Modeling a Sub-National Agroecology Policy for Sustainable Agriculture: The Case of Vihiga County, Kenya.

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ABSTRACT

Vihiga is a densely populated county in western Kenya (1047 persons/sq.km) with a peri-urban agriculture landscape and limited land carrying capacity. Sustainable agriculture and Agri-food systems using agroecology principles, is hence critical for reducing poverty, pressure on land and natural resources especially soil, while curbing loss of biodiversity. Due to lack of policy guidelines on agroecology, both biodiversity and livelihood of people within the county and the entire region is compromised. The objective of this paper is therefore to contribute towards transformation of local Agri-food systems through participating in and informing policy processes for an Agroecology action, to enable small-scale producers strengthen their practices of regenerative agriculture. Deployment of context-specific technologies is hereby proposed for Agroecology principles to be mainstreamed in relevant line-departments and agriculture sector work plans, because of their holistic approach to sustainable agriculture, while emphasizing on soil health, social inclusion (equity), better access to knowledge and support services. Using interdependent processes of evidence-based policy (EBP) and multi-stakeholder engagement according to Weiss's typology and review of twelve (12) similar policies or regulations in existence, ten (10) broad policy strategies on Agroecology are identified for local adaptation. The resulting policy initiative provides a roadmap for sustainable agriculture, using Agroecology approaches in farming some of which have historically been practiced through default by farmers. Further, with co-creation of existing knowledge and equity, agroecological production systems are promoted by use of digital technology to attract youth and women with limited access to arable land, for a wider community participation.

Key Words: Agroecology, Sustainable Agriculture, Agrobiodiversity, Agri-Food Systems.

INTRODUCTION

Globally, it is now recognized that a major transformation of food systems is needed to achieve food and

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nutrition security against the background of changes in population, income, technology, climate, and other drivers such as policy and socioeconomic interactions (HLPE, 2017). This will profoundly affect what people eat, as well as how it is produced, processed, packaged, and transported from farm to fork. Bringing about such transitions to more sustainable agricultural systems that reconcile human and environmental health with social justice, requires full implementation of agroecology practices, and this will not happen without major shifts in public policies and partnerships (Sinclair *et al.*,2019).

Agroecology has gained interest worldwide among a wide range of actors, including grassroots social processes for sustainability and in the public policies of many countries around the world (Gemmill-Herren *et al.*, 2023). Agroecology is a social movement, practice and science intertwined (Wezel *et al.*, 2009; Altieri & Toledo, 2011). It aims to build and enhance our complex agriculture institutional framework and Agri-food systems in the process. This tripartite conceptualisation of agroecology requires a fundamental change of policy and research agenda in order to achieve the desired impacts. In China, successful deployment of the circular economy-oriented ecological agriculture (Fan & Fang, 2020) promotes the acceleration of agriculture technological progress, facilitates the adjustment of rural industrial structures, expands the scale of modern agriculture and broadens the employment space in peri-urban and rural areas (Guo, *et al.*, 2023).

Although agroecology as a concept is quickly gaining ground as an alternative solution to the myriad of challenges facing current Agri-food systems, only a handful of countries have developed and are implementing agroecology policies. Even fewer sub-national jurisdictions have prepared such policies. This paper reviews the process and lessons learnt from Vihiga county of Kenya. Drawing on international best practices, and in tandem with national strategies, the **main objective** for this study is to model an Agroecology policy for sustainable agriculture and food systems. The policy aims to facilitate greater integration of agrobiodiversity in food systems using mainly regenerative agriculture (RA), by promoting nature positive landscapes, community seed banks and consumption of safe foods. The **Specific Objectives are** to **i)** Assess the suitability of existing policies that impact on sustainable agriculture and help to develop a context-specific Agroecology policy model for implementation in the Agri-food systems of Vihiga county in Kenya; **ii)** Co-creation and communication of knowledge through peer-to-peer learning, participatory validation of Agroecology principles depending on local context and capacities; and **iii)** Increase awareness on the need for government and non-state actors to increase investment in Agroecology.

In order to promote Agroecology principles (HLPE, 2019) in sustainable production systems with a focus on regenerative agriculture, strategies are needed that can feed into a larger regional policy-led design (Tittonell *et al.*, 2022; Day & Cramer, 2021; Giller *et al.*,2021)). Currently, there is lack of a comprehensive national policy framework to guide the mainstreaming of agroecology into the county integrated development plans (CIDPs) in Kenya.

Through co-creation of production and local knowledge for trade-offs, a 'Safe food-environment-market' oriented policy framework (Place *et al*, 2022) is hereby proposed for Vihiga County. Together with public-private partnership (PPP) support to agroecology, the proposed policy has potential of rapidly enhancing uptake of new technologies and value addition, while preserving traditions which positively impact on resilience. This includes more utilization of traditional and safe food, ALVs, edible fungi (mushrooms) and their end products after value addition. Furthermore, land tenure policies are also important for incentivizing agroecology because they enshrine clear long-term rights to land, favouring the adoption of many agroecology principles (Holden *et al.*, 2013) and ensuring market stability of end products.

As a densely populated peri-urban county, many people in Vihiga county are at risk of endemic food poverty and/or safety, high post-harvest losses and soil degradation, thereby raising policy concerns about the ability of the current food system to sustain livelihood with the increasing population. Integration of Agroecology principles in farming for a circular economy and increased awareness on human health

benefits and consumption of safe food, particularly ALVs will greatly be enhanced. This is because ALVs are often cultivated without the need for external input application. Given that several agroecology-related functions are devolved in Kenya, a policy intervention strategy will guide regulation and other actions at the county level. This is critical because there are a significant number of policies and strategies that appear to be conflicting or in need of harmonisation for synergy, while addressing the issue of sustainable agriculture.

Furthermore, insecure long term access to land has been observed for women and youth, thereby creating challenges for agroecology due to unfavourable land tenure systems for sustainable agriculture. Due to the average small farm sizes in Vihiga county and the limited access to land for women and youth, digital technology can provide decent work opportunities and public participation to attract more youth and women. This will be critical for social inclusion hence a wider community and multi-sectoral engagement along value chains. Furthermore, it will promote strong linkages between different institutions and clients on public-private-partnership (PPP) models and ensure a holistic value-chain development for the Agroecology sub-sector.

Sustainable agriculture policies in Kenya collectively provide a framework for the adoption of Agroecology principle elements, with such provisions as seed diversity from indigenous sources, organic inputs subsidy, training, capacity building, capital investment and other support for farmers and value chain actors. However, there is an apparent conflict of interest or lack of synergy, with no explicit policy on Agroecology that links producers and consumers in a stable Agri-food system, while addressing such aspects as soil health and other nature positive interventions.

A policy for Agroecology in Vihiga as hereby proposed, will specifically target sustainable landscape management to regenerate soil health, ensure food safety, promote intercropping and shrub domestication, while optimizing or reducing the reliance on external inputs in agricultural production.

AGROECOLOGY, POLICY, AND PRACTICE

Agroecology and its Emergence

Agroecology innovations are based on co-creation of knowledge, combining science with the traditional, practical and local knowledge base (FAO, 2018), and an enabling policy environment (Place *et al.*, 2022). Many studies have reported on the positive effects of Agroecology practices on sustainable agriculture (Altieri, 2018) as they relate to food security and production, biodiversity conservation and ecosystem services (Barral *et al.* 2015; Bezner Kerr *et al.* 2021). However, insufficient government action through appropriate policy or adoption at scale and in a transformational way (Sinclair *et al.*, 2019) is one of the main factors impeding transition to Agroecology, leading to loss of biodiversity and ecosystem functions.

Regenerative Agriculture

In recent times, regenerative agriculture (RA) has gained increasing attention in scientific literature (Rhodes, 2017; Day & Cramer, 2021; Giller *et al.*,2021), and global attention (Tittonell *et al.*, 2022) from practitioners, producers, retailers, consumers, researchers, civil society, non-governmental organizations and policy makers in various contexts. Yet RA still lacks a universal description. In the context of Agroecology, RA has no consistent, legal or regulatory definition for use in a policy framework, but the Intergovernmental Panel on Climate Change (IPCC) listed regenerative agriculture as a "sustainable land management practice" focused on ecological functions that "can be effective in building resilience of agro-ecosystems" (Olsson *et al.*, 2019). Rhodes (2017), defined RA as an alternative means of producing food that may have lower—or even net positive—environmental and/or social impacts by using principles of Agroecology. In the context of this paper, RA is both a process and an outcome (Newton *et al.*, 2020), and refers to a sustainable agriculture production system involving intercrops, minimising tillage, improving soil health,

enhancing agrobiodiversity and market access to safe food.

Agroecological Approaches to Policy Formulation: An Analytical Framework

Policies specifically designed to enhance sustainable agriculture through Agroecology practices have been reported in very few countries including Brazil (Niederle *et al.,* 2020), France (Hubert and Couvet, 2021), Senegal (Boillat *et al.*, 2021) and Ghana. However, despite several policies that support Agroecology, there are equally many other stronger policies or investments like input subsidies (Jayne *et al.* 2018) that may work against the practice of agroecology (Sinclair *et al.* 2019). Available literature has demonstrated the existence of policies whose effects are cancelled by others, for example, some rural credit programs encourage the purchase of agrochemicals, while other programs stimulate the production of organic inputs (Place *et al*., 2022).

There are thirteen (13) principles of agroecology (HLPE 2019) and 10 elements of agroecology (FAO, 2018) that can guide in designing a policy road map for implementing the transition to sustainable food and agricultural systems. These are :-recycling; input reduction; soil health; animal health; biodiversity; synergy; economic diversification; co-creation of knowledge; social values and diets; fairness; connectivity; land and natural resource governance; participation (Wezel *et al*., 2020). Furthermore, all the elements of Agroecology are interlinked and interdependent (FAO, 2018), and agroecology can thus be described as the ecology of the entire food system.

Given that consumers are increasingly demanding safer food and a closer connection to food producers at the bottom of each value chain, agroecology is an approach to transforming the food system for sustainable agriculture and provide environmental benefits and social capital. Thus, there are many policies in sustainable agriculture that may not mention agroecology specifically, but incorporate instruments to support agroecological principles or practices and therefore are in support of agroecological transitions (Place *et al.*, 2020). In addition, it is not common to find a single set of policies that address challenges or opportunities with food and nutrition security, food safety (or public health), the environment (or Soil health), social inclusion and regenerative agriculture (RA) in one stop.

Full implementation of Agroecology principles, also entail various RA practices and processes that differentiate it from conventional agriculture (HLPE, 2019), through other facilitative processes like awareness creation. Overcoming challenges and seizing of opportunities in Agri-food systems transformation requires continued efforts to provide robust analysis to inform decision making (Chan *et al.*, 2021).

Consequently, a key component of the policy formulation process is sensitisation of stakeholders to enhance knowledge dissemination and evidence base on agroecology. Other studies further indicate that awareness creation through Community Mobilization and Sensitization (CMS), is a prerequisite for better understanding and devising adoptable policies (Adhikari *et al.*, 2022) including for Agroecology and their sustainable application. An effective CMS as a continuous process will result in attitude and behavioral changes at individual and community level and brings about permanent change in action. The CMS also avoids duplication and checks on conflict of interest, while keeping in mind the seasonal calender of activities, tradition and culture of the target area and community.

For effectiveness, Maughan & Anderson (2023) suggest that the policy should improve coordination and inclusivity of efforts in seeking to promote regenerative agriculture practices, by setting up local networks, bringing together innovative farmers for participation, extensions officers for co-creation and participatory research, and other relevant actors to promote delivery of shared knowledge on Agroecology. There is also need to strengthen coherence, partnerships and synergy between the promotion of agroecology and other related or complementary policies (such as in Agroforestry, Environment, Public Health, Climate Change)

that impact on sustainable agriculture, while taking cognizance that they may differ in the way they incorporate food security and nutrition issues within their respective approaches.

There are four broad categories of policy frameworks relevant for agroecology: 'producer-oriented policies,' 'consumer-oriented policies', 'trade-oriented policies,' (Place *et al*, 2022) and a 'market-and food-environment-oriented policy' (HLPE,2017). The significance of the latter policy framework for Agroecology lies in its capacity to strengthen investment and innovation in micro, small and medium sized enterprises that support sustainable agriculture and food systems; add value locally; provide ecosystem services and create an enabling environment or incentives for young people to remain in rural areas, (Place *et al*, 2022) and can moderate rural-urban migration in context of Vihiga county. These policy frameworks will holistically support production, provide agricultural input measures that support regenerative agriculture, in line with the recommended FAO food systems framework (HLPE, 2017).

Evidence-Based Policy (EBP) Formulation

Agricultural policymakers in Kenya often seek policy options based on evidence-based analysis to promote agricultural transformation. However, the multiple conceptual models of policy-making confirm it is both complex and dynamic, and influenced by various actors, environments, choices, and constraints, given that evidence is also rarely the sole impetus for a policy change (Fedorowicz & Aron, 2021). The Organisation for Economic Co-operation and Development, defines evidence-informed policy making as "a process whereby multiple sources of information, including statistics, data, and the best available research evidence and evaluations, are consulted before making a decision to plan, implement, and (where relevant) alter public policies and programmes" (OECD, 2020).

In the case of evidence-based policy (EBP) formulation, framing and assessing the core evidence is fundamental to the ability of research to support public policy (Phillips *et al.*, 2020), and there is potential for bias or compromise with policy makers in the process of identifying the precise evidence from research needed for policy development. The various models by scholars proposed for bridging research-policy gaps, include the *engagement model* of research-policy relations, which encompasses the 'interactive' process in Weiss's typology (Omari, 2018).

In the *engagement* model (Omari, 2018) with stakeholders, linkages between researchers and policy-makers are participatory and multi-dimensional; and the purpose of the targeted research is to co-create and transfer knowledge including from secondary sources that impact on policy issues in an interactive manner. Furthermore, Oliver & Boaz (2019) reported that little empirical data for analysis and validating the processes or impact of evidence used in policy formulation, is often available to inform researchers or decision-makers in steps of policy development.

METHODOLOGY

Study Site

Vihiga County (Fig. 1), is located within the upper midland and lower midland agro-ecological zone (AEZ) of Western Kenya – Upper Midland (UM_1) and Lower Midlands (LM_2) – (Jaetzold *et al.*, 2010). The area is nestled between the degraded Maragoli hills to the south and a significant portion of the southern block of Kakamega Forest ecosystem, the only remaining Guinea-Congolian rainforest in Kenya that supports a rich biodiversity portfolio. The county lies at Latitude: 0° 03' 60.00" N and Longitude: 34° 39' 59.99" E.

Two study sites of Muhudu and Mungoma Wards in the UM_1 and LM_2 respectively were used for intercropping trials (Table 3) and soil testing to validate the need for an agroecology policy, as part of a wider study on sustainable agriculture. The study embraced the Agroecology nexus approach as described

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variously by several authors (El Bilali, 2019), in an integrated manner considering multiple variables simultaneously. Selection of the intercropping components was based on their profile from characterization, maturity period and distinct agroecological traits from secondary data, such that intercropping represented an Agroecology potential for a favourable outlook in functional biodiversity, relative to respective mono crops.

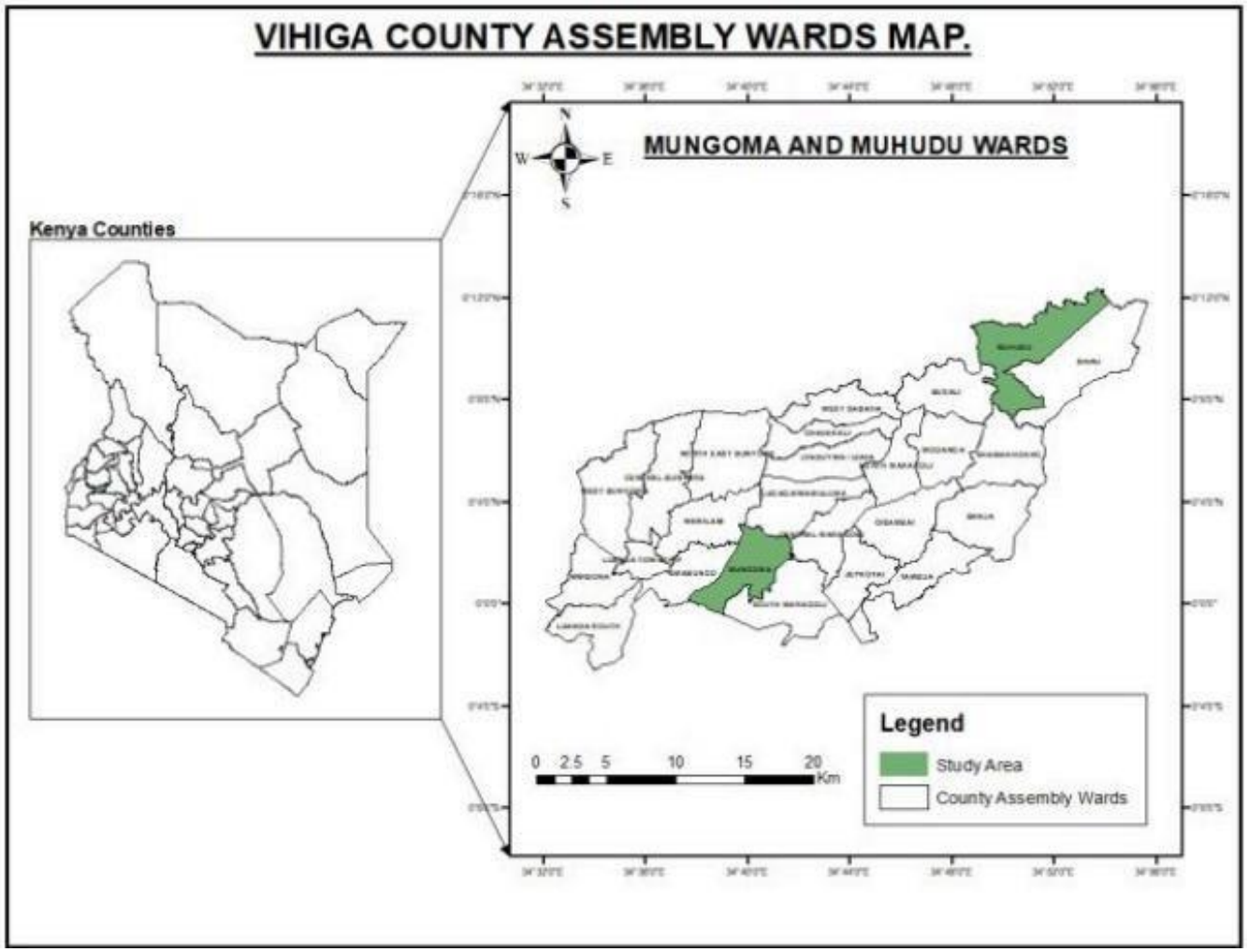

Fig 1. Map of the study area showing the location of Vihiga in Kenya and the study sites for soil testing

Table 3: Intercropping Trial

Treatment	Cropping Pattern	Intercropping Series
1	Camphor + Nerica Rice	Replacement
2	Camphor + Maize	Replacement
3	Soyabean + Nerica Rice	Replacement
4	Soyabean + Maize	Replacement
5	Camphor + Maize + Cowpeas	Mbili-Mbili
6	Soyabean + Maize + Cowpeas	Mbili-Mbili
7	Camphor Sole Crop	Additive
8	Soya Bean Sole Crop	Additive
9	Cowpeas Sole Crop	Additive
10	Nerica Rice Sole Crop	Additive

11	Maize Sole Crop	Additive
12.	Maize + Beans+ Cowpeas	Mbili-Mbili

N/B: Mbili-Mbili: Paired row planting arrangement.

Vihiga Agroecology Policy Formulation and Data Collection

The Agroecology policy for Vihiga was formulated in accordance with evidence-based policy (EBP) stakeholder engagement model (Omari, 2018) of bridging the research-policy gaps. A literature search was done on existing policies, regulations and Acts that impact on sustainable agriculture in Kenya with specific reference to soil health.

Step 1. As a *first step,* the focal entity (County Department of Agriculture in Vihiga) identified the need for an Agroecology policy to address key thematic areas of Agri-food systems impacting on the population, and factored it in the County Integrated Development Plan (CIDP) of 2023-2027. This is a prerequisite for initiating any policy intervention for rural development in Kenya. A technical panel of officials from the focal entity, Environment, Health and Social Service departments, as well as partners including Bioversity International, Rural Outreach Africa, Seed Savers, Practical Action, KALRO Kibos and Masinde Muliro University of Science & Technology was thus constituted in January 2023, by the County Executive Member for Agriculture (CECM) to midwife the process of formulating the County Agroecology policy from draft zero.

The technical panel mapped key stakeholders for on-boarding and moderated the first stakeholder inaugural meeting. Other external facilitators with interest in the Agroecology movement like the Intersectoral Forum on Agroecology and Agrobiodiversity (ISFAA) domiciled at the State Department of Agriculture-Nairobi, PELUM Kenya and Maseno University through the RUFORUM project, were subsequently involved in facilitation mainly through capacity building, benchmarking and backstopping of the technical panel and the entire process for a seamless flow of planned activities. This entailed extensive consultations and further networking with the stakeholders in Agroecology and sustainable food systems, regionally and at the national level on diverse dates from 5th December 2022 to 15th December, 2023. Significantly, the focal entity went for benchmarking to agroecology hotspots of Uganda, and Muranga County of Kenya with a group of farmers in June and September 2023 respectively, with facilitation of PELUM Kenya. Continuous stakeholder engagement was employed concurrently to keep abreast with trending Agroecology issues, and in particular to align with the draft national strategy on Agroecology for food system transformation strategy, 2024 – 2033.

The stakeholders' fora for consultations were facilitated variously by several partners including PELUM Kenya, Bioversity International & CIAT, Biovision Africa Trust, Food & Land Use Coalition (FOLU)|AGRA, Practical Action, RUFORUM and Seed Savers Network. Each forum had specific points of agenda as a build up from the inaugural and subsequent meetings. There were a total of seven (7) consultative meetings, eight (8) key informant interviews and one (1) Focus Group Discussions.

Concurrently, there were two (2) field trials supported by the alliance of Bioversity International & CIAT for soil testing, intercropping and shrub characterisation and domestication, as a means of quantitative assessment of the challenges and opportunities of implementing an Agroecology policy. Subsequently, five (5) validation workshops were held at Vihiga (Sosa)-2, Nakuru (East-Mark)-1, Eldoret (Starbucks)-1 and Kisumu (Cialla Resort)-1, to result in the draft Agroecology policy in readiness for public participation.

As required by law, public participation was inculcated in the entire process towards full realisation of the draft policy, specifically after the end of the fourth validation exercise. Upon completion, the draft policy was subjected to a technical and peer review mechanism for final validation by the line departments of

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Agriculture, Health and Environment, before submission to the county executive committee for consideration and further guidance in enactment of laws and regulations by the County government. Upon approval of the policy by the county executive, an official launch and dissemination to the public is envisaged for political by-in, public support and ownership.

Step 2. The *second step* which is complementary to the first step, entailed several activities either concurrently or in succession, and were undertaken with a view to model an Agroecology policy adapted to Vihiga county :- Community Mobilisation and Sensitisation (CMS) according to Adhikari, *et al.*, (2022) in 25 administrative wards of the county equitably, as well as training of 30 public extension officers in agroecology principles and practices of regenerative agriculture using Rapid Rural Appraisal (RRA) tools, with the support of Practical Action. These activities directly engaged each of the 4 major communities resident in Vihiga County (*Maragoli, Bunyore, Tiriki and Terik*), through youth mentors in a participatory manner to identify and document geopolitical priorities, resources, needs and solutions in such a way as to promote representative participation, good governance, accountability, entrepreneurship skills and amicable transition to Agroecology and a sustainable Agri-food system with market access.

The RRA and action planning tools applied for CMS were carefully chosen to increase public awareness in a short time, create synergy between agroecology and other relevant policies or strategies in existence, and help in knowledge transfer particularly to the youth, women and vulnerable members of the community. Focus Group Discussions (FGD) to ensure maximum community participation, were done at two (2) nature positive landscapes at Muhudu, Kakamega Forest edges and Buhani within Maragoli Hills,. The identified landscapes each acted as a trial site and focal point for transect walks to model agricultural practices of shrub-crop intercropping and also mimic a buffer zone to protect forests, degraded hills and/or protect biodiversity for sustainable agriculture.

Both step 1 and step 2 are interdependent and were interlinked in a feed back mechanism by the focal entity according to the prescription of FAO (2018); and open to interrogation during the stakeholders' workshops and subsequent validation meetings to result in a final draft of the Vihiga Agroecology policy.

A general meeting was initially held with farmers (called Barazas) in two agroecological zones to introduce the agroecology concept and study by explaining its purpose, methodology and expected outcomes. Targeted public participation to introduce the draft Agroecology policy to the community in Vihiga, was then done on 27th October 2023 and 13th December 2023 at Roddy's Eco-lounge and on 4th January 2024 at Musinaka in Emuhaya Sub-county. The targeted community participants were deliberate for an interdisciplinary approach that is requisite to Agroecology using multi-stakeholder engagement; for cascading information through sharing and co-hosting a broader public participation exercise for the final policy draft as required by law. The main focus was on a key Agroecology need of establishing an agriculture training and innovation centre to cater for co-creation of knowledge, farmer-to-farmer knowledge exchange and benefit sharing, information dissemination on potential regenerative agriculture practices and suitable agroecological enterprises for up-scaling by small holder farmers.

Data from secondary sources (Table 2) and soil testing through participatory field trials of shrub-crop intercropping at Muhudu and Mungoma (Maragoli Hills) was collected by Agriculture field staff with support of KALRO-Kibos to monitor nutrient capacity and validate secondary data on soil pH, with a view to amelioration and/or effecting on-site soil fertility improvement strategies.

RESULTS

A review of 16 existing and past policy documents, strategies and/or regulations entailed desktop research, one-on-one unstructured interviews, informal consultations and official engagement with policy makers, stakeholders and development partners: ISFAA, PELUM Kenya, Alliance of Bioversity/CIAT, Practical

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Action, Seed Savers Network, KALRO, SAVET, RUFFORUM, and FOLU, as non-state actors; and the Departmental CECM of Environment, Social Services, Trade and Agriculture in Vihiga County, as state actors.

The current status of Agroecology for sustainable agriculture in Vihiga County indicate challenges associated with achieving food and nutrition security, and policy gaps of an enabling environment. Agriculture is the backbone of Vihiga County's economy, just like other regions of Kenya where the Agri-food system relies on small scale farmers. African leafy vegetables (ALVs) as a traditional food item, maize, beans, local poultry and dairy under zero-grazing with limited value addition, are the main drivers of food and nutrition security (Table 1). Sustainable agriculture though diversification is a major focus, where over 73% of smallholder farmers in the peri-urban county cultivate up to ten different ALV varieties, with a majority of the seeds stemming from three informal sources: the local market, own seeds, and farmer-to-farmer exchanges (Wild, 2022).

Table 1. Vihiga Agri-food Systems Data

Factor/Enterprise	**Number**	**% of Total**
Total Households (HH)	143,365	100
Total number of farmers (F)	105,455	73.56
ALV farmers (% F)	41,250	39.12
Banana Farmers (% F)	38,660	36.66
Poultry Farmers (% F)	34,734	32.93
Tea Farmers (% F)	6,572	6.23
Avocado farmers (% F)	5,255	4.98
Bee Keepers (% F)	630	0.60
Number of Dairy Cattle	45,440	–
Rural poverty (% HH)	59,353	41.40
Food poverty (% HH)	43,297	30.20
Population with < 1 Acre (%)	76,983	73.00

(Source: KIAMIS © 2023)

A market survey (Minyattah *et al.,* 2022) in major urban centres reported that fresh and huge consignments of tomatoes and vegetables are often ready for dispatch to consumers across the county on specific market days. A majority of the retailers are residents within the same communities, and there is a long-term relationship that exist between smallholder farmers and retailers which makes it convenient for both parties to engage in a vertical market relationship (Minyattah *et al.,* 2022). However, with increasing food safety concerns, the existing mechanisms to determine chemical residue levels of these food commodities before they are consumed by gullible citizens, are hampered by a lack of enabling policies at county level that also ensure compliance.

Table 2. Vihiga Agroecology Fact file

Factor	**Unit**
Arable land	404.8 Km^2
Non-Arable land	126.2 Km^2
Population density	1047/km^2
Mean holding size	0.4Ha

Farmers with land titles	29%
Approx Tree Cover	14%
Rainfall (mm)	1800 – 2000
Relative Humidity(%)	41.75
Altitude (m) a.s.l	1300-1800
Main Rivers	5 no.
Protected Springs	228 no.
Soil pH	4.8 – 5.5

(Source: Vihiga CIDP, 2023-2027)

Policies Impacting on Sustainable Agriculture in Kenya

In Kenya, major agricultural decision making is devolved to the county governments responsible for their own agricultural policies, priorities and practices. Critically, the Vihiga CIDP (2023-2027) is elaborate on how the county GIS lab at Mbale can greatly assist in piloting a policy for sustainable agriculture, through periodic mapping of natural resources including soil characteristics.

Kenya has over the years developed a myriad of policies, rules and regulations that address sustainable agriculture from several different perspectives. Despite this peculiarity, all policies in the domain of sustainable agriculture, tend to reflect the country's commitment to promoting 'food and nutrition security' for food poverty alleviation in the context of a stable Agri-food system, at whatever cost. While many of the policies are motivated by a genuine desire to initiate and implement changes in the field of agriculture, others maybe inspired by specific donor projects' requirements.

Furthermore, some policy interventions have often conflicted with other important government objectives like eradication of extreme poverty, since the Government's need for revenue to achieve its policy targets also entail new tax regimes for agricultural produce and products. For example in January 2024, the government proposed to establish taxation on all farm produce including chicken and subsistence crops by smallholder farmers already battling with escalating cost of farm inputs. Apparently, there is no clear mechanism for regulating the tax regimes in both inputs and outputs of agriculture, to leverage on double taxation and further cushion the farmers against unstable markets. There are thus several different policy scenarios in Kenya that illustrate either conflicts, overlaps, complimentarity, policy gaps, or duplication of effort in deployment of agroecological principles to support sustainable agriculture in the last 2 decades to 2024 and beyond:

A. National Policies

1. Strategy for Revitalizing Agriculture – SRA (2004-2014). The Strategy entailed a unified Agricultural Sector response towards the support of sustainable agriculture. It represented the national policy for steering the revitalization and development of the country's agricultural sector over the period ending 2014. The overriding goal of the SRA was to achieve progressive reduction of unemployment and poverty in Kenya. Prior to SRA (2004) in the post-independence period, Agricultural policy was embedded in 5-year development plans aimed at land transfer programmes, smallholder development, promotion of cash crop cultivation by smallholders and large-scale farmers, import-substitution and diversification. This strategy falls in the policy domain of 'producer-oriented policies,' 'consumer-oriented policies' and 'trade/market-oriented policies,' (Place *et al,* 2022). The main goals at the time were intertwined with the overall socio-economic policy to achieve high per capita incomes equitably distributed, freedom from want, ignorance, disease and exploitation. However, poverty is still endemic in many counties of Kenya to-date, while some of the main challenges yet to be surmounted include food security, malnutrition, and low participation of

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youth in agricultural development.

2. Agricultural Sector Development Strategy (ASDS): 2010–2020. This strategy focused on enhancing agricultural productivity and competitiveness. It recognizes the importance of sustainable practices and includes provisions to support agroecology and regenerative agriculture, such as promoting soil health, water conservation, and biodiversity conservation. The ASDS was intended to build further on the gains made by the SRA, as a guide for public and private sectors' efforts in overcoming the outstanding challenges facing the agricultural sector in Kenya. The strategy falls under the 'market-and food-environment-oriented policy' of Place *et al.*, (2022). Besides ensuring food and nutritional security for all Kenyans, the strategy aimed at generating higher incomes as well as employment, especially in the rural areas. Moreover, it was expected to position the agricultural sector as a key driver in achieving the 10 per cent annual economic growth rate envisaged under the economic pillar of Vision 2030. Under the ASDS, agricultural sector ministries were expected to ensure that farmers, producers, processors and marketers of agricultural produce employ the most contemporary methods and technologies, for highly productive enterprises, commercial in nature and competitive at all levels. There was a notable 4-year overlap between SRA (2004-2014) and ASDS (2010-2020).

3. The National Environment Policy-NEP (2013). The policy proposes a wide range of measures responding to environmental issues and challenges, through sustainable management and use of the environment and natural resources. The Policy provides a framework for sustainable development of the Environmental Sector and recognises the link between agriculture and enhanced biodiversity conservation for ensuring food security. It states that biodiversity provides genetic resources for food and agriculture and therefore constitutes the biological basis for food security and support for human livelihoods. The policy recommends development and implementation of integrated land use management strategies which an agroecology strategy can also address more effectively by including stewardship and social inclusion. Another key objective of the NEP is to strengthen the legal and institutional framework for good governance, effective coordination and management of the environment and natural resources, yet there are some provisions in NEP that are an apparent duplication in another set of regulations in the Kenya National Agroforestry Strategy (2021 – 2030). The proposed promotion of organic farming, soil policy, seed access, benefit-sharing mechanisms and green energy can enhance both agrobiodiversity and agroecology under one roof. Analytically, the policy falls under the 'market-and food-environment-oriented policy' (HLPE,2017). However, many issues of the environmental, sit with the national government and hence harmonising agricultural and environmental policy in support of policy objectives at the county level is a still big challenge.

4. The Seeds and Plant Varieties Act 2012, (Revised 2015): These are a set of rules and regulations for seeds and plant varieties (conservation, access and benefits sharing of plant genetic resources for food and agriculture) enacted in 2015. They seek to among others, conserve biodiversity for endangered plant species at risk of extinction. The Act promotes *in situ* and on farm conservation, by seeking to conserve ecosystems and maintenance of viable plant populations of species in their natural surroundings, whether domesticated or cultivated. Farmers and local communities' efforts to manage and conserve on-farm plant genetic resources are protected; the traditional knowledge associated with plant genetic resources is also protected; and there is equitable participation of farmers in sharing of benefits and capacity building arising from associated traditional knowledge, the utilization of plant genetic resources and royalties. This law falls under the 'producer-oriented policies,' of Place *et al*, 2022).

Seed is the single most basic agricultural input for sustainable production, which accounts for a fundamental role in food security. However, the Seed Act does not have provision to promote the use of registered farmer varieties of seed and vegetatively propagated material at community level, despite the existence of locally managed seed-banks. Another key shortcoming is the narrow genetic base of commercialized germplasm

while there are several more in the custody of farmers but considered informal. The 'informal' seed sources also have plenty of traditional technical knowledge and accompanying sustainable practices not well recognized and documented. Yet, protection of traditional knowledge relevant to plant genetic resources for food and agriculture is considered one of the most fundamental farmers rights, as provided in the International Treaty for Plant Genetic Resources for food and Agriculture (FAO,2023).

***5.* The Crops (Food Crops) Regulations, 2016:** Under **s**ection 40 of the Crops Act, 2013, the national government in consultation with the Agriculture, and Food Authority (AFA) and County Governments, made the Crops regulations. Among a raft of regulations prescribed include the establishment and enforcement of standards in grading, sampling and inspection, tests and analysis, specifications, units of measurement, code of practice and packaging, preservation, conservation and transportation of food crops to ensure food safety and proper trading. While this is in line with an agroecology policy intervention, there is an apparent conflict of interest especially with the appointment of 'Crop Inspectors' given that agriculture is a devolved function of county governments under the supreme law, Kenya constitution 2010. The regulations fall under the 'consumer-oriented policies' of Place *et al.*,

6. The Kenya Climate Smart Agriculture (CSA) Strategy (2017-2026): recognizes the link between sustainable agriculture, biodiversity, climate change, and food security. It aims to sustainably increase agricultural productivity and incomes, adapt and build resilience to climate change; and reduce or remove greenhouse gas emissions. While CSA proposes a transition to a more environment-friendly agriculture, It fundamentally differs from agroecology. The strategy falls under a 'market-and food-environment-oriented policy' (HLPE,2017). However, the CSA strategy does not provide a holistic path to transformative and sustainable agriculture systems in tandem with the 10 agroecology principles as prescribed by FAO (2018). The range of CSA practices also include genetically-engineered seeds or livestock, large-scale industrial farming or pesticides — practices that enhance the business volumes through taxation of the private corporate sector, including international conglomerates with vested interest in profit margins. This raises issues of affordability and accountability to the local farming communities in Kenya.

7. National Climate Change Action Plan (NCCAP): 2018-2022. This plan aimed to strengthen the country's path towards sustainable, climate-resilient development while achieving low carbon, climate resilient development. It builds on the previous Action Plan spanning the period 2013-2017. The plan committed Kenya to ensuring a climate resilient society by mainstreaming climate change into County Integrated Development Plans. The plan included measures to promote climate-resilient agriculture: To promote food and nutrition security by enhancing productivity and resilience of the agricultural systems; improving crop, livestock and fisheries productivity through the implementation of climate-smart actions and promote diversification of livelihoods to adjust to a changing climate. The plan fell within the ambit of ASTGS (2019-2029) and there was apparent lack of harmony and wider stakeholder participation.

8. Agriculture Sector Transformation and Growth Strategy (ASTGS): 2019-2029. The policy document acknowledges that performance of the agriculture sector is suboptimal with regard to sustainable production, value addition, food security and nutrition. This is basically Kenya's current strategy for transforming the agriculture sector, with emphasis on increasing the resilience of livelihoods, by addressing food system risks of poor land use and soil status, climate change, pests, diseases and global price shocks. Notably, the strategy addresses growth in agriculture in an integrated manner with focus on production enablers including other sub-sector policies.The strategy has nine (9) flagships divided into six anchors and 3 enablers. The strategy entails a 'producer-consumer-trade' nexus and a 'market-and food-environment-oriented policy' (HLPE, 2017).

The policy recognizes the need to promote sustainable agriculture and includes provisions to support agroecology. For example, in order to make agriculture more sustainable, the strategy envisages the establishment of small and medium-sized storage facilities combined with best practices in post-harvest

handling to curb waste and improved storage for food safety. Among the high-impact initiatives prioritized for implementation include soil mapping to ensure farmers use the appropriate inputs to support production, thereby mainstreaming resilience and risk management as per the Malabo declaration, 2014.

The strategy aims to increase farmers productivity and shift production from subsistence to a digital and market-oriented output, whereby the Kenya Integrated Agriculture Management Information System (KIAMIS) will be crucial in implementation. However, the strategy seems like an overlap of the CSA (2017-2026), and conflicting or duplication of effort in farm input subsidy while addressing food and nutrition security. The strategy is also explicit in support of subsidized inputs, some like fertilizers with acidifying effect on soils, by stimulating the private sector's ability to supply agro-dealers, and reducing the distances for farmers who need to travel to collect their subsidies.

9. National Agricultural Soil Management Policy:2023. This policy provides a framework for planning and implementation of agricultural soil management programmes in Kenya. Other policies and strategies with provisions related to soil as a natural resource for increased agricultural production at the national government level include: The National Agricultural Sector Extension Policy 2012; Draft National Land Reclamation Policy 2013; Sessional Paper No 1 of 2017 on land use policy; National Environment Policy 2013; Draft Agricultural Policy 2019; National Irrigation Policy 2017; National Forest Management Policy 2014; the National Food And Nutrition Security Policy 2011; Strategy for Revitalizing Agriculture (SRA) 2004; Agriculture Sector Development Strategy 2010; National Climate Change Response Strategy 2010; Agricultural Sector Transformation and Growth Strategy 2019, among others. However, these various agricultural sub-sector policies and strategies that have been developed have fallen short of impactfuly addressing declining soil fertility as an important resource for sustained agricultural production.

10. National Agriculture Policy (2021): Kenya's National Agriculture Policy emphasizes sustainable and climate-smart agriculture. It recognizes agroecology as a viable approach and promotes the use of organic farming techniques, conservation agriculture, and integrated pest management. The Policy adheres to relevant provisions of the regional economic communities while recognizing and embracing international standards in crop, fisheries, animal products and food or feed safety. The previous National Agriculture Policy of 2019 proposed the promotion of soil conservation and organic farming for sustainable crops production, and promotion of research in the utilization of land resources for crops, livestock and fisheries production. The policy has several provisions that are a clear duplication of the CSA (2017-2026) but it falls within a 'producer-oriented policies,' 'consumer-oriented policies', 'trade-oriented policies,' (Place *et al.*, 2022).

11. Kenya National Agroforestry Strategy (2021 – 2030). The goal of this strategy is to restore productive capacity and build resilience of the agricultural resource base while contributing to climate change adaptation and mitigation through enhanced agroforestry practices in Kenya. The strategy also aims to mainstream agroforestry more coherently in national policies, and among the specific objectives include investment in agroforestry through strengthening of agroforestry-based value chains and enabling environment for enhanced participation of women, youth and marginalized groups. The strategy is explicit in support for attainment of county and national government commitments and international conventions, eg. the Malabo Declaration 2014, by leveraging on these commitments, financing, innovations and inclusion of the private sector. However, the strategy largely appears to either complement or duplicate other strategies like ASTSG (2019-2029) and CSA (2017-2026), in context of sustainable agriculture and adaptation to climate change respectively. The strategy falls within a 'market-and food-environment-oriented policy' (HLPE, 2017).

12. National Policy on Gender and Development (2019): This policy builds on the National Policy for Gender and Development of 2000, and Sessional Paper No. 2 of 2006 on Gender Equality and Development which envisaged women empowerment and mainstreaming the needs of women, men, girls and boys in all

sectors of development in Kenya so that they can participate and benefit equally from development initiatives. This policy seeks to ensure that all citizens live in dignity and protected from all adverse shocks including poverty. Further, the policy re-affirms the need for gender equity and empowerment to enhance participation of all groups for the attainment of sustainable development. This provides a convergence with Agroecology principles and practices, which also put a strong emphasis on human and social values and seek to address gender inequalities by creating more opportunities for youth, women and other vulnerable groups in the digital economy.

B. County Policies

1. Muranga County Agroecology Policy 2022-2032. The Murang'a County Government in collaboration with the Institute for Culture and Ecology (ICE) and other partners enacted into law, the Murang'a Agroecology Policy 2022-2032 and the Murang'a County Agro Ecology Development Act, 2022. The Act promotes use of organic farming practices and production of organic products. This was the first county in Kenya to formulate and implement an agroecology policy, thereby setting a precedent for other counties for the integration of agroecology principles and practices into a legal framework through government actions. With the promising prospects of agroecology in addressing the challenges of food systems, especially the adverse effects of external inputs on the environment and human health, the government and agricultural stakeholders are obligated to provide both technical and financial support to enhance the implementation of this policy on agroecology. Notably, the policy is heavily skewed towards organic farming practices of agroecology. This policy is both a 'producer-oriented,' and 'consumer-oriented' (Place *et al*, 2022).

2. The Vihiga County Agroforestry Policy (2022) recognises agroforestry (AF) as a traditional land use system among the inhabitants of Vihiga County, and as a farming strategy that sets priority on food security in improving the livelihood status of farmers. Traditional systems are one of the best examples of ecosystem services providing several goods and services, such as conserving soils by improving fertility levels and reducing erosion. Further, such systems enable provision of quality water for local consumption, fodder for livestock, fuel and timber for use as energy and construction materials, and traditional crops for food security. In recent times agroforestry has grown to provide impetus to commercialization in the form of producing fruits, timber products, honey, herbal products, among others with significant market value and potential for establishment of cottage industries. The policy is in line with a 'market-and food-environment-oriented policy' (HLPE,2017). However, there is no clear-cut mechanism from seed procurement to marketing of the AF products, and the policy link to the National Agroforestry Strategy (2021 – 2030) is not apparent.

3. County Integrated Development Plans (CIDPs): Kenya's devolved governance system allows county governments to develop their own agriculture-related policies and plans. At the county level, the functions assigned to County governments by Kenya Gazette Supplement No. 116 of 9th August 2013 include implementation of programmes in the agricultural sector to address food security in the county; development of programmes to intervene on soil and water management, and conservation of the natural resource base for agriculture. The CIDPs are further expected to spur the formulation of other policies thatare explicit on sustainable agriculture eg. Food safety, management of soil systems, and practices like regenerative agriculture as complementary to conventional agriculture.

4. Others. The Vihiga Municipal Solid Waste Management Policy 2019 under Environment department and the Sustainable Land Management (SLM) Policy for Vihiga County (2022) under Agriculture department, are some of the development plans that can be categorised as agroecology user friendly: The Solid Waste Management Policy has provisions for recycling while the SLM is in tandem with the Nagoya Protocol on Access and Benefit sharing; promotes better land management practices that lead to better soil erosion control, reduced pressure on land and natural resources hence lesser conflicts; disaster management like in landslides; climate change adaptation, biodiversity conservation, stable agroecosystems and decreased

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poverty from higher agricultural productivity of adjacent, non-forest land. However, the SLM lacks a value chain approach to production techniques, and may thus not deliver substantial social and ecological benefits as envisaged in the proposed agroecology policy for Vihiga County.

DISCUSSIONS

Vihiga County is a relatively small peri-urban landscape in Western Kenya region covering 563 Km^2, with a population which is estimated to grow to 634074 (304869 male, 329205 female) with a density of 1125 persons/Km^2 by 2027 (CIDP, 2023-2027). This population is mainly derived from four distinct communities and representing one of the highest population densities in Kenya (KNBS, 2019). Rain-fed agriculture is the main source of livelihoods in the County, contributing about 85% of the employment opportunities for the total population (MoALFC, 2021). African leafy vegetables (ALVs), Bananas, Tea, Local poultry, and Dairy are the key value chain commodities that contribute significantly to household food security and livelihoods (Table 1). Other economic activities include rural cottage industries, wholesale and retail trade, quarrying and small scale mining from non-arable land.

Despite being endowed with a rich agrobiodiversity, Vihiga is also one of the counties in Kenya with high levels of malnutrition. In addition, with increasing bio-safety concerns, consumers are skeptical about potential health risks of unsafe food, uncertified seeds and contaminated soils, without a policy direction. At ecosystem level, Vihiga is one of the many counties in Kenya and the Global South in general at risk of soil degradation, that is associated with resource-intensive production systems which have caused massive depletion of soil fertility in densely populated landscapes (MoALFC, 2021).

Thus, apart from poor knowledge of Agroecology, the main challenge to surmount in the context of farmers' own seed sources for ALVs, is lack of an enabling policy to empower community seed systems with improved access to seed or planting material. Smallholder farmers face various challenges in accessing and multiplying the seeds/planting material, whereby local seed banks are undermined by commercialization of seeds through exclusive intellectual property rights, or patents by major seed companies. Agroecological transition is therefore constrained by the overwhelming vested interest among key value chain actors profiting from current Agri-food systems along certain value chains, and who may resist disruptive technologies e.g. Agrochemical manufactures, suppliers and dealership in general.

Another challenge is from institutions that have over time promoted high input agricultural production through various types of initiatives including subsidies (Jayne *et al.*, 2018) in support of the poor and vulnerable farmers; and skewed government programs relating to rural advisory services on basic agronomic practices, against weak information on natural resource management (Nkonya *et al.* 2017; Berhane *et al.*, 2018), and inadequate deployment of Geographical Information Systems (GIS) .

Concerns about soil health, food safety, benefit-sharing, equity and appropriate safeguards regarding market access and equitable resource management, could thus be addressed by a regulatory policy framework to co-create production in a safe and level playing field through public private-partnerships (PPPs) and mapping of natural resources for decision making. In these regards, Vihiga County has pioneered the establishment of a fully functional GIS lab for mapping natural resources in western Kenya. The GIS tools offer enormous opportunities for planning and sustainable management of natural resources, with digital capabilities and support for circular economies to enhance livelihoods (CIDP, 2023-2027).

Evidence as Basis for an Agroecology Policy

An Agroecology policy was envisioned in the Vihiga CIDP (2023-2027) as an institutional requirement, and provides evidence-based solutions on key challenges or opportunities of the wider Agri-food system, such as food poverty, resilience, agricultural diversification, population density, land carrying capacity, food safety

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and soil health concerns. The agroecology policy formulation process entailed a review of other similar policies and secondary data, validation field trials, multi-stakeholder consultations and benchmarking, which identified some specific key challenges and opportunities for small holder farmers, the youth and women eg. regenerative agriculture, access to land and entrepreneurial capacity, access to a mobile phone with WiFi capabilities, agricultural credit and insurance, and general agribusiness information.

Regenerative Agriculture

Regenerative agriculture (RA) has been defined in several and different conflicting ways as both a process and an outcome, from 'a system of farming principles and practices that increases biodiversity, enriches soils, improves watersheds, and enhances ecosystem services' (EIT Food, 2023); to 'a long-term design that grows as much food using as few resources as possible in a way that revitalizes the soil', while offering soil carbon sequestration (Wiltshire and Beckage, 2022); optimizing resource management, alleviating climate change, with co-benefits of water retention and biodiversity (Schreefel *et al.*, 2020).

A notable observation in this study was the apparent lack of a common understanding on what is regenerative agriculture vis-a-vis organic farming as a farm practice. Organic farming is a form of regenerative agricultural production that excludes the use of synthetic substances, like pesticides, herbicides or inorganic fertilisers, and genetically modified organisms (GMOs). For example, Muranga County promotes organic farming practices with institutional support complete with certification, while farmers in Vihiga practice Agroecology by default, especially in regard to cultivation of ALVs as traditional crops, where absolutely no chemical soil additives or pesticides are used. The intercropping trials (Table 3) for validation had 12 treatments including four treatments of Camphor basil shrubs (*Ocimum kilimandischarum*) grown in association with cow peas (*Vigna unguiculata*), maize (Zea Mays), NERICA rice (*Oryza sativa*) and Soya beans (*Glycine max*) but involved absolutely no usage of pesticides or soil amendments. Only foliar applied liquid organic fertilizer was used on companion crops. A comprehensive soil test including for soil acidity (pH) was done before transplanting the shrubs and after harvesting the entire intercrop:

The soil test results from Muhudu Ward and performance of the shrub intercropping trials, exhibited varying results of critical importance for evidence based policy making. The soil acidity as a function of pH, decreased significantly after intercropping with *Ocimum sp* shrubs and mapping with GIS technology (Fig. 2). The Camphor basil (*Ocimum kilimandischarum*) shrub intercropped plots appeared to moderate soil acidity within the growing period. This result has positive implications for the use of natural control methods in soil nematodes and disease causing pathogens

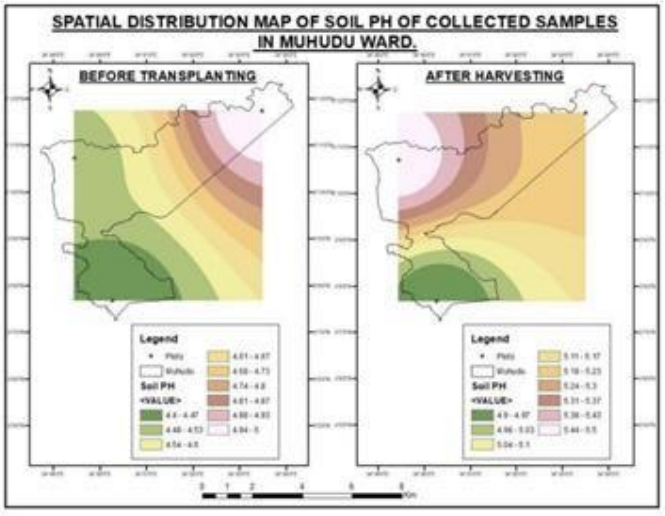

Fig.2 Soil pH Results at Muhudu Ward test site.

Regenerative agriculture is hereby demonstrated by the reduction in soil acidity after a period of intercropping. This is in agreement with Rhodes (2017) who also reported that "regenerative agriculture has at its core the intention to improve the health of soil or to restore highly degraded soil, which enhances the quality of water, vegetation and land-productivity.

In this paper, regenerative agriculture (RA) is embedded in Agroecology as opposed to conventional agriculture, and positively impacts the environment, through the framework of ecosystem services. This is in agreement with Guo *et al.*,(2023) who further reports that RA in context of the sustainability theory, is focused on a circular economy for enhancement of production efficiency. This apparent overlap in defining RA is in agreement with Newton *et al.,* (2020) that the absence of a clear understanding of what regenerative agriculture is or is not has structural implications for policy and program development (Goswami *et al.,* 2017), and consumers may be misled or confused about the significance of a claim about food produced using regenerative agriculture.

Opinion from farmer-to farmer exchanges between Vihiga and Muranga Counties of Kenya are in agreement with Giller *et al.*, (2021) that regenerative agriculture represents a re-framing of what has been practiced in the past, but now considered as contrasting approaches to the future of agriculture- namely Agroecology. Thus, for purposes of this paper, agroecology is a subset of sustainable agriculture.

However, despite the declining soil fertility owing to higher soil acidity in most parts of the county, farmers will often prioritise on immediate food security needs, focusing on the perpetual cultivation of staple crops such as maize and beans with acidifying fertilizer. While these priorities result in short-term sustainability impacts, it is also at the expense of other ecosystem services that may be provided by shrubs for increased soil health, and which takes several seasons for beneficial effects to be realised. These results strongly suggest more diversification to short term high value crops for improved soil health management.

Conventional agriculture stakeholders and practitioners including government subsidy programmes, often recommend a certain rate of inorganic fertilizer application for desired increase in crop yields and productivity, with lesser emphasis on addressing the increasing levels of soil acidity. On the other hand, proponents of organic farming mostly activists, are more concerned about maintaining the natural conditions of soil than higher yields per unit area as a result of inorganic inputs application.

The Vihiga Agroecology policy therefore proposes a context based definition of RA and strives to take the middle ground by advocating minimal use of external inputs for regenerative agriculture, and empowering producers to make an informed choice on basis of consumer preferences. In addition, the policy borrows from several scholars (Tittonell *et al*., 2022; Giller *et al*., 2021; Rhodes, 2017), for local adaptation and context, to propose that RA is synonymous with a sustainable agriculture practice, and embedded in agroecology as a complimentary means of managing an Agri-Food system that has a net positive environmental and socio-economic impact.

Soil Health

Agroecology (Altieri, 2018) can support the health of both small holder agriculture producers and entire consumers, as well as linking soil health with resilience for sustainable agriculture (Davis *et al*., 2023), by eliminating the need for harmful synthetic chemicals, and inorganic fertilizers with acidifying effect on soil (Opala *et al*., 2012). In Argentina, Dominguez *et al.*, (2023) reports that recognizing the negative impact of the current practices on soil health is a necessary step to promote a change toward agricultural systems that are more socially and environmentally sustainable. In Kenya however, many stakeholders and professionals across the socio-economic and biophysical divide have different motivations for understanding what constitutes soil health, and a notable observation in this study was that engagement of the stakeholders to

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arrive at a consensus was tedious and complex to result in almost a stalemate.

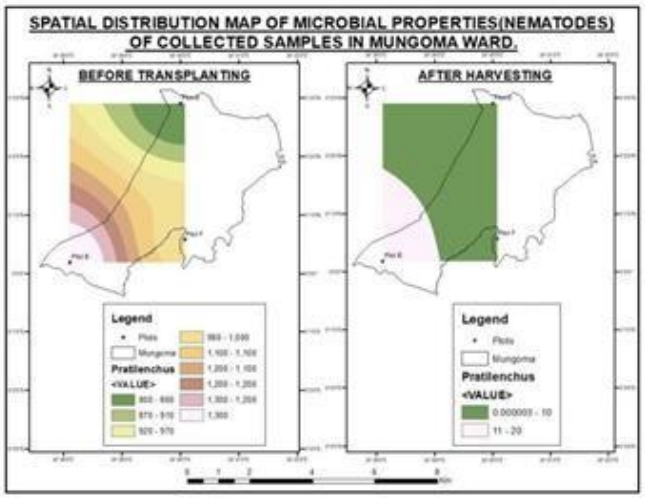

Fig.3 Spatial Distribution of Nematodes at Mungoma Ward test site.

Consequently, the results from Mungoma Ward (Fig.3) helped to validate key policy decisions on soil health through enhanced agrobiodiversity, for natural control of destructive nematodes like *Pratilenchus sp.* The nematode count before transplanting and after harvesting the intercrops, showed a sharp decline after mapping with GIS technology (Fig. 3), which is hereby attributed to the repellance capacity of the shrub roots of camphor basil (*Ocimum kilimandscharicum*), suggesting a potential natural control method. These results are in general agreement with Oliver & Boaz (2019), that empirical data can be useful in validating evidence to inform researchers or decision-makers in steps of policy development.

The Proposed Agroecology Policy Model

The most common anomaly with policies impacting on sustainable agriculture in Kenya, is the apparent segmentation of approaches even within the same policy document. In some policies, sustainable agriculture is presented as a stand-alone objective and not integrated into other approaches, while in a few other policies it appears as a semantic expression with no clear definition or further clarification. For example, while the CSA recognises sustainable agriculture and biodiversity conservation as key drivers of food security, it also seeks to promote the use of genetically modified seed and planting material, which is in subtle conflict with the Crops Act, 2013. This displays a general lack of coherence in objectives and collaboration between policy makers at national level and end users at county level, through a process of co-creation and exchange of knowledge.

A. Co-creation and Knowledge Ex-change

It was observed that 'Farmer-to-Farmer' knowledge sharing between Vihiga and Muranga counties, inspired more interest in regenerative agriculture and this may encourage broader adoption of new technologies in Agroecology among producers and other value chain actors. On co-creation and knowledge transfer, the Muranga Agroecology Policy provides for a training curriculum at Muranga University of Science and Technology in partnership with the county government, as learnt from the benchmarking visits.

A take-home advantage of the exchange visits included the opportunity of learning from each other to identify practices that could be beneficial in other contexts and respective home countries, e.g. the participatory guarantee system (PGS). Farmers in Muranga County were found to be growing spinach (*Spinacia oleracea* L.) vegetables and some shrub/trees like Moringa (*Moringa oleifera)* organically and

certified through PGS, while farmers in Vihiga grow African leafy vegetables (ALVs) organically by default, because the ALVs grow well naturally without the need of external inputs. Since not all RA practices preclude the use of agrochemicals, Vihiga farmers and stakeholders agreed on the need to reduce or minimize their use considering there are several alternative methods of integrated pest and disease control, as reported by Giller *et al,* (2021). This is also in agreement with Wezel *et al.,* (2020) that Agroecology in a broader sense is minimizing synthetic and toxic external inputs, while using ecological processes and ecosystem services for the development and implementation of agricultural practices.

Small farm sizes averaging 0.4ha with no fallow periods (Table 1), and higher soil acidity was observed in the field intercropping trials (Fig. 1), as a key challenge that may affect farmers' diversification to other farm enterprises (Table 2). The majority of farmers cultivate on less than 1 acre of land (73%), suggesting stiff competition for space in intercropping systems, as well as human habitation and nutrients for crop and livestock production. Only 29% of the Vihiga population have land title deeds and this suggests a worse situation for women and youth, in accessing land for agricultural purposes. The majority of the world's poor populations (about 80%) live in rural areas and rely mainly on agriculture to make a living (UN, 2023). Even though Vihiga is largely a peri-urban county, the rural communities often experience social marginalization due to a lack of access to resources, and information, with poverty rates of 41.4% and food poverty at 30.2%, this represents a significant level of social inequality and vulnerability of the population. But studies have demonstrated how agroecology can reduce the inequalities of poverty through policy action (Place *et al.,* 2022).

The immense potential of GIS to support small scale producers in resource management, was demonstrated during digitalisation of the soil test results and other farming outcomes, using the GIS mapping for better access to information on soil health. This suggests a great potential in the use of ICT by youth, women and local communities for agroecological interventions.The Agroecological fact file (Table 1) from secondary sources and the Agri-food systems data (Table 2) formed the basis for more evidence to support the need for a policy, which is further in agreement with Philips *et al.,* (2020), while determining relevant evidence in contextualised policy formulation.

The foregoing results therefore informed a proposed Vihiga Agroecology policy in a participatory manner, anchored on the following ten (10) action points:-

i. Creation of an Agricultural Training and Innovation Centre (ATIC) to serve the technology needs of small scale producers, equipped with staff and artificial intelligence capacity to facilitate the adoption and monitoring of agroecological practices in both nature positive landscapes and outreach programmes. This is a centre of excellence in on-farm demonstration and agribusiness incubation for African leafy vegetables (ALVs), Mushrooms, Herbs & Spices, Local poultry, small farm machinery, Hydroponics and small scale irrigation. This policy strategy addresses the Agroecology principles of diversity, co-creation and sharing of knowledge.

ii. Empowering the County government to embrace public private partnerships (PPP) in sustainable agriculture for capacity building, farmer-to-farmer exchanges, co-creation of knowledge and increased land use efficiency; Promotion of mentorship programs with partners, targeting 4-K Club in schools, TVETs and transitional farmers to scale up implementation of agroecology at landscape level. This policy strategy addresses the Agroecology principles of responsible governance, efficiency, creating synergies, sharing of knowledge and enhancing human values.

iii. Interventions for protecting the rights and livelihoods of youth and women through a halt in further sub-division of land beyond a certain uneconomical limit to be determined through a task force; and create investments opportunities in digital rural services to remove or minimise information gaps between rural and peri-urban areas of the County, targeting the flow of goods and services along agroecology value

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chains; Pre-market surveys and mapping of aggregation centres with GIS, will provide baseline data for inputting the digital hubs. This policy strategy addressees the Agroecology principles of efficiency, resilience, human and social values as well as a circular and solidarity economy (enabling environment).

iv. Proposed recruitment and training of Community Agroecology Workers/facilitators, as subject matter specialists or master trainers with experience in capacity building of Agroecology. They will be equipped as resource persons to train farmers and other service providers on agroecology and provide backstopping at field level, coordinating learning and sharing within extension units and interface with other components of the agriculture and food system. This will enhance farmer knowledge and awareness, through deliberate efforts to promote positive attitudes among smallholder farmers regarding the multiple benefits of Agroecology. This policy strategy addresses the Agroecology principles of co-creation and sharing of knowledge.

v. Recommendation as a statutory requirement for the procurement of traditional foods for public institutions like hospitals and schools/colleges, that include agroecologically produced and locally sourced African leafy vegetables (ALVs). As an incentive, this is intended to strengthen joint investments by government and the private sector, towards support and innovation in micro, small and medium-sized enterprises to facilitate Agroecology at production level and transitions to value addition. This policy strategy addresses the Agroecology principles of efficiency, responsible governance, circular and solidarity economy (enabling environment).

vi. Development of agro-ecological specific production models for small and medium scale farmers from case studies to revive and upscale traditional food and seed systems. Further stakeholder engagements will identify partners to establish five community seed banks, one in each of the sub-counties in Vihiga; and revive food festivals that were traditionally observed after every harvest period. Farmer-to-Farmer exchanges will focus on providing successful examples or case studies of successful farmers who have adopted similar practices. This policy strategy addresses the Agroecology principles of creating synergies, benefit sharing, culture and food traditions, in an enabling environment.

vii. Support farmers' rights and autonomy regarding local and indigenous seeds, seed systems and livestock breeds; seek to reduce harmful chemical residues in soil and foods within and across county boundaries; Crop and livestock waste will be bio-converted to useful end products, including organic fertilizer and green energy. Further, the policy will guide the implementation of standards of production in the Agroecology sub sector, that is in line with both national and internationally set quality standards. This policy strategy addresses the Agroecology principles of resilience, recycling, food traditions, good governance and an enabling environment.

viii. Harmonise Agroecology related laws or regulations that exist, from Agroforestry, Crops, Public Health, Soil conservation, Sustainable Land Management to Climate Smart Agriculture practices that compliment each other. This policy strategy addresses the Agroecology principles of creating synergies, efficiency, and responsible governance.

ix. Facilitate an agricultural insurance scheme for crops and livestock, targeting shorter value chains to better connect producers, markets and consumers in the Agri-food systems, through contract farming. This policy strategy addresses the Agroecology principles of creating synergies, efficiency and resilience.

x. Promote the development of stable markets (Including virtual) for agroecologically produced outputs, organic nutrient inputs and investing in ecosystem services (ES) from agriculture and agroforestry products. This policy strategy addresses the Agroecology principles of efficiency, circular and solidarity economy (enabling environment).

B. Key Observations

1. Several counties of Kenya including Vihiga have included provisions that support agroecology and regenerative agriculture in their 5-year CIDPs (2023-2027), with initiatives such as soil mapping, training and innovation centres and programs, promotion of farmers' producer cooperatives, and support for sustainable agriculture practices in general. However, there is an apparent disconnect between the CIDP, and the sectoral annual workplans and departmental budgets, with frequent shifting of government priorities in relation to pending or historical bills as well as Ward based development programs.
2. The varying administrative protocols and financial management systems often leads to delays in disbursement of funds between the national and county governments, leading to barriers in smooth implementation of policy with synergy.
3. Free and open access to seeds and planting material is key to sustaining livelihoods, improving food security and enhancing agrobiodiversity, through partnerships with county development partners like Seed Savers Network, the alliance for Biodiversity International/CIAT and 'Practical ACTION'.
4. Improving knowledge and skills on agro-ecological approaches to farming among extension workers and service providers, can result in more farmers especially women and youth significantly improve on their access to skilled labour in agroecology.
5. There are significant overlaps, duplication and conflict of interest among key policies that address sustainable agriculture in Kenya. While some of the policies are motivated by a genuine desire for transformation, others maybe motivated by donor interests of projects and/ or programmes in the Agri-food system space.
6. The State Department of Agriculture and other stakeholders under the umbrella of Kenya Organic Agriculture Network (KOAN) initiated the process to draft a policy in 2009 to promote organic farming in Kenya. Once enacted, the policy was expected to help in developing a value chain of organic products to ensure market differentiation between organically and conventionally produced agricultural produce. This initiative was dropped in favour of a more holistic National Agroecology Strategy for Food Systems Transformation that is being developed. The strategy will provide guidelines and standards for organic production and certification, supporting agroecological principles and sustainable agriculture.

CONCLUSIONS

Lack of an enabling policy to provide incentives for implementing agroecology principles in production systems at county level in Kenya, maybe a big constraint to agricultural transformation. The proposed Agroecology policy framework incorporates the principle elements of agroecology in a synergistic manner, to the extent that one strategy can address several elements concurrently. Significantly, the policy will strengthen investment and medium sized enterprises that support sustainable agriculture and food systems; add value locally as well as create an enabling environment for young people to remain in rural areas. The policy will further deploy context specific technologies, to promote the use of ICT in agriculture and food systems for agroecological interventions.

Flagged Opportunities

Recognizing the role of partnerships and impact of innovative approaches including policy shifts for scaling out technologies is critical, as much as avoiding duplication, overlaps and conflict of interest in designing an agroecology policy. The policy framework will contextualize the needs of small-scale producers and farm families in Vihiga county of Kenya, and other regions with similar agroecological dynamics in the Global South to provide market access for nature positive outputs. Specifically, the Agroecology policy formulation

process flagged out the following opportunities and/or action plans in Vihiga county:-

1. Cold storage agribusiness for ALVs, fruits and Aggregation Centres in Peri-urban Agriculture setting;
2. Enhanced agrobiodiversity through shrub-crop intercropping and bionematicide potential for natural pest control;
3. Minimal use of agrochemicals for sustainable soil health and increased food safety;
4. Eradication of *Eucalyptus sp* in crop farmlands, riparian areas and common boundaries for small holder farmers;
5. Commercial mushrooms cultivation and mushroom bio-conversion;
6. Contract farming and agricultural insurance for market stability and resilience.

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LIST OF ABBREVIATION AND ACRONYMS

ALV	African Leafy Vegetables.
CGV	County Government of Vihiga
CIDP	County Integrated Development plan
EBP	Evidence Based Policy
FAO	Food and Agriculture Organisation
GIS	Geographical Information System
Ha	Hectare of land
HLPE	High Level Panel of Experts
IPM	Integrated Pest Management
ISFAA	Intersectoral Forum on Agroecology and Agrobiodiversity
ITK	Indigenous Technical Knowledge
LM	Lower Midland Agroecological Zone
LR	Long Rains (season)
MoALFC	Ministry of Agriculture, Livestock, Fisheries & Cooperatives
NERICA	New Rice for Africa
PAPOLD	Participatory Analysis of Poverty, Livelihoods and Environmental Dynamics
PES	Payment of Ecosystem Services
SAS JMP	Computer program for statistical analysis developed by JMP
SAVET	School of Agriculture & Veterinary Sciences
SR	Short Rains (Season)
UM	Upper Midland Agroecological Zone.

DEFINATION OF TERMS

Agrobiodiversity: the variety of nature-based and stable ecosystems, where all plant and animal species co-

exist with soil micro-organisms to benefit agriculture and the food chain.

Agroecology: the application of ecological concepts and principals in farming.

County: any of a semi-autonomous devolved region of Kenya.

Ecosystem Services (ES): the benefits people obtain from ecosystems', both natural and managed, categorized as: provisioning, regulating, supporting and/or cultural.

Food security: the physical and/or economic access to nutritious, safe and sufficient food by all people at all-times which meets their dietary needs and food preferences.

Household (HH): a house and its occupants that are regarded as a unit. It consists of one or several people who live in the same dwelling and share meals.

Regenerative Agriculture (RA): a system of farming practices that seeks to rehabilitate and enhance the entire ecosystem of the farm with emphasis on soil health, intercropping and market access to safe food for sustainable agriculture.

Small scale farm(er): any farming enterprise or agripreneur operating on less than 5Ha of land.

Soil Health: the continued capacity of soil to function as a living ecosystem that sustains both plants and animals, as well as good humans' relationship with nature.

Sustainable Agriculture: a system of farming that is economically viable, socially responsible and ecologically sound for present and future generations.

Ward: an administrative unit within a County of Kenya as established by law and represented by a Member of County Assembly.

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