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Living Laboratory: A Model for Co-creation and Sharing Knowledge and Skills in Building Resilient Food Systems. Experiences from Mosop Subcounty, Nandi County, Kenya

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Abstract

Today's unsustainable and inequitable food system demand attention from all stakeholders. Malnutrition is on the rise, the food systems activities are responsible for biodiversity loss, water depletion, and land degradation. The top-down agricultural development research and practices have been increasingly called into question. Living lab as both an approach and a platform for supporting agricultural research and extension advisory services could be applicable in a wide range of settings and diverse actors. The main aim of the study was to investigate whether climate change affects smallholder dairy production in Mosop. The author explores the potential of the living lab model for analyzing and building resilient and sustainable dairy production systems. The study employed case study method in Mosop Sub County. The study used key informant interviews and focus group discussions involving project implementers and beneficiaries for data collection. Mosop subcounty documents the promising climate adaptation strategies promoted by the program for climate smart livestock through the LL model. The findings indicated that climate change is taking place and is already affecting dairy production in Mosop. The adaptation strategies most effective in addressing impacts of climate change on dairy production include; feed conservation especially silage making; use of crop residues (maize stovers) and 24H feed fermentation. The findings also indicated that the principle of inclusiveness, transparence and realism according to the living labs models contributed to project outcomes. The livestock extension officers acknowledged that the social learning happening around the networks of pioneer adopters is an innovation mechanism in and rural advisory and agricultural extension. Both the farmer respondents and livestock officers, further agreed that, if supported and motivated this farmer to farmer horizontal learning is an effective model for scaling locally-led climate change adaptation in agrifood system and environmental landscape. The findings indicate the LL model allows the involvement of a diversity of actors; it allows experimentation in reality thus grounding it to co-creation. However, for LL to thrive, it requires an open mindset and reversal learning especially for the agricultural advisory service providers and researchers. This study recommends that there is a need for designing interventions towards resilient dairy production systems but most importantly, these should account for local contexts, priorities and preferences. This will enhance uptake and adoption, consequently enhancing resilience and sustainability.

Keywords: ***Living lab, food systems, climatic change***

Introduction

The global demand for food is expected to double by 2050. The UN estimates that the world population is expected to increase to 9.6 billion, therefore, Agri-food systems throughout the world are expected to feed this growing population with food which is not only healthy and nutritious, but also sustainably produced (UNDESA, 2013).

To address the effects of climate change on food systems, adaptation actions are in need. Since climate change effects are context based, locally-led climate adaptions are most effective. Lupp, (2020) posits that **a**daptation to climate change is perceived as a learning process, and strategies need to integrate all stakeholders in all levels of development and planning. under this a paradigm shift, societal roles are changing; citizens, private sector and civil society have more responsibility in the spirit of participation. The response to the effects of climate change on dairy production requires actions including changes in roles and behaviors of many different actors in the dairy value chain (Gamache et al, 2020; UNDESA, 2015)

Living labs, have emerged to be one of the participatory approach useful in acquisition of relevant knowledge and skills needed to promote and implement climate change adaptation and mitigation action. This research explores the possibilities of living labs as innovative approach and assess how they can contribute to climate adaption needs (innovation, information, participation and social learning)

What is a Living Lab?

Lab refers to the intentional experimentation as it is done in a laboratory, while living refers to the fact that this is conducted in a real-life setting in contrast to an artificially created space" (ENoLL, 2021). Living labs are therefore presumably geographically or institutionally bounded spaces where stakeholders conduct experimentation for socio-technical innovation together". Generally, "experiments are conducted, monitored, and conducted again with improvements from the previous round, in order to generate useful knowledge in a real-life setting.

Living labs. are defined as "user-centred, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real life communities and settings" (ENoLL, 2021). Living Lab generally stands for an organization of actors dedicated to an open-innovation process with the purpose of building "spaces that facilitate explicit experimentation and learning based on participation and user involvement" (Voytenko et al., 2016). Living labs are presented not only as an approach but also as a concept, a method or a locus of experimentation (Bergval & Stahlbrost, 2009). Living labs are promoted as catalysts to foster interaction between science and society. Living labs allow for the design and testing of prototypes, while enriching the design process by immersing it in the daily life of communities of users (Bergvall-Kåreborn et al., 2009).

While the living lab model was started in the late 1990's, it's significant application has increased only from 2006, when the European Network of Living Labs (ENoLL, 2021) was established, as part of its policy. Living Labs have been used to innovate practices and tools across sectors including health care, urban planning, application design, service delivery and information management and technology (Bergvall-Kåreborn et al., 2009). However, few studies exist about living Lab application in food system analysis in Africa, especially in Kenya (Ondieki & Moturi, 2019).

The Living Lab Model (LL) has been proposed as an innovative approach which utilizes whole system analysis. The living lab outlines a promising framework and approach to tackle food system resilience. Living lab research and practice has grown alongside the acceptance of collaborative and transdisciplinary approaches as effective for addressing complex problems, specifically when dealing with transitions to sustainable, resilient and adaptive societies.

This study explored the use of living lab model with regard to knowledge co-creation processes and social learning and its application in building resilient dairy production systems through locally and farmer-led climate adaptation and action.

The Living Lab Approach

Living labs are physical regions or virtual realities where stakeholders from public-private-people-partnerships (4P) of firms, public agencies, universities, institutes and users, all collaborating for creation, prototyping, and listing and validating new technologies, services, products and systems in real life contexts (Hooli & laldp, 2016). Living Lab Model is inspired by three theoretical scenarios; systems thinking; appreciative inquiry; and need finding. System thinking is involved to understand our own worldview and that of the other stakeholders. Appreciative inquiry encourages research and development practitioners to start the, development and research cycle by identifying different stakeholders and their dreams and visions how research can improve the outcomes of the project (Ondieki & Moturi, 2019). This includes a focus on opportunities, related to specific trends, contexts or user groups.

Bergvall-kareborn et al. (2009), explains three different perspectives to the concept of living lab namely; living lab as an environment, as a methodology and as a system. They argue that all three are rather complementary and not contradictory. The key principles of living ab are value, influence, sustainability, Openness and Realism. Realism LL approach is that innovation activities should be carried out in a realistic, natural real-life setting. Since all stakeholders have their individual local reality, everyone has a potential useful view of how the current situation can be improved (ENoLL, 2021).

Taking the step from participation or involvement to Influence, domain experts and user needs and ideas should be clearly traceable. It is important to understand user needs and motivation as well as how the needs can be met by innovation. Users can also be involved and have influence on Innovation processes for democracy, learning or economic reasons (ENoLL, 2021).

The difference between the living lab and other development approaches is in their focus on the vertical value-chain in which customers, producers and suppliers are involved (Compagnucci et al., 2021). The Living lab approach does not only aim at involving end users in the development processes, but also strives to facilitate the interaction between other relevant stakeholders, such as research organizations, companies, public sector and society as a whole (Voytenko, et al. (2016).

From the process perspective, Living lab is an innovative platform it encompasses two ground breaking ideas. First, managing a multi-organizational, inter-disciplinary collaboration for innovation and secondly, engaging intensively with end users (methodological and instrumental challenge). The strength of the living labs approach arises from combining stakeholder participation and end user involvement with a high degree of exploration and flexibility (Cunningham & Cunningham, 2016).

The democratic element in this method is significant as the various interests, perspectives and types of knowledge can be involved as part of the co-creating process towards improving sustainability challenges (Voytenko, et al. 2016).

Secondly, LL can address challenges and develop solutions for complex problems facing agri-food ecosystems. This is achieved by using multi-pronged approaches, maximizing the combined expertise of all participants and empowering them to work together in equal, meaningful and productive way. Living Labs can be a vehicle for the contextualization, democratization and strengthening of the food systems (Ondieki & Moturi,2019). By co-designing and co- developing agricultural research and advisory activities, and engaging trans disciplinary approaches that integrate participants with expertise in natural and social science disciplines, LL platform be used; first, to gather data on multiple dynamics at play in the performance of food system activities, drivers and outcomes and in the dissemination of result (Compagnucci et al., 2021)

Lastly, LL could build a community of trust between participants from various backgrounds, including producers, scientists and other interested parties. Thus, increasing participant engagement in LL activities and outcomes (Compagnucci, et al., 2021). In addressing food system challenges, participants are engaged in all phases of the project, including the identification and selection of problem issues, implementation of activities, monitoring, and evaluation of the process. This could improve the utility, effectiveness and adoption of agricultural practices and technologies through a user-centric innovation process.

Elements of Living of Lab

Living labs are contextualized in real life environment where activities are conducted. The end users and stakeholders are engaged in the activities. Real life environments incorporate daily life and everyday settings and experiences (ENoLL, 2021). Therefore, the LL model can be described as an innovation ecosystem anchored in the open innovation and user-oriented innovation approach, with the main focus on active user engagement and stakeholder participation.

Living lab are co-designed by the research partners with local communities and relevant stakeholders taking into account local culture, knowledge and traditions as well as the new possibilities offered by research, technology and innovation (**Ingram, 2018**). Hence, the LL provides a platform for co creating innovative solutions with end users by enabling them to reflect upon the lived experiences.

Given that living lab approach has been successfully applied in other fields to address complex issues. The use of living lab can lead to similar success in agrifood system. This paper presents a case study application of LL approach in a climate smart livestock program in Mosop sub county, Nandi County.

This research paper investigates the characteristics of living lab approaches that support the development of climate adaptation practices and more sustainable local agrifood systems. Specifically, the guiding objectives in this paper are; to explore the defining principles of living labs, and find out the possible contribution of living lab approach to climate adaptation in the dairy production sector in Mosop Subcounty, Nandi County.

Methodology

The study was conducted in Mosop Subcounty, Nandi County. This location was selected because 92 percent of the households own a dairy cow and agriculture is the main economic activity. Dairy is the leading sector in terms of employment, income earnings and overall contribution to the socioeconomic wellbeing of the locals. The data collection methods employed for the study were key informant interviews and focus group discussions. This involved the program for climate smart livestock project implementing personnel and project beneficiaries. Eight key informant interviews were conducted, this involved interviewing the two livestock production officers, three ILRI researchers and three farmers (pioneer adapters). Three focus group discussions with beneficiary dairy farmers were conducted. Both the key informants and focus group discussions focused on three questions:

1. How is climate change affecting dairy production in Mosop subcounty?
2. How did the program for climate smart livestock address the effects of climate change on dairy production in Mosop?
3. What was the contribution of the of the living lab approach in implementing the program for climate smart livestock project?

Findings

Climate Changes in Mosop Subcounty

According to the key informants and focus group discussion participants, the study area is already experiencing climate change. Climate change perception by the farmers indicated that they have already experienced prolonged dry spells and extreme temperatures. They all had witnessed increased number of months without rainfall from three to five months. The extreme temperatures are highest in January to March and lowest in July to August. All these changes affected smallholder dairy production in the area. The respondents noted that there was cattle mortality and reduced milk production during the prolonged dry spell, as a result feed shortages and heat stress. Other negative impacts caused by climate change reported in the dairy production enterprise in the community included inadequate livestock feed due to prolonged dry spells, livestock deaths during the dry season; abortions and still births and emergence of new livestock diseases. Discusants also opined that reduction in milk production during the dry spells most affected their socioeconomic welfare.

Living Lab Model in the Program of Climate Smart Livestock Project

According to the key informants who were implementers of the project of climate-smart livestock, it deviated from the conventional top-bottom approaches of research-extension-farmer methodology. The program promoted the farmer-led participatory research and extension which is utilized the LL model. The project of climate smart livestock utilized the LL approach to develop climate adaptation practices in dairy production. This was done by close involvement of the stakeholders and farmers who are the end users of these technologies.

The process of implementing the living lab innovation model in Mosop Subcounty followed the following steps:

1. Identifying the living lab learning site
2. Identifying the living lab actors/partners
3. Mapping the living lab actors/stakeholder
4. Conducting sensitization forum
5. Establishing shared roles for the actors
6. Testing of existing/emerging climate adaptation strategies at the learning sites

In choosing the innovation space, the farmers from the locality who were positive in terms of technology adoption were selected by the community members. Three farmers were chosen to host the living lab activities. These farmers are called pioneer adapter farmers. Demonstrations, field days, trainings, social network meetings and data collection were conducted in these farms.

Climate Adaptation Strategies Co-created, Tested and Promoted in the LL in Mosop

During the experimentation phase, the Participants agreed to test and evaluate existing strategies/practices to address feed shortage and periodicity in the locality. The key informants reported the following to have been used by the positive deviant farmers to curb the challenges of climate change in their farms; 1). Silage making; 2). Rotational grazing; 3). Use of maize stovers; 4). Use of Total Mixed Ration; and 5). 24 Hour fermentation of feed. The focus group discussion revealed that silage making, use of maize stovers and the 24H feed fermentation were the most effective strategies in navigating the effects of climate change on smallholder dairy production in the study area.

Scaling out Adaptation Strategies in Locally Led LL Model

During the scaling phase the pioneer adapters took the lead by developing their social networks. A social network consists of members of the community who interact regularly and share a common interest. The technologies and practices for adaptations diffused throughout the villages via the social networks. According to the village administrators, most of the households in the proximity of the pioneer adopter farms have adopted the feed conservation technologies especially silage making, fodder establishment and urea treatment of maize stovers.

According to the extension officers, the project and associated institutions provided a platform for farmers to strengthen their capacities through mentorship and linkages to support chains services including input suppliers, markets, and other support services. The processes supported the adoption and scaling of the adaptation strategies aimed at building resilient and sustainable dairy production systems.

The key informants (livestock extension officers) acknowledged that the social learning happening around the networks of the pioneer adopters is an innovation mechanism in rural advisory and agricultural extension. Both the farmer respondents and livestock officers, further agreed that, if supported and motivated this farmer-to-farmer horizontal learning is an effective model for scaling locally-led climate change adaptation in agrifood system and environmental landscape.

Discussion

Livestock production especially dairy production is a vital part in economy of Mosop Subcounty, Nandi. However, sustaining the dairy productivity throughout the year is a challenge in the rainfed system practice by the dairy farmers in the area. This is aggravated by climate change. Interventions in climate-smart livestock require prioritization to identify the context specific practices and technologies for the dairy value chain.

Climate smart livestock is a livestock system that is resilient to climate change and offer efficient mitigation potential without compromising livestock productivity, food security and livelihoods. The main principle of climate smart livestock is efficient use of natural resources and protecting livestock from adverse environmental impacts (Giro & Kumar, 2022).

From the findings, it is confirmed that climate change is taking place in Mosop Subcounty and its effects have been felt mostly by smallholder dairy farmers. Analysis of this study of climate smart livestock project implementation has led to grounded understanding of three critical factors for effective implementation of climate smart livestock production projects to address climate change impact on smallholder dairy production: 1). Building strong partnerships to co-design and develop interventions that improve resilience and sustainability; 2). Capacity strengthening of key stakeholders - farmers, extension agents and research students in the process; and 3). Social learning mechanisms are grounded in LL approach since farmers adopt the climate smart practices from their peers. This is in agreement with the elements of the LL approach (Hooli, 2016; Bergvall-Kåreborn & Ståhlbröst, 2009).

Findings from the study agree with literature of El Bilali (2018) and Bergvall-Kåreborn et al., (2009) that living lab as social innovation dimension seek to involve citizens in local climate adaptation. The development of niche innovations within the framework of the LL lends particular importance to the relationship and cooperation between local actors (Ingram, 2015). Emphasis on locally-led climate action through collaboration with other stakeholders in co-creation empowers the end users, for example, the pioneer adapters have been able to create their social networks and are offering farmer-to-farmer extension services. The model farms

(living labs) act as learning environments to build adaptive capacity, this led to creating resilient livelihoods and communities. The main goal of the program was to create local solutions from local experiences for the local people.

The learning experiences from the particular pioneer adopter farms were replicated in other farms in the communities thus scaling. This confirmed the elements of the living lab were also at play: knowledge production, prototyping; and learning; multi-stakeholders; user involvement and engagement (Cunningham & Cunningham, 2016**;** Ondieki & Moturi, 2019**)**.

However, living lab as an approach requires time as social processes develops slowly and engaging with many stakeholders with divergent views is also a challenge. There is a positive enablement of institutions and social innovation, broad participation and collaborative learning as evidenced by emerging local engagement platforms including - farmer social networks, model farms and adaptive technologies. This has strong linkage to sustainability of the program gains even after the exit. Transition towards climate resilient agrifood systems aims moreover to empower actors to transform their environment. It allows citizens to negotiate the rules of governance of their agrifood systems, and to participate in decision making on the direction to choose (El Bilali et al. 2018). According to Gamache et al. (2020), transition of agrifood systems is accompanied by a political issue of citizen empowerment. In this respect, the citizen-centric living-lab is an interesting tool to allow the involvement of actors who are currently not necessarily integrated into the decision-making process. In this case study a social network of dairy farmer group emerged and this is used for advocacy and voicing what their needs are. Through the farmer led extension processes the adaptation practices are spreading hence the LL model is supporting the production of contextualized, actionable knowledge to contribute to inhabitants' empowerment and the concrete transformation of dairy production in tandem to the changing climate.

Conclusion

This study concludes that the climate in Mosop Subcounty is changing and the smallholder farmers are most affected.

Recommendations

In order to address the impact of climate change in the study area adaptation strategies are in needed. The innovation LL model presents an opportunity to leverage its methodological framework to engage local dairy value chain actors to co-create, test and promote adaptation strategies against climate change. These range from idea generation (ideation phase), experimentation (concept phase), to prototype development and Testing and validation (development phase). The greater the level of participation during the innovation LL model, the more effective the diffusion and adoption of these strategies. For the policy makers in the county government of Nandi, dairy sector stakeholders and service providers, this paper recommends that incorporating LL principles in both in policy making and practice can improve the outcomes of interventions towards a sustainable and resilient dairy production sector.

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