nomadic healthcare program provides mobile healthcare to mothers and children across the 850,000 acre conservancy, and has established a Nomadic Montessori Education system to access difficult to reach communities. Conservation has also benefited through this model, with Namunyak now being home to Kenya's 2nd largest elephant population and Kenya's largest population of Reticulated giraffe. This, she said, showed the interdependency between responsible environmental stewardship, healthcare and education.

Review of the Workshop Design

Participants split into groups to refine the workshop's vision, objectives, hypotheses and outputs/outcomes. Important points raised in these discussions are summarized in **Figure 1**, below.

The workshop was framed around three major problems/barriers to achieving our proposed vision of an investment case for co-management of public health and ecosystems in Africa. These were discussed with participants in a series of pre-workshop webinars, giving rise to three hypotheses that were carried forward to the workshop.



The Sarara Foundation's healthcare program provides mobile healthcare to mothers and children across the 850,000 acre conservancy, and has established a Nomadic Montessori Education system to access difficult to reach communities

Figure 1: Feedback received from participants on the workshop's vision, objectives, hypotheses & outputs

THE VISION

To create an investment case and de-risking mechanisms for co-management of public health and ecosystems in Africa

Suggested goal: To build an investment case for co-management of public health and ecosystems in Africa to catalyze innovative financial instruments that de-risk financing

Participants felt this statement reflected an objective as opposed to a vision. The following vision was suggested: **"A world in which co-management of ecosystems and public health, through embracing diverse knowledge systems, enables people to thrive"**

...but, achieving this is constrained by

THREE problems

Problem #1

Sustainable food systems are a key piece of this

The African health care sector is estimated to be worth \$259B by 2030, and increasing emphasis is being placed on health as a preventative expenditure. However, health financing on the continent tends to be vertical, at the expense of more integrated solutions to complex, environmentally driven disease threats.

Opportunities to finance preemptive health system interventions (e.g., early warning systems, animal health improvements) jointly with ecosystem management to counter these threats has yet to be explored using traditional or blended finance.

Problem #2

For investors to direct resources towards co-financing public health and ecosystem management, they need to identify interventions with the highest potential to improve human health, advance sustainable development goals, and de-risk investments.

However, despite recognition of disease risks incurred by ecosystem degradation, there is little consistent evidence linking changes in land-use and biodiversity to human health. The effect sizes of disease control strategies are rarely measured.

Problem #3

For co-management to be feasible and effectively implemented, the value to different stakeholders of interventions that target ecological levers and public health system improvements need to be clearly understood.

1. Are these the correct problems? How do we know that addressing them will lead to success?
2. Are we talking about well-being more than freedom from disease?
3. Integrated data systems are weak-to-non-existent. Targeted investments need to be made in One Health data platforms that allow sharing of data across disciplines.
4. Why Africa? Do we think there is more leverage here?

This will require a lot of education for investors, many of whom are currently unaware

In this workshop, we are gathering **transdisciplinary expertise** from **Africa & further afield** to understand how these problems can be overcome, to build an investment case that facilitates improvements in public health systems and ecosystem management in Africa

We begin the workshop with **three hypotheses**

Hypothesis 1

There is a social dimension linked to poverty and conflict underlying this

- Changes in climate, land use change and will increase disease risks and financial burdens for Africa if we carry on as business as usual.
- Managing ecosystems for conservation and/or sustainable food production reduces health risks posed by communicable and non-communicable diseases in Africa.
- Public health system improvements also offer an opportunity to mitigate risks posed by environmentally-mediated diseases.

Must link to indigenous knowledge

Hypothesis 2

These 'levers' are economically beneficial because:

- they maintain human productivity (by reducing economic losses to due illness),
- they reduce the cost of health care to families and governments,
- they reduce financing repayment risk.

Connecting them therefore provides opportunities for more effective financing of human health and environmental sustainability that reallocate risks associated with investments.

& animal productivity

Need evidence of contribution of environmental drivers

Hypothesis 3

Successful implementation relies upon

- interventions being designed a way that they provides clear value to local stakeholders, and,
- effect sizes being estimated in such a way that they can provide confidence to investors

Combined metrics/ actionable data is critical

Must be able to demonstrate value of integrated financing

Interventions must be developed with communities and other actors

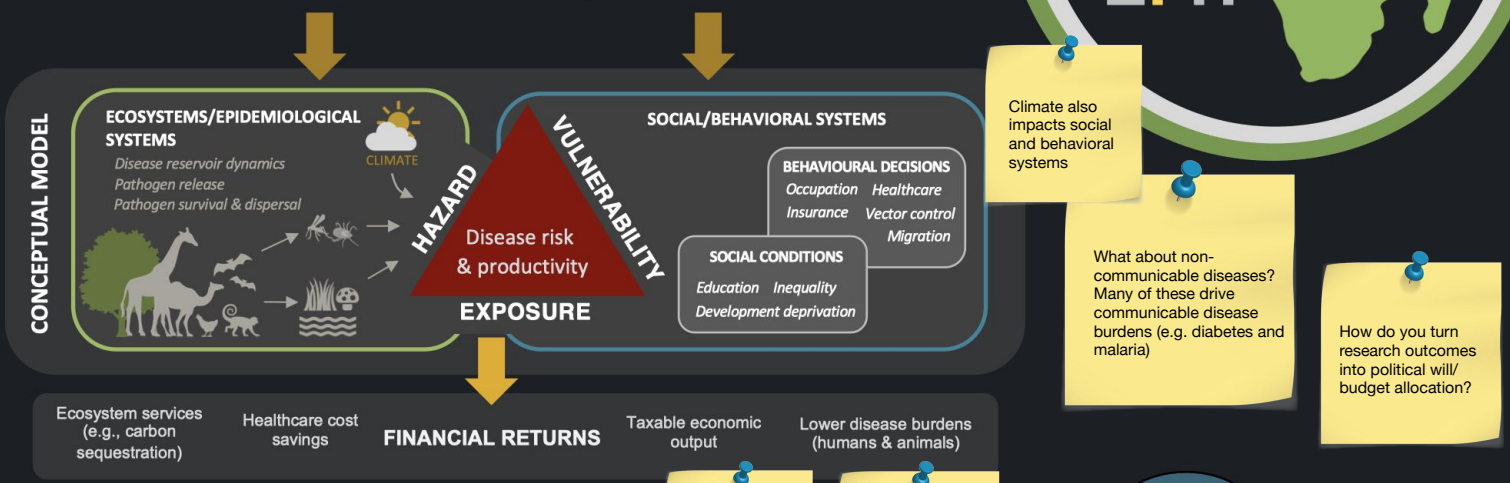
40 participants ...with expertise in...

ecology, economics, epidemiology, ecosystem services, public health, economics, finance, biogeochemistry, remote sensing, artificial intelligence, policy, sustainable nature resource management and more...

Needs a regulatory structure that can be enforced

4-day in-person gathering in Samburu, Northern Kenya

... which will be tested by developing a **conceptual model** and applying **systems thinking**



THREE CASE STUDIES

of environmentally mediated disease systems and the public health infrastructure that serves affected populations of humans and animals, which allow us to evaluate and refine our conceptual model

Being able to measure & quantify health, social and natural capital is crucial

How do you scale up from case studies to identify generalizable principles across landscapes?

What do we know

What don't we know

Where could we intervene

What matters to stakeholders?

How is public health & ecosystem management currently financed in Africa?



OUTPUTS & Outcomes

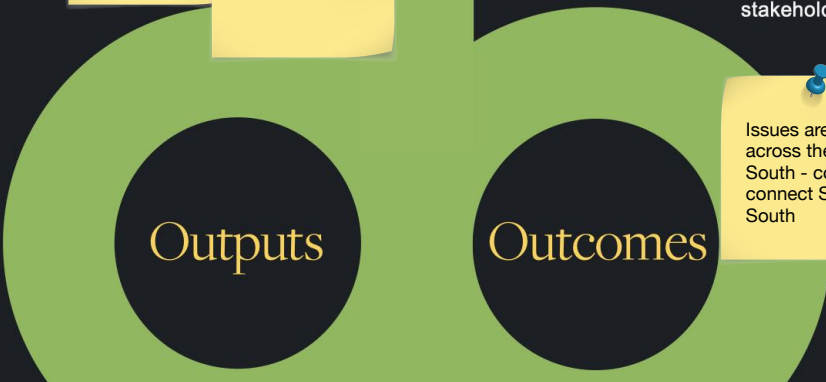
STRATEGY
 Information will be harvested on what it would take to achieve our vision. This will be translated into a fully costed strategic plan and theory of change.

How will the strategy be structured? Who will do what?

Communications outreach is also crucial

SYNTHESIS
 A new, more integrated way of thinking about environmentally-mediated disease control, that could better serve local stakeholders and lead to significant new investment opportunities.

SCIENCE
 A conceptual framework for how science could unlock traditional and blended finance to drive improvements in health and sustainable development in Africa, leading to a high impact paper.



Issues are felt across the Global South - could connect South South

AFRICA-LED
 African science & policy is positioned at the forefront of evidence-based solutions linking sustainable economies, tropical ecosystems and public health worldwide.

POLICY
 A white paper that sets the boundaries on when sustainably managed ecosystems are complementary to public health systems and posits how one would think about developing financing vehicles for these cases. Plus, a side event at COP16 and the 8th World One Health Conference.

Policy paper should have a narrow focus, and be about interventions more broadly than complementary cases

COLLABORATION
 New interdisciplinary partnerships and collaborations between scientists working in Africa, the US and Europe, framed around the issues addressed in the workshop.

How to make change? Embrace disruptive thinking, positive deviance



Dr Éliane Ubalijoro,
Director General of CIFOR-
ICRAF discusses the
workshop's hypotheses
with other participants

Using a conceptual model and series of case studies, we sought to explore these hypotheses with participants, thereby generating the information required to create a roadmap with which they could be tested. The conceptual model essentially served as a general framework to capture the linkages between changing environmental and social systems, disease and economics within a given landscape, in such a way that interventions with the greatest potential to deliver health and sustainability benefits and financial returns on investment can be identified. Three case studies, each representing a different landscape-disease system of relevance to different localities in Africa, were used to test and refine the conceptual model and address the following questions:

1. How is public health currently financed on the African continent, and would joint financing of health systems, food production & sustainable ecosystem management be an attractive proposition to financing organizations?
2. Can a framework that captures the linkages between changing environmental and social systems, disease and economics be used to identify interventions that most effectively deliver health and sustainability benefits and financial returns on investment, within a given landscape? What value proposition do these interventions hold to local stakeholders?
3. What are the data gaps and other unknowns that need to be addressed for investors and decision makers to direct resources towards co-financing public health, ecosystem management and sustainable food production?

Day 2: 19 March 2024

The workshop's second day was dedicated to refining and testing a framework (the 'conceptual model') for identifying entry points for co-managing ecosystems, food systems and public health systems.

Conceptual Model Review

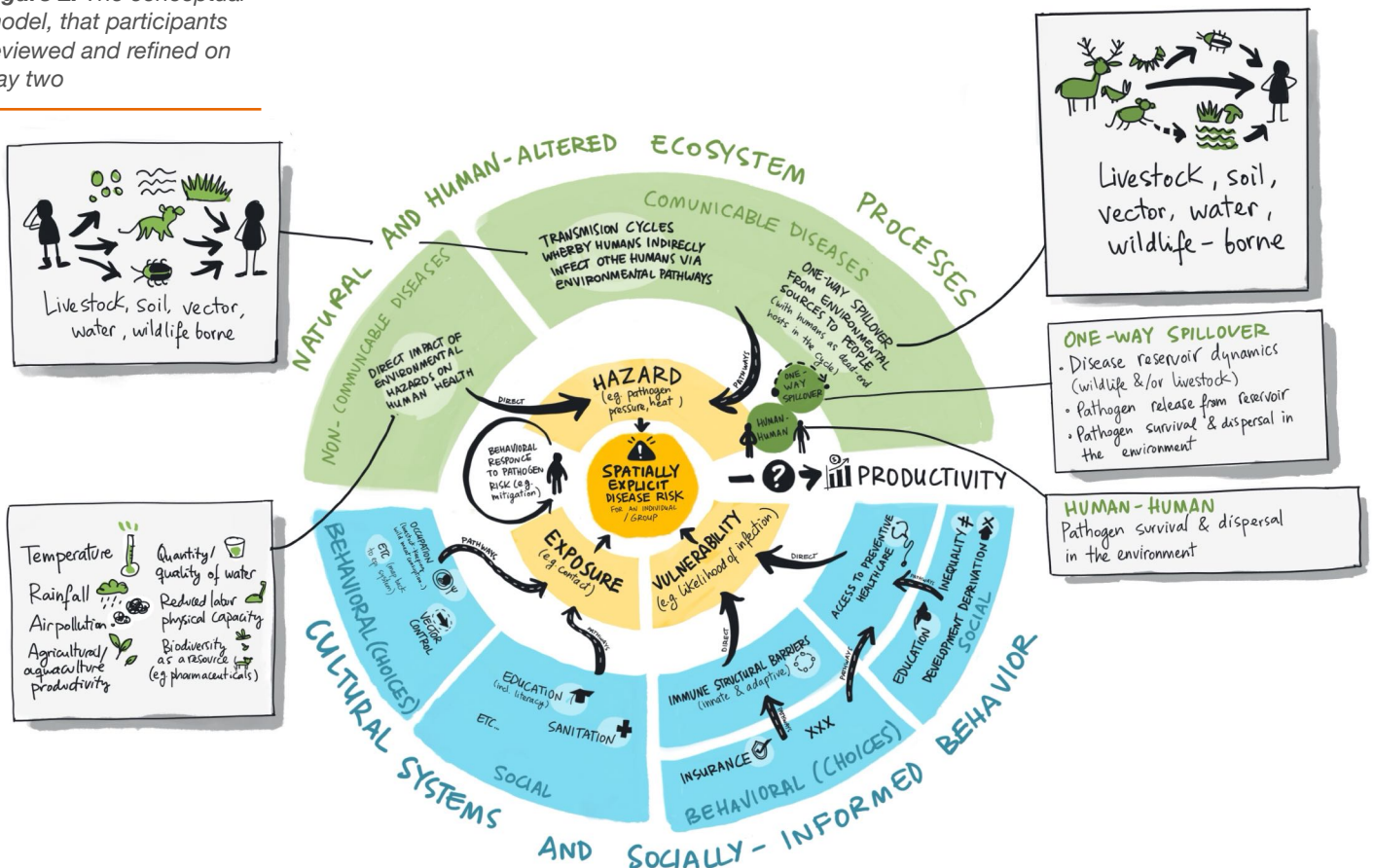
Participants began by reviewing the conceptual model for the ecological, social and epidemiological pathways that mediate human disease risk in a given landscape. In this framework (Figure 2), disease risk is expressed as a factor of hazard, exposure and vulnerability. James Hassell explained that this was conceived from a disease ecology perspective, where epidemiological processes (occurring in the environment) feed in from the boxes in green to influence the hazard to which humans are exposed at a given point in time and space. Disease hazards may be non-communicable (e.g. heat) or communicable (pathogens borne by vectors, livestock, wildlife etc). Social and behavioral factors feed in from boxes in blue to determine where and when people are exposed to hazards, and their level of vulnerability.

Considering hazard, exposure and vulnerability in this way enables disease risk to be estimated for a population of individuals at any given point in time and space. It is assumed that disease risk could be extended to a measure of the economic costs imposed by disease (i.e., morbidity and mortality), represented here as 'productivity'.



Participants refined and tested a framework for identifying entry points for co-managing ecosystems, food systems and public health systems

Figure 2: The conceptual model, that participants reviewed and refined on day two



Working in three groups, participants reviewed the framework, considering its main assumptions, and the key pathways and variables that were missing. The following themes emerged through these interactive discussions:

- The framework assumes that disease risk and productivity are the primary outcomes of interest. Is this a suitable measure of human well-being? How can the broader sustainability and economic benefits of intervening in the processes outlined in this framework be captured (e.g., food security, biodiversity conservation, carbon sequestration, natural capital etc.)? In economic terms, how should productivity be defined?
- As key components of epidemiological pathways, the management of agricultural and livestock systems needs to be further defined. Local stakeholder involvement including indigenous knowledge needs to be more explicitly captured.
- A more explicit breakdown of the social and behavioral pathways is required. E.g., social factors that influence behavioral choices, how to capture that human behavior is dynamic and not static, whether behavior and culture should be framed as of the environment, and how to capture behavioral responses to changes in disease risk and productivity.
- As depicted in this framework, the pathways are linear. Is this a necessary simplification or should more bi-directionality and feedback loops be included?
- The framework represents processes occurring at many different scales. How can the scales at which specific investment (as interventions) are made be matched with the scales at which outcomes are measured?
- Although not necessarily required as part of the framework, the availability and accessibility of data and how a diversity of data streams are being merged will have a huge impact on operability.

“

Participants reviewed the framework, considering its main assumptions, and the key pathways and variables that were missing



Case Studies

Following review of the conceptual model, the workshop moved to focus on whether this framework is suitable for identifying entry points for co-management of ecosystems, food systems and public health when applied to ‘real-world’ landscape-disease systems.

Participants were assigned to one of three case studies;

- **Rodent-borne disease in a lowland forest ecosystem**, supporting forest and rural smallholder agriculture. This is characteristic of emerging infectious diseases in humid and sub-humid tropical areas of Central and West Africa.
- **Mosquito-borne disease in a rangeland ecosystem**, supporting grasslands, extensive pastoral agriculture and growing urban centers. This is characteristic of emerging and endemic vector-borne diseases in semi-arid and arid landscapes across much of the Sahel and Southern Africa.
- **The impacts of heat on ecosystem health** across an urban to rural gradient in Africa.

Using the conceptual model as a point of reference, groups began by mapping out the pathways linking ecological, social and behavioral processes to disease outcomes. Notably, the model was used in different ways to achieve a shared understanding of each case study; for instance, the group working on heat reframed the model from the perspective of “drivers”, “pressures” and “impacts”.

Equipped with a shared understanding of their landscape-disease system, groups were encouraged to brainstorm interventions focused on management of ecosystems, food systems or public health systems. For each intervention, participants explored evidence gaps, risks and the value proposition to key stakeholders. Groups were joined by members of the Samburu community to get their perspective on the suitability of interventions, as experts in living with environmental variability and local stakeholders.

Different approaches to identifying and prioritizing interventions emerged. For example, the group working on rodent-borne disease developed interventions targeting agroforestry and green waste management at the rural and urban ends of the land-use gradient respectively. Participants working on mosquito-borne disease split into subgroups, with one identifying interventions in a rural pastoral grassland setting, and the other identifying interventions in peri-urban and urban environments where a mosaic of pastoral, agropastoral and urban livelihood strategies coexist. Participants subsequently reconvened to integrate and prioritize interventions across this rural-urban gradient.

The group working on heat adopted a different approach; once identified, interventions were compared against a set of criteria with which their value to different stakeholders (e.g. resource requirements for implementation and impacts on environmental and social development goals) could be evaluated.

Prioritized interventions for each case study are outlined in **Table 1**. There was consensus across the groups that, when paired with ‘real-world’ landscapes, the model helped contextualize complex processes and enabled people with differing expertise to identify landscape-level interventions with combined impacts on health and other key sustainability indicators.



(Above) Participants brainstorm interventions for mosquito-borne disease. (Below) The group working on heat mapped interventions onto a framework representing their landscape-disease system, and then used a multi-criteria decision analysis approach to compare interventions

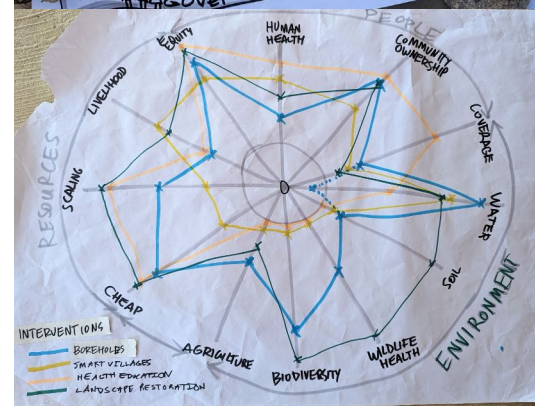
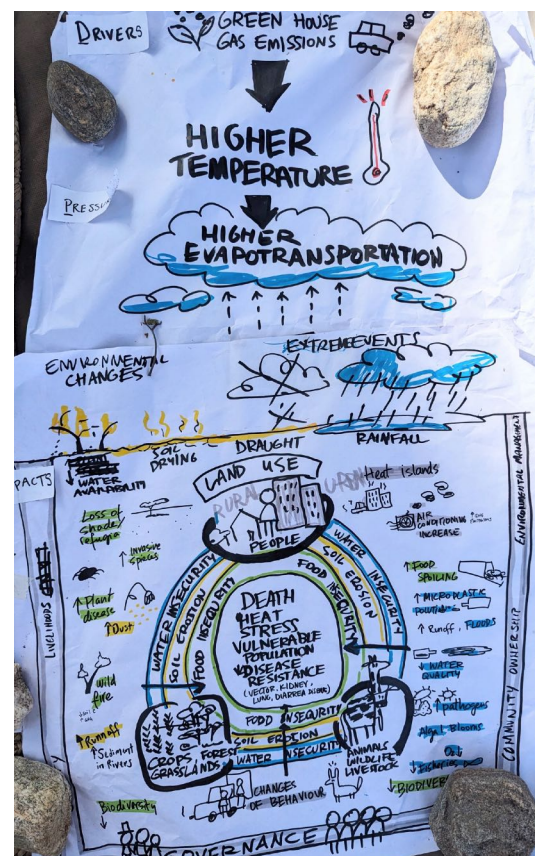


Table 1. Interventions prioritized by each group

Landscape-disease system	Intervention	Evidence gaps & risks	Key Stakeholders & value proposition
Rodent-borne disease	<p>Agroecological practices that reduce rodent-borne disease risk, while increasing biodiversity, food safety and food security. <i>Specifically:</i> Agroforestry to disincentivize deforestation, leading to increased soil health and biodiversity, a reduction in rodent populations (due to increase in predation and competition), and increased income to farmers from food production.</p>	<ul style="list-style-type: none"> The availability of data to measure impact across the system Surveillance of rodent-borne diseases, and rodent abundance estimates Identification of the most important variables that could be levers 	<p>The local community (who are at risk of disease) Food producers & consumers Healthcare workers Local & national government (e.g. human & animal health services, environmental protection services) Development organizations</p>
	<p>Green waste management in permanent informal settlements to reduce rodent and vector-borne disease risk. <i>Specifically:</i> vegetation to filter organic waste, latrines & solid waste management</p>	<ul style="list-style-type: none"> Availability of health data on inhabitants of informal settlements Surveillance of rodent-borne diseases, and rodent abundance estimates The impact of green waste management practices on other hazards (AMR, pharmaceuticals) 	<p>Community living in informal settlements at direct risk of disease Surrounding (i.e. in-contact) communities Local government (e.g. human & animal health services, environmental protection services) National government Local politicians Development organizations</p>
Mosquito-borne disease	<p>Investing in ecosystem services that allow function of ecosystems at times of stress, to avoid forced migration. <i>Specifically:</i> reduction of environmentally induced migration (rural -> urban) by implementing measures that make the environmental resource base more resilient to change; such as water management, grazing management (see "herding for health" below) and land tenure.</p>	<ul style="list-style-type: none"> The ability to demonstrate that landscape-level environmental interventions have a measurable impact on health and economic productivity Mis-match between the scale at which the intervention is taking place, and indicators of success are being measured. 	<p>Rural pastoral communities - resilience, risk avoidance, economic improvements. Urban pastoral communities - risk avoidance (less pressure on public health and social systems due to lower migration). Local government - governance plans for greater social & environment impact Politicians - recognition, social impact Private enterprise - business through implementation Private equity financial institutions - carbon market impacts of grassland restoration Development organizations - social & environmental key performance indicators</p>
	<p>Herding for health - improve livestock management practices, to address degraded rangelands and improve human and animal health. Including best practices and capacity building for reduced herd sizes, livestock species/breeds, mixed herd foraging, rotational grazing systems etc</p>	<ul style="list-style-type: none"> How should success be measured? Metrics could include <i>health</i>: livestock body condition, disease burden; <i>environment</i> forage quality, % bare ground, soil organic carbon, <i>economic</i>: market price, household income security 	<p>As above</p>
	<p>Prediction/early warning of disease risk to best allocate resources at relevant spatial scales. This is built on a model of integrated participatory surveillance, in which community members collect data on environmental conditions, vector populations, and syndromic data on animal and human health. This is supported by investments in telecommunications.</p>	<ul style="list-style-type: none"> Accuracy and resolution of the model(s) - restricted by gaps in our knowledge of the system. How to integrate participatory environmental, ecological and social data in probabilistic models. How to make sure that the model outputs are informative to different decision-makers? 	<p>Rural pastoral communities - risk avoidance, better human & animal health, lower treatment costs, jobs, telecoms access, less forced migration. Local government (e.g. human & animal health services) - quicker, more effective decision-making. Politicians - recognition, social impact. Development organizations - social development key performance indications.</p>
	<p>Value chain interventions that ensure a low risk of disease introduction from farm to fork.</p>	<ul style="list-style-type: none"> Measuring the cumulative impact of improvements along a value chain on human health and economic productivity Introduction of environmental stress elsewhere in the system (e.g. new markets for animal-sourced foods drives increased livestock populations) 	<p>Rural & urban pastoral communities (producers) - risk avoidance, household economic improvements. Rural & urban pastoral communities (producers) - risk avoidance. Local and national government - civil servants & politicians - recognition, social impact Private enterprise - better food safety, more revenue Development organizations - social development key performance indications</p>
Heat	<p>Installation of solar-powered boreholes for non-irrigation purposes (drinking water) & related infrastructure like reticulated pipelines, animal watering points etc.</p>	<ul style="list-style-type: none"> Quantifiable metrics/indicators to measure impact on human health and economic productivity 	<p>Multiple co-benefits spread across rural & urban communities, local and national government, NGOs & development funders in the realms of clean energy, water security, equity and health. Also easily scalable.</p>
	<p>Landscape rehabilitation and sustainable management. <i>Specifically:</i> rehabilitation and restoration of trees and other vegetation types to counteract the effects of degradation and deforestation.</p>	<ul style="list-style-type: none"> Causal pathways Quantifiable metrics/indicators to measure impact on human health and economic productivity How do co-benefits accrue away from the location targeted for intervention/ investment? 	<p>Multiple co-benefits spread across rural & urban communities, governance institutions, NGOs & development funders, private equity financial institutions and entrepreneurs. Tree planting in heat exposed areas leads to disease prevention, and water and biodiversity conservation. Approach also provides leverage for other ecosystem-health initiatives.</p>
	<p>Integrated heat-health behavioral change education program from communities. <i>Specifically:</i> an education program for behavioral change required in response to heat exposure and for managing health complications. Including; promotion of health work practices in the context of heat stress, promotion of WASH, health-health early warning triage for vulnerable population with community health workers, and water intake guidelines.</p>	<ul style="list-style-type: none"> Lack of heat-health early warning systems Lack of evidence-based best practice guidelines on heat-health public education Lack of incorporating indigenous knowledge into education programs 	<p>Multiple co-benefits spread across rural & urban communities, local government (e.g. community health workers), national government institutions and NGOs & development funders. Education is scalable and provides synergies with structural intervention programs to address the impacts of heat. Education also underpins the effectiveness of all other interventions, but is individually ineffective.</p>

Participants with a background in economics and finance met to map out the incentives and instruments for financing public health or ecosystem management in Africa. This group also discussed the types of information and measurements that matter to financing organizations when they are deciding whether to invest in projects.

Take-home messages from this discussion include:

- There are an incredibly diverse range of financing organizations with differing incentives to provide financial support. These range from impact and influence on sustainable development goals, foreign policy and political process, to economic financial returns and managing long-term risk. Some of these incentives align with the interests of scientists.
- An equally diverse array of investment vehicles could be leveraged to finance joint improvements in ecosystems, sustainable food systems and public health systems. These include grants to support research and government interventions (e.g. surveillance programs), subsidies and tax incentives to support trade, public goods, and biodiversity conservation, and bonds, equity, loans, debt swaps, blended finance and grants to support sustainable infrastructure, climate resilience and sustainable ecosystem management.
- To be attractive to investors, interventions must i) address an unmet need/solution, and be simple to describe, ii) have a clear timeline for completion, iii) demonstrate a quantifiable change, and clearly identify how this will be measured, and iv) fulfill the investor's mandate - whether for impact, financial returns or both.
- Examples of appropriate measurements for an intervention targeting rodent-borne disease through agriculture production systems include change in grain production or profit, change in % organic matter in the soil, change in population of rodent predators and change in health clinic cases or spending on human health.



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A diverse array of investment vehicles could be leveraged to finance joint improvements in ecosystems, sustainable food systems and public health systems

Members of the finance group, representing Africa Development Bank, CIFOR-ICRAF, FSD Africa, Nature Finance, International Fund for Agricultural Development (IFAD), Kenya National Bureau of Statistics, University of California Irvine & Yale School of the Environment.

Day 3: 20 March 2024

On day three, participants continued working on case studies before reconvening as a whole group to share their findings.

Making an investment case for integrated interventions

Adopting a format reminiscent of the popular US TV show "Shark Tank" - where entrepreneurs pitch their ventures for investment - participants from each of the three case studies presented a high-impact intervention to the finance group. Each of these interventions operated at a scale that was spread across the management of ecosystems, food systems and public health, in their respective landscape-disease systems.

The finance panel evaluated each group's 'pitch', to see whether it could meet the criteria required to be considered an investment opportunity. Given the panel's diverse background, each intervention was evaluated from the perspective of investors interested in different types of 'returns'; profits, value being assigned to assets (such as climate change mitigation), and social and environmental key performance indicators.

Insights from this session include:

- Science and finance (particularly in the public sector) often share an end goal of sustainable development impact, but divergent views on implementation and measurements of success limit collaboration across these sectors.
- There exist significant untapped financial opportunities to support research and implementation efforts at the interface between ecosystems, food systems and health. However, for scientists to capitalize on this, perspectives on data collection and types and accuracy of measurements need to be more closely aligned with public and private sector investors. E.g.
 - Investors are interested in change - so to be interested in an intervention, changes that result from this intervention on the system must be measured.

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Adopting a format reminiscent of the popular US TV show "Shark Tank", participants from each of the three case studies presented a high-impact intervention to the finance group.



- Investors would need to know the effect size of this change, but prioritize a range of certainty over absolute accuracy.
- Strengthening financial acumen and knowledge of financing instruments among scientists would also facilitate more effective communication and engagement with the financial sector. Many scientists are unaware of the returns on investment that investors are interested in, even when these overlap with their goals (e.g., social or environmental key performance indicators).
- Standard operating protocols for evaluating interventions collect quantitative data that could be translated into economic cost models with relatively little effort.
- Blended financial vehicles, with support from development banks like the African Development Bank, can make integration of interventions across landscapes more commercially attractive to investors, by de-risking transactions.

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Robert welcomed the group, gathering them around the fire to speak about the current Samburu world view and how they are handling the severe environmental challenges facing their ancestral lands

Bush dinner and storytelling

That evening, participants were driven to a large open area of dry river bed at the centre of Namunyak Conservancy where they gathered in a large circle for dinner. Before food was served, Samburu warriors entertained everyone with traditional song and, for which audience participation was strongly encouraged! After dinner, **Tilas Lekango** (a Samburu elder and workshop participant) presented a charming and interactive briefing - complete with laser pointer - on the constellations, first from the point of view of the Samburu and then of the ancient greeks.

Robert Lemayian, a Samburu elder and general manager for Sarara, then welcomed the group, gathering them around the fire to speak about the current Samburu world view and how they are handling the severe environmental challenges facing their ancestral lands. Robert eloquently described how the Samburu know their needs and their land and are quite competent to be included as full participants in planning for land use, grazing and water management. He took questions from the audience, playing the crowd like a master with wit and a clear idea of his message.

Many in the group were struck by how comfortable the workshop's Samburu hosts are with their cultural identities, while embracing the modern world with their deep and insightful knowledge of the challenges we face as a planet.



Day 4: 21 March 2024

On the workshop's fourth and final day, participants came together to consolidate views and discuss next steps in developing an investment case for co-management of ecosystems, food systems and public health.

Proceedings were opened by **Hon. Pauline Lenguris MP**, the Women's Representative for Samburu and member of the Kenyan Government's Parliamentary Committee on Health. She expressed her gratitude that Samburu County was chosen as the venue for this workshop. She explained that her role is to represent the Samburu community and spoke very eloquently about the impacts of prolonged drought and emerging healthcare challenges (such as malnutrition and cancer) facing her constituents. She also spoke about the work being done to address these challenges, noting nomadic healthcare programs which are seeking to achieve universal health coverage, biodiversity conservation, and the importance of empowering women as agents of change. Hon. Lenguris finished by pledging the Government's support to the outcome's of this workshop, and encouraging participants to work with the Samburu community in designing projects and interventions.



Hon. Pauline Lenguris MP - the Women's Representative for Samburu, addresses workshop participants

Open space

The rest of the morning was spent identifying gaps and forward actions through a series of small group activities. This visioning exercise was built around the following six questions;

- What is the vision, and how can it remain rooted in the origin (Namunyak Conservancy)?
- What organizational structures could bring the vision to life?
- How do we engage stakeholders who could align with our vision?
- What are the key scientific evidence gaps that need to be overcome to design landscape-level ecosystem-food system-health interventions, and measure their impact?
- How should we frame the workshop's scientific and policy outputs, and communicate this to broad audiences?
- How do we bridge the gap between science and finance?

These conversations were open, allowing participants the freedom to move between groups, reviewing outputs and seeding new ideas.

Outcomes from these discussions included:

- A vision statement, designed around the future that members of the Namunyak community who participated in the workshop would like to see in 2050, was termed the "Namunyak Declaration". This vision and guiding principles would serve to anchor EFH to Namunyak, and ensure that future work is guided by the needs and knowledge of local communities. There was also a strong sense that interventions designed with the people of Namunyak could serve as an initial case study for the initiative, with a view towards translation and impact at a much broader scale.

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A vision statement, designed around the future that members of the Namunyak community who participated in the workshop would like to see in 2050, was termed the “Namunyak Declaration”.



- A series of guiding principles for how EFH should be structured, including the need to:
 - be anchored on the African continent,
 - commit to working closely with local communities, embracing diverse knowledge systems and ensuring that they are participants in and beneficiaries of our work,
 - operate at the interface between science, policy and practice,
 - have a mission-oriented thematic structure, that is guided by a theory of change and strategic plan
 - make independent decisions (unconstrained by institutional bureaucracy),
 - be financially sustainable over the long-term,
 - have a clear time commitment from team members.
- The need to conduct a comprehensive stakeholder mapping process, and use a framework such as RACI (responsible, accountable, consulted and informed) to clarify and define roles and responsibilities when engaging key stakeholders. The “Big 5” - government, communities, academia, NGOs, and financing organizations must be engaged early in the inception process.
- Key scientific evidence gaps, which include:
 - prioritization of diseases that are impacted by global environmental change, based on risk and morbidity/mortality,
 - can tipping points/thresholds at which degraded ecosystems pose a disease hazard be identified?
 - generating sufficient causal evidence to simulate the future impacts of multiple interventions on complex environment-food-health systems over time,
 - collection and harmonization of sufficient data across disciplines, with which the impact of interventions targeting ecosystems, food systems and health could be measured,
 - understanding how land-use change affects hydrological processes and water security, and what the key indicators of disease associated with this are,
 - understanding feedback loops between disease risk, health interventions and ‘risky’ behavior,
 - understanding the environmentally-mediated causal pathways of co-infections/co-morbidities, and their impact on health,

- how can ecosystem services and infrastructural health system input be connected to outputs that accurately reflect human disease transmission (if infectious), recovery (i.e., morbidity and mortality) and economic productivity?
 - how does financial risk scale with project size and scope (in terms of interventions)?
- Identification of potential outputs targeted at the financing and scientific communities, and outreach materials, which included:
 - a high-impact position paper presenting the conceptual model and explaining how suitable interventions targeting ecosystems, food systems and public health systems could be identified within a landscape, based on the case studies discussed in this workshop,
 - a policy brief looking at how science can inform finance architectures, policies and practices, and how finance can be made more accessible to transform science,
 - policy briefs/finance papers explaining how health and finance measurements could be connected, and making the case for integrating interventions across landscapes as a de-risking mechanism,
 - scientific papers - e.g. a deep dive into one of the case studies developing during this workshop (such as agroecology and health), evidence gaps, indicators that could be used to measure and extrapolate the impacts of interventions across landscapes,
 - synthesis of data gaps, a data inventory and data release, framed within the types of landscape-disease systems (and points of intervention) identified in this workshop,
 - communications materials for the general public (e.g. a workshop report, coordinated press release, an animated YouTube video), and the support of a communications expert,
 - activities dedicated to highlighting the bi-directional impact of the Namunyak community's involvement in the workshop, and mechanisms to maintain this engagement moving forward.

Way forward

In the workshop's final session, participants reconvened to map these gaps and forward actions against a one-year timeframe. From this, emerged a **roadmap for implementation** (Figure 2).

Participants expressed their willingness to move this agenda forward, and roles and responsibilities were assigned to specific tasks. It was agreed that the workshop co-leads (James and Joseph) would take responsibility for coordinating these forward actions, and spearheading development of the EFH initiative. The group also agreed that participation should be broadened beyond those who were able to attend the workshop, and therefore agreed to find ways in which the broader community of scientists and practitioners working in Africa could be engaged.



EFH road map

EFH ideation

Collaborations borne out of the Smithsonian Global Health Program's work with peer institutions in Africa

EFH inception

March 2024, Namunyak Conservancy, Samburu.

Organization

Design EFH's organizational structure and find a home for the initiative in Africa. Key needs: embedded within African science, policy & practice, able to draw on global expertise, mentorship & incubation, support in accessing funders.

Seek core funding for Phase I & seed funding for initial case study in Samburu. Map & develop TOR's for "Big 5" stakeholders, draft theory of change.

PHASE I

Science, finance & policy

Establish an online platform for ongoing collaboration, whereby group can work together on outputs from the workshop. Broaden our community to include African scientists who were unable to attend the inception workshop.

Strategic plan

Develop a phased, fully costed, five-year strategic plan and business plan. Identify goals, outcomes, activities & resources. Seek funding.

Return to Namunyak for 2nd workshop in 2025 to report back to community

PHASE II

Implementation of strategic plan allows us to meet our objectives & goals

Phased approach

PHASE I OBJECTIVES 2024-2025

- Inception workshop
- A community of practice to collaborate on workshop outputs
- An organizational structure
- A 10-year strategic plan, and donor engagement
- Core funding to execute the strategic plan

PHASE II OBJECTIVES 2025-2035

- Launch EFH's mission-oriented approach through a ten-year program of activities that allow the initiative to meet its goals & objectives