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Connecting environment, health and livelihoods: how community experiences inform integrated programming in Rukiga District, Uganda

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ABSTRACT

Introduction The climate crisis has profound effects on people's lives, particularly those reliant on subsistence agriculture and ecosystem goods for their livelihoods and health. There is growing recognition of the interconnections between human health, environmental degradation and climate change, but little research on the pathways of these interconnections that could inform programme development and little attention given to community experiences and perspectives that provide essential insights into how cross-sector programmes could better address health, livelihoods and environmental needs.

Methods Between April and June 2021, we conducted in-depth interviews and focus group discussions with residents across eight parishes affected by climate change in Rukiga District, Uganda. We investigated peoples' perceptions and experiences concerning health, climate, environment and livelihoods, then codeveloped integrated cross-sector solutions with non-governmental partners to respond to identified challenges. We analysed data using thematic content analysis.

Results Community members articulated how increasingly unpredictable seasons and rainfall patterns lead to crop failures, soil erosion and flooding exacerbated by widespread practices of tree cutting and growing non-native plants. The burning of upland and wetland vegetation caused further degradation, reducing access to clean water. These led to inadequate nutritious food and malnutrition. Respondents noted that large family size puts pressure on available land, yet they have poor family planning services and information. Men who could not provide for their families reportedly spent money on alcohol; behaviour which was associated with gender-based violence.

Community experiences and viewpoints were discussed at workshops and meetings with non-governmental organisations and health partners to identify key evidence-based interventions and develop integrated messaging to address the interconnected needs articulated by community members.

Conclusion Listening to the experiences and views of community members is essential to designing impactful, sustainable programmes to address interconnected health, environment and livelihood needs. Researchers can broker this through formative research and cocreation workshops with local responders.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Human pressures on ecosystems threaten biodiversity, ecosystem services and the ability to sustain natural resource-dependent livelihoods. Human pressures on ecosystems are therefore a threat to human health and well-being. Yet, governance, systems and resourcing of development initiatives to address this cycle remain disjointed, which undermines efforts to achieve health, gender, climate, environment and poverty reduction Sustainable Development Goals (SDGs). Integrated solutions are thought to enable communities and states to better respond to the interconnected challenges of human population dynamics, human and animal health, and the health of the ecosystems on which we all depend, but robust research has been lacking.

WHAT THIS STUDY ADDS

⇒ This study provides empirical evidence of the interconnections between the health, environment and livelihoods sectors and how programmes can integrate and adapt to respond to related, cross-sector needs.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This research can inform the development of more effective cross-sector programmes that improve environmental health, sustainable livelihoods and the visibility, accessibility and quality of family planning (FP) services. Ultimately, this leads to healthier ecosystems (with fewer human pressures and improved outcomes for species) and healthier people (with improved birth spacing, nutrition and livelihood opportunities, and reduced unmet FP needs and unintended pregnancies).

INTRODUCTION

The health of environmental resources (that provide ecosystem services like food, grass for mats) is intimately connected with the well-being of people;[1] both are increasingly being affected by climate and environmental change. Environmental challenges include soil erosion caused by heavy rainfall

and flooding that washes away productive soil not only in highland areas but also in lowlands where riverbanks burst, flood and wash away good soils on their banks.[2 3] Flooding also pollutes drinking water sources.[4 5] Climate change also causes unpredictable rainfall and droughts which can destroy growing crops, resulting in poor harvests, hunger and malnutrition,[6 7] and increases the frequency of flooding events.[8]

Due to climate change and environmental degradation, livelihoods are diminished, exacerbating poverty.[9–11] Additionally, where population growth is high, it is harder for the available natural resources to be sustained, as there is constant pressure for food, housing and access to basic healthcare services, including family planning (FP). Thus, human pressures on ecosystems threaten biodiversity, environmental resources, the ability to sustain livelihoods, and, therefore, human health and well-being. These threats intensify inequities in access to critical health services including rights-based FP and reproductive healthcare.[12–14] Furthermore, poor households are more likely to face environmental disasters,[15] because those households often live in more environmentally vulnerable areas. Clearly, many sectors connect at the level of the household and local community. Indeed, the vision of the Sustainable Development Goals (SDGs) is one of the cross-sector connections, though a cross-sector governance framework was never elaborated.[16]

Uganda is a highly decentralised country with multiple sectors present at the district and subcounty governance levels. For example, the Department of Natural Resources is responsible for implementing the presidential guide to reduce the encroachment of the wetlands and sensitises people on sustainable use of the wetlands and their catchments. The Department of Agriculture provides agricultural extension services to support farmers, including sustainable farming techniques. The District Department of Health is responsible for FP and general health services at static and outreach facilities. In addition, multiple non-governmental organisations (NGOs) provide services and interventions in each of these sectors. There is growing interest in cross-sector working,[17] yet there is little information about how these sectors intersect at grass-roots level, and what (if anything) government agencies and/or NGOs provide in terms of intersectoral programmes. Yet such information is needed to inform genuinely integrated responses, including cross-sector programmes that address both FP and general health needs—including nutrition—as well as sustainable livelihoods for development.

A new partnership led by the Margaret Pyke Trust (MPT: an NGO which cocreates programmes integrating reproductive health, climate and biodiversity action) in Rukiga District aims to provide a model for integrated programming. MPT, working together with Rugarama Hospital (RH: providing clinical outreach) and the International Crane Foundation (ICF: providing wetland and Grey Crowned Crane conservation and sustainable livelihoods), seeks to holistically address related environmental, livelihoods and healthcare needs through integrated programmes.

In this paper, we examine how the members of rural communities in Rukiga District, Uganda understand and experience the interconnections between environmental health, livelihood practices and FP. We describe how formative research was used to identify the requirements for integrated programming in a poor, climate-crisis affected region, to address holistically sustainable livelihoods, environmental conservation and reproductive health.

Theoretical orientation

To guide our presentation of findings, we adopt the Model of Human Interaction with the Environment that was advanced by Hammond,[18] as a useful framework for identifying the key pathways by which human activity degrades the environment on which human health depends, and prioritise areas for intervention. Although developed to describe big polluting industries in the global north, this model can be adapted to analyse our results from the remote small farming communities in Rukiga district. The model identifies and defines four areas of interaction between human activity and the environment: source, sink, life support and impact on human welfare. Their relevance to our project is, first, *source* recognises that from the environment, people derive energy, food, building materials and other natural resources for their economic activities. Thus, these resources and biological systems (such as soils, wetlands and forests) on which farmers depend must be protected from degradation. Second, *sink* recognises that natural resources are in fact degraded by human activity, including unsustainable farming practices (eg, deforestation, non-native planting) causing soil erosion and pollution (eg, from pesticides and fertilisers). Third, *life support* describes how the earth's ecosystems, especially unmanaged ecosystems, provide essential life-support services. These range from the breakdown of organic wastes (such as in the wetlands) to nutrient recycling (sustainable farming) to oxygen production (trees) to the maintenance of biodiversity (native species). As human activity expands and degrades or encroaches on these ecosystems (eg, farm soils being washed into wetlands; soils depleted by fertilisers; non-native species contributing to soil erosion), it can reduce the ecosystem's ability to provide such services. Finally, *impact on human welfare*: this holds that polluted air and water and contaminated (or destroyed) food affect human health and welfare directly.[18 19]

METHODS

Study setting and participants

Rukiga District in western Uganda comprises steep upland slopes and low wetland areas. Wetlands are significant for both people (food and water security, flood prevention and livelihoods) and Uganda's national bird, the Endangered Grey Crowned Crane (for nesting sites).

The majority of people in Rukiga District undertake small-scale farming, traditionally on the steep valley sides and, increasingly, the wetland valley bottoms. Growing human activity is putting increasing pressure on the ecosystem and cranes, leading to degraded wetlands, fewer cranes and poor soil quality in upland farms. Furthermore, access to health and, in particular, FP services is poor while the need for services is high. The unmet need for FP is estimated to be 30%, with available modern contraceptives only meeting 50% of existing demand.[20]

This was a formative study using qualitative research methods in four parish communities in Rukiga District (Nyakagabagaba, Kitojo, Kihanga-Sindi and Burime), served by the Partnership. All these communities benefit from the Rushebeya/Kanyabaha wetland, which is increasingly under threat.

Data collection

From April to July 2021, five focus group discussions (FGDs) were conducted in each community (28 in total), each consisting of four to six participants, stratified by both gender (male and female) and age (18–25, 25–49 and 50+ years), except for the 50+ years group, which was mixed with an equal number of males and females. Participants were purposively sampled. After the FGDs, 40 Key Informant Interviews (KIIs) (10 per community) were conducted. Participants were purposively selected to represent the different age groups and gender (excluding those who had participated in the FGDs) from the community with the help of community leaders. Written informed consent was obtained from the participants before participation in the study. Experienced qualitative researchers (one male-RM, and three females, GN, PO and US) conducted the FGDs and KIIs, each lasting between 60 and 120 min. The FGDs and KIIs were conducted within the study villages in an environment that was safe for both the participants and the researcher, including schools and church buildings. A semistructured guide was used to gather information on the problems affecting the community and the possible connections between these problems.

Data analysis

FGDs and KIIs were conducted in Runyankore/Rukiga, audio-recorded, transcribed verbatim and translated into English. The transcripts were cross-checked by the researchers (RM, GN, PO and US) against the audio recordings to ensure accuracy. Transcripts were coded manually. Data were organised using Nvivo V.12 and analysis was a combination of deductive and inductive. We used thematic analysis to interpret the data, drawing on the research questions as well as emergent themes.[21 22] The analysis was an iterative process of discussion and revision between the wider research team. The researchers generated a list of recurrent codes by independently reviewing transcripts several times and making notes of key ideas and codes. After completing the initial round of coding, the researchers scrutinised the new codes and comparisons were made to check and ensure consistency. Discrepancies in the coding were re-examined, and an initial coding framework and codebook were developed and used after consensus on the final codes. Data were organised by assembling emergent themes and identifying recurring patterns and categories in context to the research questions. Finally, we used the Model of Human Interaction to help explain and further interpret our findings. We present the overall findings from the FGDs and KIIs organised by the final themes.

Intervention development

Staff from each of the implementing partners (MPT, RH and ICF) worked alongside the research team before any interventions occurred, engaging with communities to participate in the formative research, helping with data collection and participating in extensive discussions of the research findings and the implications for planned programme interventions. Two workshops with staff from each of the implementing partners (MPT, RH and ICF) were held to discuss the research findings' implications for planned programme interventions in health-outreach services, wetland and crane conservation, and sustainable livelihoods activities. Numerous one-to-one discussions were held between the research PI (SM) and staff at MPT (including KL who managed the programme). A number of planned programme interventions were modified, and new ones were introduced as a result of the research.

Patient and public involvement

The design of the project was informed by the long-term working of the partner organisations in the community. This was through community meetings with the different stakeholders at different levels. Besides, the data for this study were collected from the community members who shared their experiences on the problems that they face, the interconnections of these challenges and how they can be addressed. The participants were recruited with the help of the community leaders, some of whom took part in the KIIs. The results have been shared with the community through community meetings and festivals conducted by the partner organisations.

Ethical considerations

We obtained informed written consent from all the participants for those who were literate. For participants who were not, a witness confirmed that they had understood the purpose of the study. The witness was somebody who was chosen and trusted by the participant.

RESULTS

Participants articulated many interconnections between the changing climate, environmental degradation and their health needs, specifically around food security and nutrition and the closely related issues of population pressures and their unmet FP needs.

The Model of Human Interaction with the Environment has four categories as described earlier (source,

sink, life-support and welfare), but these became hard to disentangle in our analysis of multisector issues. We therefore merged themes and presented two overarching clusters of issues. The first shows how natural *sources* of health and income, namely fertile soils and healthy wetlands, are being degraded by changing farming practices (the concept of *sink*). The second illustrates how the degradation of wetland ecosystems (*life support*) affects human health and *welfare*, in particular through contaminated water, dwindling food supplies, and localised population growth.

Degradation of essential agricultural and wetland resources

Erosion and degradation of fertile soils

The communities of Rukiga are agricultural, deriving their income, food and health from the land. They grow crops including potatoes (known locally as 'Irish'), beans, bananas, peas and sorghum, which all rely on healthy soils to produce enough food. Participants explained how changing farming and cultivation practices (clearing vegetation, cutting trees and growing non-native grasses) contribute to degrading soil fertility and increasing soil erosion. When the vegetation cover is cleared on the hillslopes, there is nothing to hold the soil together when it rains, and all the fertile soil is washed away in flooding that can be seriously endangering not only crops—resulting in malnutrition—but also life and making access to healthcare services more difficult.

> In the hills, there are many problems. People with trees in these hills at times cut them because they need money. Consequently, when it rains, soil erosion becomes too much and sweeps away all the hilly soils. (KII-Female-55 years-Village C)

> Most of the time poor feeding is caused by a lack of food; for instance, people don't have where to dig and fail to get food hence poor feeding. (GD-Females-18-25 years-Village B)

> […] If our soils were yielding much, we would have enough food and we would also have some money. (GD-Females-26-50 years-Village D)

Participants said that people cut the trees to find alternative income generation from making charcoal or selling timber. This makes the land more susceptible to soil erosion and flooding, as does a reduction in traditional agricultural practices like trench-digging and growing of native Napier grasses to prevent runoff and soil erosion. These collectively silt up the wetlands.

> In the ancient days, hills were covered by grass and whenever it rained, this grass would help to control the floods but now, they were destroyed. […] floods come and destroy all the crops. For me in my lifetime, I had never seen heavy floods as I see now. (KII-Female-26 years-Village B)

> Because of landslides and floods taking away the top fertile soils, lands no longer yield much. Floods take away all the soil to there in the swamps. (KII-Female-53 years-Village C

Increasing use of fertilisers and agrochemicals has also affected the environment by reducing soil fertility, making crop growth hard without their use. Participants revealed that in the past, people would grow crops organically without spraying because diseased crops were not common. However, today they spray crops that did not previously need spraying, like sorghum. The participants also talked of pesticides contaminating food, causing health problems.

> People in the past did not use fertilizers and pesticides but today, you cannot cultivate without pesticides and fertilizers. The chemicals we use are dangerous to our soils and render them infertile. (GD-Females-18-25 years-Village A)

> The chemicals we use seem to be damaging the environment. For example, when we use fertilisers, crops yield well but when you stop using them, even the little you were getting is no more. (KII-Female-59 years-Village C

Encroachment of wetlands

Over time, the location of farming has changed from the steep hillsides to the valley bottoms as these changing cultivation practices have left upland farms unable to produce sufficient food:

> … people encroached on wetlands for farming. It's only in wetlands where people get good harvests for example Irish potatoes and maize for food and income. (KII-Female-55 years-Village A

Farmers feel they have no option but to cultivate in the wetlands, and some participants acknowledged that the wetlands are now their main—even only—site for the growing of crops and gaining an income because it is where the fertile soils have been washed. Yet, they are not suitable for farming because as rainfall patterns become more unpredictable, they regularly flood:

> We normally cultivate in swamps expecting the dry season to set in as Irish potatoes germinate and start flowering, it abruptly rains heavily and destroys our crops. Then, all the Irish potatoes we had cultivated rot. You find you had hired the garden; you had acquired a loan, and you end up not harvesting anything. GD-Male-26-50 years-Village A)

Encroaching on the wetlands has wider ecosystem effects. Wetlands are the habitat of the critically Endangered Grey Crowned Crane, bringing the cranes into greater proximity to people, with negative consequences. The cranes dwell and breed in the wetlands, but with the increased human activities, they find it hard to breed. They also destroy the crops that are grown in the wetland. This can be a source of tension between conservation and livelihood goals. Participants also noted that sometimes wetlands are burned to enable fishing, especially mudfish (*freshwater eel*), putting further pressure on the wetland ecosystems. Nevertheless, it is important to note that

the participants well understood the importance of the wetlands as a critical part of the ecosystem, controlling flooding and contributing to rainfall formation, which was much needed in the community.

> When it comes to a woman, she is the one now going to cut down swamps to get some grass to use in making mats, which she can sell and get children's school fees. (KII-Female-35 years-Village B)

> Wetlands (swamps) bring rain and hold water not to move at a high speed and thus controlling flooding and erosion. (KII-Male-77 years-Village C)

Thus, communities were aware of the benefits of protecting wetlands but felt they had no choice but to farm there because their arable lands were no longer yielding as they used to and they received no support from government extension workers, either from agriculture or environment. Overall, participants articulated well *how* human practices degrade the environment and affect livelihoods and consequently their health.

Direct and Indirect Impacts of degradation on ecosystems, human health and welfare

Soil erosion to wetlands, floods, landslides

Erosion of soil to the wetlands and subsequent encroachment by farmers leads to the degradation of ecosystem services (cleaner water, reeds for weaving and protection against flooding). Silting with agricultural soils means the natural function of the wetland to filter water and control flooding is incapacitated and other economic activities there are affected.

> Another thing, those who do handcraft like weaving mats, and baskets, and those who keep bees from there get affected. This results in unemployment. KII-Male-67 years-Village D)

It also exposes people directly to health problems including water-borne diseases. The displacement of wetland-dwelling animals like snakes has forced them to move nearer where people stay, increasing the risk of snakebites. Wetland farming also exposes people to malaria (not usually present in uplands):

> Mosquitoes bring malaria. Now, when you are cultivating in that swamp and mosquitoes bite you, you contract malaria. (KII-Female-19 years-Village B)

Soil erosion, floods, and landslides led to road closures, affecting people's ability to sell and obtain food and healthcare.

> If the roads are not worked upon and they are in bad conditions which is an environmental problem, and you get sick from here and you fail to get where to pass and you fail to reach like [Name of hospital] you might die from this side which becomes a health problem. GD Females-26-50 years-Village D)

Landslides and floods also deposit eroded soil into water sources and wetlands, contaminating water for human consumption and putting people at risk of water-borne diseases.

> Landslides are environmental. When they slope down into the valley, they find our water springs and make our water dirty. Now when our water gets dirty, we drink it and get sick. (GD Males 26-50 years-Village B)

> We feed poorly and drink un-boiled water then suffer from typhoid. When you take long without eating, you feel hungry and suffer from ulcers and things like that. (KII-Male-35 years-Village A

Localised population pressure, poverty, violence and poor healthcare

Localised population pressures are reducing available land for farming, meaning people are not able to meet their family's nutritional needs, nor provide income to support healthcare or education for family members. Participants noted they had seen a reduction in available land/farm sizes because of the expectation that children (especially males) inherit their parents' farmland, yet land cannot be continuously subdivided. Consequently, many families have insufficient food because of too little available land.

> It's a problem here. You find a person has around ten pieces of land. He produces like six boys and has to give them where to build. Yet, these boys also want to produce [children]. Yet the children they produce also want to split on the other piece to give them. So, that becomes a problem. (KII-Female-45 years-Village D)

This increases pressure on people (to support their growing families) and their environment, as they search for more land to live on and cultivate.

> Now, when people increase, you see, they come and start cutting down trees to cultivate, they cause deforestation, and this causes lack of rain. […] It prompts people to burn up swamps, others hunt down animals to get what to eat and they reduce. (KII-Male-30 Years-Village B)

Poverty and lack of income also lead to domestic conflict and increased alcohol consumption, as many participants explained.

> Now because of having no other source of income, when a child gets sick, you do not have money. When you fail to get food, you fight with the woman. So, I think failure to get daily income is the leading cause of our problems. (GD Males 23-50 Years Village B)

> Every time, the man is at the bar instead of getting a hoe and going with the wife to dig. […] So, you find the woman working alone to sustain a big family. Their income will reduce. KII-Female-33 years-Village A)

Domestic violence can increase the risk of unintended pregnancies, which is compounded by poor access to FP and quality sexual and reproductive health services, including information on and choice of different methods. The participants narrated that whenever they go to the nearby health centres, they do not find FP

services, and by the time they plan to go to other health centres, the women are already pregnant.

> Only that you find a specific individual has failed to comply with a certain method and does not have another option to use. Some do not know how to use certain methods like condoms. They end up producing eight children complaining that their health has failed to comply with family planning. They used only one method and concluded that they could not manage family planning. (KII Female 46 years-Village B)

> [I]f we had a better operating hospital, these small issues would be solved also. For example, for the women who want to use family planning, you find that at Rwanjula Health Centre, however, no Nurse can insert an IUD in a woman. (FGD Males 26-50 Years Village C)

Furthermore, respondents noted that with their favoured method of contraception (implants), it was often easier to find a healthcare worker to insert it (when implants were available) than it was to find someone to remove it. This is because few healthcare staff were trained.

Overall, the cumulative and inter-related pressures that deplete livelihoods have significant effects on wider society, affecting mental health and gender relations that have serious effects on family and individual welfare.

Using research to inform NGO-delivered interventions

Our formative research findings were specifically intended to inform the development of interventions being delivered by the partnership of NGOs operating in Rukiga District, Uganda. Our findings showed that people in the community were well aware of the interconnected nature of the health, environmental and livelihood challenges they faced and the sources of good health (fertile soils, healthy wetlands, accessible and quality health services). From their descriptions, and informed by the study framework, we mapped out a series of pathways by which their main sources of livelihoods (soils, healthy wetlands) are degraded by human actions leading to soil erosion and encroachment of wetlands (sink and destruction of life support), which in turn has a serious impact on human health and nutrition (welfare). Onto these, we mapped potential points of intervention, based on our findings, depicted in figure 1.

Four intervention points were identified. First, the expansion of sustainable livelihood options and farming practices addresses the farming-related sink/destruction factors in the figure and improves soil fertility (a source). ICF already had a suite of livelihoods programmes, including promoting the planting of local Napier grasses to prevent run-off and flooding; working with farmers to provide sustainable livelihoods (including growing crops more resilient to unpredictable rainfall seasons), preventing tree cutting and promoting wetland restoration and provision of small-group savings initiatives. The formative research was used to shape and tailor some of these interventions, including rewording the written mandates of the savings groups to encompass not only farming but also health uses for the money being saved, ensuring that alternative livelihood options are available to men and women. This was aimed at preventing male livelihoods from being lost and to help

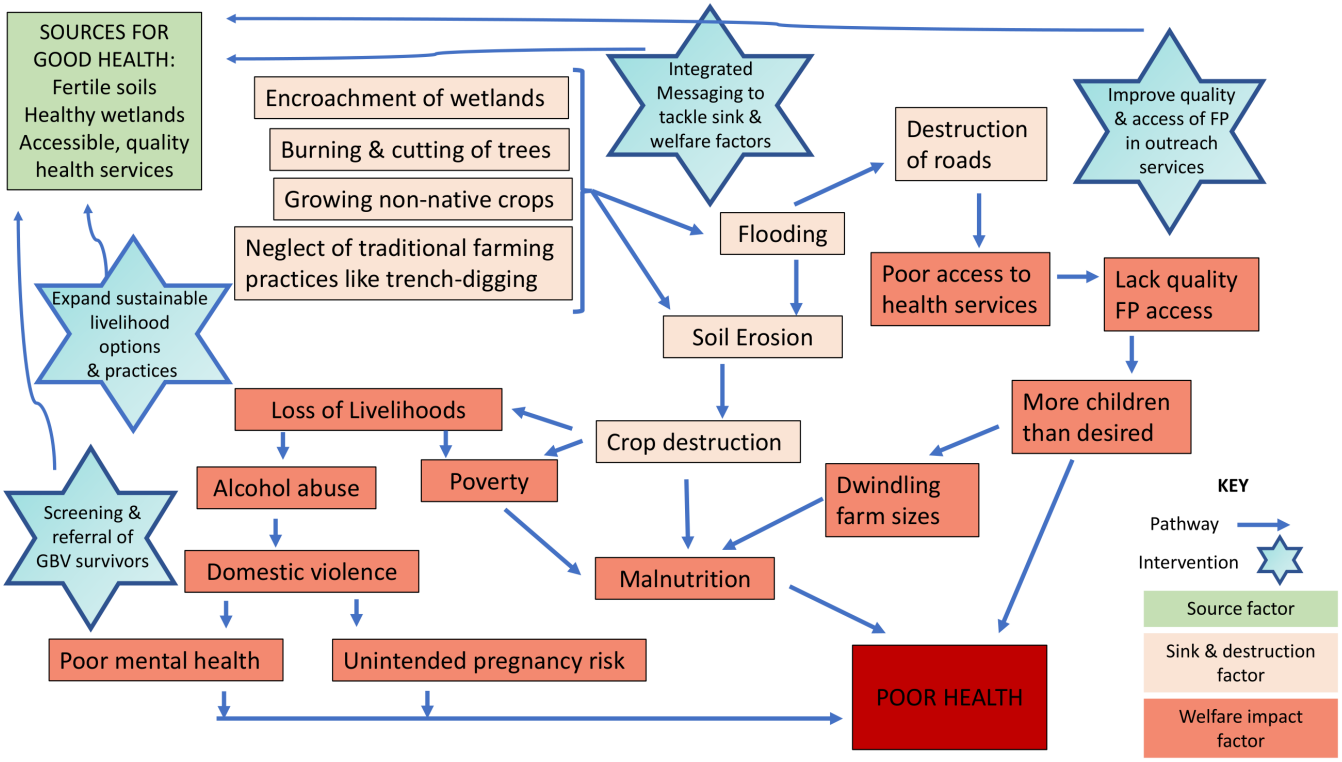

Figure 1 Tackling interconnected challenges: pathways and interventions.

to tackle gender-based violence (GBV). Support was also expanded in partnership with decentralised government actors. Our finding on the absence of agricultural extension workers in study sites, who support wetlands restoration and environmental protection but were not present due to limited resources, was addressed by ICF working closely with the Rukiga District Department of Natural Resources and Production to complement their work by helping to negotiate the development of bylaws that govern the use of hillslopes by communities including digging trenches and planting Napier grass to prevent erosion. Additionally, the implementing partners are working with the subcountry and district agriculture extension officers to train people on sustainable agronomical practices including climate-smart agriculture aimed at increasing the productivity of hillslopes to reduce the need for the communities to expand agriculture to the wetlands.

Second, integrated messaging was developed, based on the communities' understanding of interconnections, on the importance of tackling both environment/livelihoods and FP/health needs. These messages address a range of health (welfare) and livelihood (sink/destruction) factors. The NGO partners and academic researchers held several meetings to discuss key messages and nuances that would highlight interconnections and the importance of a community-wide approach. Partners and academics agreed to a core set of messages on wetland and crane conservation, FP, nutrition, waterborne diseases, sustainable farming techniques, safe waste disposal and soil fertilisation methods. The NGO partners deliver these messages through a range of mechanisms. Posters and written materials are distributed in community clinics, schools and during livelihoods activities. Talks are given by the NGO partners (conservation and health experts) (often together), and drama is performed at health, livelihoods and conservation events as well as in church meetings, schools, community festivals and other local events. The intention is to encourage both men and women to take responsibility both for FP/family health, wetland and crane conservation and undertaking sustainable livelihoods.

Third, improving the quality and accessibility of FP services is a priority for healthcare activities and addresses a critical healthcare (welfare) issue identified by communities. RH and MPT improved the quality and frequency of outreach services and trained all outreach staff on rights-based, quality FP service provision, including the removal of implants. These services are promoted through diverse project activities by the partners.

Finally, addressing GBV through cross-sector interventions also addresses a specific healthcare (welfare) issue that was identified. None of the partners previously worked in GBV, nor was it a planned part of their interventions, and therefore they were advised not to attempt to offer specialist services. However, in discussions, partners did agree to intervene in two specific ways. First, health staff were trained on screening and referral (to other NGO services) of victims of GBV disclosed during outreach services. Alongside this, and addressing the root causes, support for livelihoods opportunities is explicitly being offered to both men and women so that men can also provide for their families.

DISCUSSION

Despite many policies on environmental management in Uganda, the rate at which the environment is being degraded is startling[23] and seriously affects health and welfare. In the absence of existing literature, our findings add to the knowledge base of how environment and health are connected in rural Uganda and how holistic integrated programmes can (and must) address multiple entry points.

Our results are consistent with other studies from Asia and North Africa that found that human activities affect natural resources that in turn affect people's health and livelihood.[3 24] Our study goes further by utilising a framework drawn from environmental science which helped us to map the pathways by which human actions affect natural resources and therefore identify multiple entry points to address interconnected challenges to maximise the benefits to health and welfare. This is an important addition to the literature on multisector action, which is seen as key to achieving the SDGs, addressing social, economic and environmental dimensions of health. Yet, there is a lack of evidence on how to achieve multisectoral action (or intersectoral action, as it is referred to by non-health researchers), particularly in low-income and middle-income countries.[25 26] There have been calls for future research to pay specific attention to the roles of non-state actors and models for mutual learning and implementation research.[26 27] Our analysis provides a direct contribution to this.

In our study, the degradation of wetlands led to immediate consequences for our respondents (flooding, reduction of clean water and increase in disease). It is known that as the environment is degraded, new life-threatening diseases come into play.[28] In Rukiga district, there were previously no cases of malaria, but with continuous encroachment on the wetlands, the breeding areas of disease-causing organisms spread, as is recognised in other studies,[7 24] and this affects the ability of people to achieve sustainable livelihoods[29] and consequently affects their health. Our finding that widespread soil erosion and floods distort the quality of wetland water and exacerbate water-borne diseases is also supported by findings from countries as diverse as China, Chad and the USA.[1 5 30 31] Authors from different countries note that sustained environments can better regulate disease and improve the quality of air,[32] and wetlands are globally important for carbon capture.[33 34]

In our study, environmental shocks affected agricultural production, exacerbating poverty—similar findings are seen elsewhere.[1 6 9] Respondents in our study reported that loss of earnings caused by degraded ecosystems not only increased poverty but also GBV and intra-family difficulties also found elsewhere.[10] As women took over chores (farming; income generation) traditionally done by men, men turned to stealing from their wives—also seen in poor communities in

Bangladesh[35]—and alcohol: poverty and alcohol consumption are known triggers for GBV.[36]

Our study found that limited access to FP services played an important mediating role between environments, livelihoods and health. The lack of FP services led to an increase in unintended pregnancies and larger than desired family sizes in these communities, a factor that respondents saw as responsible for the dwindling farmlands. These farmlands are not able to sustain family members, as other studies have found.[37] Moreover, these pressures contribute to continuous encroachment on the wetlands, which leads to flooding and malnutrition due to low access to food, as has been seen elsewhere.[6 38] Respondents in our study called for improved FP services, in line with a growing call from other authors for increased voluntary rights-based FP services to help adapt to the challenges of climate change and environmental degradation.[14 39 40]

An important aspect of the programme reported in this study was the pre-implementation interaction with community members that allowed the study team to develop integrated messages and targeted interventions to address the challenges identified by people themselves. It is relatively unique for NGOs to start with extensive community engagement and exploratory research. It takes time, commitment and money, but it is critically important for shaping programmes relevant to the beneficiaries' needs. Our experiences hold lessons for the development of future cross-sector programmes. Programmes capable of protecting health in the context of the climate crisis and severe environmental change must be able to address multiple interconnected needs. To design programmes effective in doing this, it is necessary to start by listening to the people affected to understand their views and experiences as well as local opportunities that can be utilised to address the challenges identified. To help other organisations and individuals do this, we developed a toolkit for others to use https://margaretpyke.org/toolkit/?

Study strengths and weaknesses

The community member engagement in the study was an important strength. People were ready to identify the challenges that affect their communities as well as draw the connections between these changes. Their insights paved the way to understanding integrated programming holistically and sustainably. Another strength is that our results represent the views of a wide range of people including age, gender, community and economic backgrounds.

A limitation was that this was rapid research—time was short to conduct in-depth exploratory research that might have further informed programme interventions. The other limitation of the paper was that due to lack of funding, we were unable to share the final causal framework with the communities for their input and approval.

CONCLUSION

In this study, community members were well able to articulate multiple interconnected challenges they faced, enabling the research team to map pathways by which people's main sources of livelihoods (soils, healthy wetlands) were degraded by human actions (sink and destruction of life support) leading to poor health and nutrition (welfare). Using this analysis, the researchers worked with programme implementing partners to identify the most important points of intervention to address multiple challenges. Listening to, then acting on, experiences and views of community members is essential to designing impactful, sustainable programmes to address interconnected health, environment and livelihood needs. Researchers can broker this through formative research and cocreation workshops with local responders. This kind of community-informed, cross-sector programming is essential if health and welfare in the context of climate change and severe environmental degradation are to be properly protected.

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Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by The London School of Hygiene and Tropical Medicine Research and Ethics Committee (24031), Makerere University School of Social Sciences Research and Ethics Committee (MAKSS REC 10.20.447/CR) and Uganda National Council for Science and Technology (HS1137ES). Participants gave informed consent to participate in the study before taking part.

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REFERENCES

1 Onuoha F. Environmental Degradation, Livelihood and Conflicts: A Focus on the Implications of the Diminishing Water Resources

of Lake Chad for North-Eastern Nigeria. *Afr J Conflict Res* 2008;8:35–61.
2 Alam GMM. Livelihood Cycle and Vulnerability of Rural Households to Climate Change and Hazards in Bangladesh. *Environ Manage* 2017;59:777–91.
3 Ayeb-Karlsson S, van der Geest K, Ahmed I, *et al*. A people-centred perspective on climate change, environmental stress, and livelihood resilience in Bangladesh. *Sustain Sci* 2016;11:679–94.
4 Burke TA, Cascio WE, Costa DL, *et al*. Rethinking Environmental Protection: Meeting the Challenges of a Changing World. *Environ Health Perspect* 2017;125:A43–9.
5 Yang T. Association between perceived environmental pollution and health among urban and rural residents-a Chinese national study. *BMC Public Health* 2020;20:194.
6 Hawkes C, Ruel M. The links between agriculture and health: an intersectoral opportunity to improve the health and livelihoods of the poor. *Bull World Health Organ* 2006;84:984–90.
7 Havea PH, Hemstock SL, Combes HJD. Preparing for better livelihoods, health and well-being—a key to climate change adaptation. In: W LF, ed. *Climate Change Adaptation in Pacific Countries*. Cham: Springer, 2017: 87–99.
8 Shahzad L, Tahir A, Sharif F, *et al*. Vulnerability, well-being, and livelihood adaptation under changing environmental conditions: a case from mountainous region of Pakistan. *Environ Sci Pollut Res* 2019;26:26748–64.
9 Yang X, Guo S, Deng X, *et al*. Livelihood Adaptation of Rural Households under Livelihood Stress: Evidence from Sichuan Province, China. *Agriculture* 2021;11:506.
10 Barrett CB, Travis AJ, Dasgupta P. On biodiversity conservation and poverty traps. *Proc Natl Acad Sci U S A* 2011;108:13907–12.
11 Lawlor K, Handa S, Davis B, *et al*. Poverty-environment relationships under market heterogeneity: cash transfers and rural livelihoods in Zambia. *Envir Dev Econ* 2020;25:291–314.
12 Crist E, Mora C, Engelman R. The interaction of human population, food production, and biodiversity protection. *Science* 2017;356:260–4.
13 Aukema JE, Pricope NG, Husak GJ, *et al*. Biodiversity Areas under Threat: Overlap of Climate Change and Population Pressures on the World's Biodiversity Priorities. *PLoS One* 2017;12:e0170615.
14 Mayhew SH, Newman K, Johnson D, *et al*. New partnerships, new perspectives: The relevance of sexual and reproductive health and rights for sustainable development. *Health Policy* 2020;124:599–604.
15 Narloch U, Bangalore M. The multifaceted relationship between environmental risks and poverty: new insights from Vietnam. *Envir Dev Econ* 2018;23:298–327.
16 Waage J, Yap C, Bell S, *et al*. Governing the UN sustainable development goals: interactions, infrastructures, and institutions. *Lancet Glob Health* 2015;3:e251–2.
17 Hahn S, Anandaraja N, D'Agnes L. Linking Population, Health, and the Environment: An Overview of Integrated Programs and a Case Study in Nepal. *Mount Sinai J Medicine* 2011;78:394–405.
18 Hammond AL. Environmental Indicators: A Systematic Approach to Measuring and Reporting on Environmental Policy Performance in the Context of Sustainable Development. Washington D.C: World Resources Institute, 1995.
19 A. Akintunde E. Theories and Concepts for Human Behavior in Environmental Preservation. *J Environ Sci Public Health* 2017;01:120–33.
20 Uganda Bureau of Statistics (UBOS) and ICF. Uganda demographic and health survey 2016. Kampala, Uganda and Rockville, Maryland, USA UBOS and ICF; 2018.
21 Belotto MJ. Data Analysis Methods for Qualitative Research: Managing the Challenges of Coding, Interrater Reliability, and Thematic Analysis. *TQR* 2018;23:2622–33.
22 Braun V, Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006;3:77–101.
23 Rwakakamba TM. How Effective are Uganda's Environmental Policies? *Mt Res Dev* 2009;29:121–7.
24 Shameem MIM, Momtaz S, Rauscher R. Vulnerability of rural livelihoods to multiple stressors: A case study from the southwest coastal region of Bangladesh. *Ocean & Coastal Management* 2014;102:79–87.
25 Amri M, Chatur A, O'Campo P. An umbrella review of intersectoral and multisectoral approaches to health policy. *Social Science & Medicine* 2022;315:115469.
26 Trowbridge J, Tan JY, Hussain S, *et al*. Examining Intersectoral Action as an Approach to Implementing Multistakeholder Collaborations to Achieve the Sustainable Development Goals. *Int J Public Health* 2022;67:1604351.
27 Rasanathan K, Atkins V, Mwansambo C, *et al*. Governing multisectoral action for health in low-income and middle-income countries: an agenda for the way forward. *BMJ Glob Health* 2018;3:e000890.
28 Wesche SD, Armitage DR. Using qualitative scenarios to understand regional environmental change in the Canadian North. *Reg Environ Change* 2014;14:1095–108.
29 Wang W, Zhang C, Guo Y, *et al*. Impact of Environmental and Health Risks on Rural Households' Sustainable Livelihoods: Evidence from China. *IJERPH* 2021;18:10955.
30 Schure MB, Kile ML, Harding A, *et al*. Perceptions of the Environment and Health Among Members of the Confederated Tribes of the Umatilla Indian Reservation. *Environ Justice* 2013;6:115–20.
31 Byron L, Akerlof KL. Climate and health concerns of Montana's public and environmental health professionals: a cross-sectional study. *BMC Public Health* 2021;21:1778.
32 Prato S, Dano E, Zundel T, *et al*. Policies that strengthen the nexus between food, health, ecology, livelihoods and identities. 2018.
33 Bonetti G, Limpert KE, Brodersen KE, *et al*. The combined effect of short-term hydrological and N-fertilization manipulation of wetlands on CO2, CH4, and N2O emissions. *Environ Pollut* 2022;294:118637.
34 Valach AC, Kasak K, Hemes KS, *et al*. Productive wetlands restored for carbon sequestration quickly become net CO2 sinks with site-level factors driving uptake variability. *PLoS One* 2021;16:e0248398.
35 Ahmed I, Ayeb-Karlsson S, van der Geest K, *et al*. Climate change, environmental stress and loss of livelihoods can push people towards illegal activities: a case study from coastal Bangladesh. *Climate and Development* 2019;11:907–17.
36 Vyas S, Heise L. How do area-level socioeconomic status and gender norms affect partner violence against women? Evidence from Tanzania. *Int J Public Health* 2016;61:971–80.
37 Awazi NP, Quandt A. Livelihood resilience to environmental changes in areas of Kenya and Cameroon: a comparative analysis. *Clim Change* 2021;165:1–17.
38 Kaiser ML, Hand MD, Pence EK. Individual and Community Engagement in Response to Environmental Challenges Experienced in Four Low-Income Urban Neighborhoods. *IJERPH* 2020;17:1831.
39 Gaffikin L, Aibe S. Addressing Family Planning Access Barriers Using an Integrated Population Health Environment Approach in Rural Uganda. *Afr J Reprod Health* 2018;22:100–10.
40 Renzaho AMN, Kamara JK, Doh D, *et al*. Do Community-based Livelihood Interventions Affect Sexual and Reproductive Health and Rights of Young People in Slum Areas of Uganda: a Difference-in-difference with Kernel Propensity Score Matching Analysis. *J Urban Health* 2022;99:164–89.