The Potential of Agroecology to Hedge against Climate Change

and build Resilient and Sustainable Livelihoods and Food Systems

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# Executive Summary

# Introduction

## Rationale: the need to bring agroecology into climate change discussions

Climate change has severe negative impacts on livelihoods and food systems worldwide, with adverse future projections, seriously undermining current efforts to improve the state of food security and nutrition (FAO 2016), especially in Sub-Sahara Africa (SSA). The 2018 report on the State of Food Insecurity raised an urgent appeal to accelerate and scale-up actions to strengthen resilience and enhance adaptive capacity in agricultural sectors.

As recently highlighted by the Intergovernmental Panel on climate change special report on Global Warming of 1.5°C and special report on land (IPCC, 2018; IPCC, 2019) also by the State of the world’s Biodiversity for Food and Agriculture (FAO, 2019) and various other recent key publications, there is an urgent need for a transformational change of our food systems towards more Sustainability and Resilience.

At COP 21, the 2015 Paris Agreement finally recognized “the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change”. As a response, in 2017, at COP23 in Bonn, the international community adopted a decision to have a work stream on agriculture through a three-year Koronivia Joint Work on Agriculture (KJWA). Ecological and sustainable agriculture and food systems, through their potential for adaptation, mitigation and building resilience, are a fundamental part of the solution to tackle climate change. They are uniquely placed to help countries to deliver on climate goals and the 2030 Agenda for Sustainable Development.

Since the very first international symposium on agroecology in 2014, organized by the Food and Agriculture Organization of the UN (FAO), followed by regional conferences and a Second International Symposium on agroecology in 2018, agroecology is featuring well on the global Agenda. FAO’s governing bodies highlighted the importance of agroecology and called at the 26th Committee on Agriculture and at the 40th Conference in 2018 for the need to strengthen normative work and evidence-based work, to foster research and increase the collection of evidence and qualitative data.

The launch of a global initiative aiming to scale up agroecological production systems in support of the SDGs (the Scaling-up agroecology Initiative[[1]](#footnote-2)) in 2018 and this year’s HLPE report on “Agroecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition” further illustrate the momentum on agroecology and the multi-level dynamism for the topic: from the field, to the national, regional and international levels.

Agroecology has an important role to play in transforming agriculture and food systems and is often cited as a promising systemic approach to unlock adaptation and mitigation potentials in agriculture and food systems and build resilience for a sustainable development.

FAO’s Seminar on agroecology (FAO, 2018) identified two levels of contributions on how AE could hedge against climate change: First by increasing the resilience of the farmers through diversification at farm and landscape levels and soil management. Diversification at the crop level also increases income diversity and therewith resilience towards losses through climate change. Improved soil management in combination with diversification increases soil fertility soil water-holding capacity, carbon sequestration and reduces erosion. Second, by strengthening the adaptive capacity to climate change: by diversification of knowledge through participatory events, social networks and reliving of traditional system knowledge.

Many experiences, data, evidence and results exist in the field, in different countries, led by farmers, civil society organizations, research and some supported by governments, which support this affirmation. Indeed, numerous reports (Baker et al 2019), from research organizations, civil society and grassroot organizations, present agroecology as a promising systemic approach to address the climate issue by unlocking adaptation and mitigation potentials and building resilience.

Despite this increased visibility in public debates and the claimed good performance of agroecology for transforming agriculture towards increased sustainability, it is not yet widely adopted by farmers. This is traced back to various reasons such as lack of enabling institutional and policy environments and the strong pressure from ongoing industrialization and commercialization, or lack of funds for research and education (Nicholls and Altieri 2018).

As agroecology has been existing long before climate change was seen as a major threat for agriculture sectors, there is still insufficient comprehensive and structured evidence supporting this claim as well as too little information made available on the broader political and political-economic challenges and constraints that need to be considered and addressed when building on the agroecology approach to hedge against climate change. Unlike in the more food system focused fora, such as the CFS 46 (with the endorsement of HLPE 2019), which are increasingly highlighting the essential role of agroecology in food systems transformations, agroecology does not yet get the same recognition and visibility in the climate change discussions. The evidence compiled in this study is and will be fed to the UNFCCC level to substantially contribute to the discussions, especially into the Koronivia submissions on 2b, 2c and 2d (see Chapter 2.2)

## Overall objective and set-up

Responding to FAO’s governing bodies’ call for increased evidence-based work on agroecology, this study aims at highlighting the linkages between agroecology and climate change, by providing evidence on the technical (understood as ecological and socio-economic) and policy potential of agroecology to build resilient food systems.

It has the objective provide evidence to the question: **How can agroecology contribute to climate change adaptation, mitigation[[2]](#footnote-3) and resilience, both in terms of practices and policies?**

Inspired by the idea that transformation will only happen through a coordinated articulation between all levels which are key for innovation (considering the local level of action and implementation, the national level defining the governance framework and the policies and the international agenda of the global level), this study brings together different levels of analysis:

1. At the international level:

* **A technical potential analysis through a meta-analysis**: which provides a scientific evidence from peer reviewed articles of the performance of agroecology in relation to climate resilience building (adaptation and mitigation)
* **A policy potential analysis**: which assesses the potential for agroecology to be considered and recommended as a relevant adaptation / mitigation approach in the agriculture-climate discussions.

1. At the national level: **Two country case studies** (Senegal and Kenya), each of which includes:

* **A technical potential analysis** which provides a better understanding of the ecological and socio-economic performance of agroecology, based on a rigorous comparative analysis answering to the question “are and if so why agro-ecological agroecosystems are more resilient than non-agroecological ones?”
* **A policy potential analysis** which provides a better understanding of the current political context as well as the enabling environment and the obstacles for agroecology to be considered in the decision-making process and out-scaling.

Figure 1: Illustration of the two levels (international and national) of analysis and the four components (Meta-analysis/International analysis of the policy potential/ national analysis of the policy potential/ local/national analysis of the technical potential). It also indicates content-wise overlaps.

The results of this study also aim to promote discussions around agroecology in national and international climate fora. By linking it closely to the KJWA process, the results of the Meta-analysis feeding several submissions of the KJWA (in particular elements 2b; 2c and 2d), this study pprovides an additional opportunity to bring agroecological solutions and good practices into the climate discussions, the overall results planned to be presented throughout several events during COP 25 in Chile in December 2019.

This study was carried out in 10 months (from March 2019 to December 2019), through a close multi-level (FAO Headquarters and Country Offices), inter-divisional (Plant Production and Protection - AGP, animal health - AGA, and climate change and environment - CBC) and multistakehoder collaboration, combining research (Research Institute of Organic Agriculture – FIBL, the Senegalese Institute for Agricultural Research and Bioversity International in Kenya) and civil society organizations ( Biovision Foundation for Ecological Development - Biovision, Enda Pronat in Senegal ). It was also open to external experts (who met twice during an Advisory group) and which members were part of the peer-review process. This interdisciplinary and multiscale study set up reflects and respects the complex nature of agroecology and climate change.

## Synergies with ongoing work and partnerships

Building on the 10 elements characterizing agroecology, part of the implementation of the Scaling-up Initiative on agroecology, this study is - as a co-benefit - pilot-testing the global knowledge product on agroecology (GKP- 2), developed by FAO in close collaboration with experts; the multidimensional assessment framework of agroecology (TAPE) (see 1.4.1). Considering the five main assets of the Sustainable Livelihood Framework, as well as the 13 indicators brought forward by Cabell and Oelofse (2012) in their publication on Agroecosystem Resilience Assessment (mobilized in the FAO SHARP tool), this analysis will collect and compile data and results from on-going field projects (see 1.4.2) .

Sinclair et al. (2019) have just recently published a background report for the Committee on Adaptation flagship report, on a similar question, “the contribution of agroecological approaches to realizing climate resilient agriculture”. The authors come to the conclusion that “Agroecological approaches have proven ability to simultaneously address specific climate hazards, enhance the resilience off farming systems to climate change and to improve the flow of a range of ecosystem services”. We made sure to build on existing findings, and have included the main findings and sources of GCA 2019 into this report, in particular into our meta-analysis. Finally, it builds on evidence stemming from relevant reports, in particular, the 2019 High Level Panel of Experts on Food Security and Nutrition report on agroecology (HLPE, 2019), the Global Center on Adaptation (GCA) Study (Sinclair et al., 2019) and the Swiss-National FAO committee discussion paper.

## Definitions and Concepts

### Agroecology framework: how to understand agroecology in this study

Complexity, context-specific and based on bottom-up and territorial processes being at the heart of agroecology, there is not one universal definition for it. Indeed, recent years have seen the multiplication of definitions of agroecology, nuances depending on the authors, institutions or CSOs, highlighting its dynamic concept (HLPE, 2019). Nonetheless, there is a consensus that agroecology embraces three dimensions: a transdisciplinary science, a set of practices and a social movement (Wezel et al., 2009; Wezel and Silva, 2017; Agroecology Europe, 2017)

Defined as one of the options of sustainable land management, including agroforestry (IPCC, 2019), Altieri (1995) defined agroecology as the application of ecological sciences to the study, design and management of sustainable agriculture. Integrated land-use systems that maintain species diversity, agrobiodiversity, the improvement of ecological processes and delivery of ecosystem service, the strengthening of local communities and recognition of the role and value of indigenous and local knowledge are core elements of agroecology (IPCC, 2019).

The HLPE report defines Agroecological approach to sustainable food systems for food security and nutrition as follows: “Agroecological approaches favour the use of natural processes, limit the use of purchased inputs, promote closed cycles with minimal negative externalities and stress the importance of local knowledge and participatory processes that develop knowledge and practice through experience, as well as more conventional scientific methods, and address social inequalities. Agroecological approaches recognize that agrifood systems are coupled social–ecological systems from food production to consumption and involve science, practice and a social movement, as well as their holistic integration, to address FSN.” Agroecology thus provides possible transition pathways towards more sustainable food systems, based on a holistic and systemic approach (IPES-Food, 2016). During its historical evolution, the focus of agroecology went from the field, farm and agroecosystem scales to encompass, over the last decade, the whole food system.

Bridging ecological and social dimensions, people-centered, knowledge-intensive and rooted to sustainability, agroecological approaches aim at transforming food and agriculture systems, addressing the root causes of problems and providing holistic and long-term solutions as expected by the 2030 Agenda (FAO, 2018). Agroecology particularly contributes to no poverty (SDG1), zero hunger (SDG2), good health and wellbeing (SDG3), decent work and economic growth (SDG8), responsible consumption and production (SDG12), climate action (SDG 13) and life on land (SDG 15) (CNS-FAO, 2019).

Encompassing aspects related to the three pillars of sustainable development (environment, social and economic), several sets of agroecological principles were developed by different actors so as to characterize inherent properties of agroecology.

Stemming from FAO regional seminars[[3]](#footnote-4), seen as an analytical tool, the FAO 10 elements of agroecology aim at helping countries to operationalize agroecology. They provide an overall framing of important properties of agroecological systems and approaches, as well as key considerations in developing an enabling environment for agroecology.

* Six elements relate to the description of common characteristics of agroecological systems, foundational practices and innovation approaches: **Diversity; synergies; efficiency; resilience; recycling; co-creation and sharing of knowledge**
* Two relate to context features: **Human and social values; culture and food traditions**
* And two relate to the enabling environment: **Responsible governance; circular and solidarity economy**[[4]](#footnote-5)

As illustrated below, these 10 elements reflect elements encompassing different scales (agroecosystem and food system), different levels of transitions towards sustainable food systems (as defined by Gliessman, 2007). When levels 1 and 2 are incremental, levels 3 to 5 are transformational.

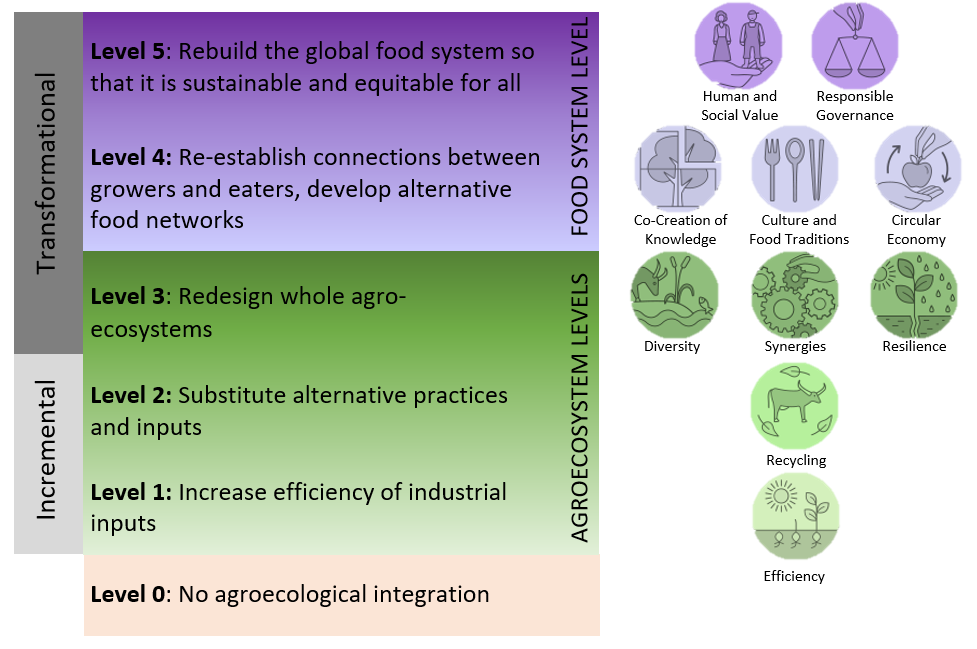


Figure 2: The 10 elements of agroecology understood according to: the levels of transition towards SFSs (Gliessman, 2007). Source: Biovision 2019, <https://www.agroecology-pool.org/> , inspired by (HLPE, 2019)

This study builds on these 10 elements, as analytical lenses framing what is understood by agroecology. It therefore adopts a systemic approach of agroecological agroecosystems, considering the entire food system (from production to consumption, considering the enabling environment).

### Climate Resilience

Climate change is expected to affect agriculture and food security in various ways and the effects being more negative than positive. These effects will be sector and region specific. With regard to regions and taking Africa for example as the focus of this study, the food production systems in this region are heavily exposed and sensitive. Crop production is mainly rainfed and livestock system are often unsheltered or unprotected. These, together with high intra-and inter- seasonal climate variability, high frequency of droughts and floods make African agriculture to be the most vulnerable (IPCC, 2014). There is therefore a need to reduce this vulnerability and to adapt agricultural systems to climate change and to enhance their resilience.

Vulnerability is the degree to which a system is susceptible to shock and stress (climatic variability and extreme weather events) and thus unable to cope or function due to lack of adaptive capacity (Folke, 2006). Vulnerability in this context is the function of exposure and sensitivity and it depends on the capacity of a system to respond (adaptive capacity). Sensitivity is the degree to which a system is likely to be affected by an exposure (climate variability) and together determine the potential impact of a shock (climate variability and change) (Fritzche et al. 2014).

Resilience on the contrary is defined as the ability of a system to absorb the shock, maintain its function during the shock or be able to return to its state prior to the shock (IPCC, 2012). According to (Gitz and Meyback, 2012), resilience goes further than shock absorption or return to previous state but rather about adapting and learning to cope with changes and uncertainties. To achieve this, systems and including agriculture will need a certain degree of capacities and these are: absorptive capacity, which is the ability to cope with and absorb effects of shocks and stress; adaptive capacity – ability of systems including the components of a system to adjust and adapt to shocks and stresses while functioning in accordance with the objective of the system, and transformative capacity which is the ability to drastically change in order to assume the new function.

According to Altieri et al. (2015), vulnerability of agricultural systems could be reduced by the response capacity which is embedded within the agroecological characteristics of the farm and adoption of adaptation strategies that can moderate the harm. Possible adaptation actions vary and have to depend on the context specificity of where agriculture is carried out.

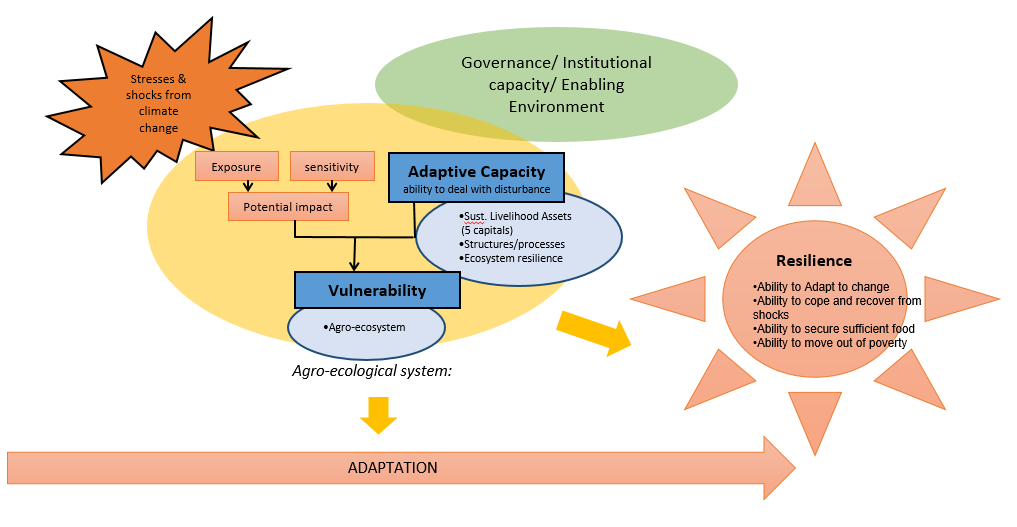


Figure 3: Resilience framework depicting a generic adaptation process and how the elements of adaptation interact to achieve resilience (adapted from FAO, 2017, DFID Disaster Resilience Framework (2011), TANGO Livelihoods Framework (2007), DFID Sustainable Livelihoods Framework (1999), Fraser, et al. (2011)).   
Building stronger resilience to climate change and resilient livelihoods requires increasing adaptive capacity and reducing vulnerability of agro ecological systems and livelihoods. These components of resilience may at the same provide mitigation co-benefits.

###### Measuring Resilience

Resilience is a challenging concept to measure (Cumming at al. 2005). The claims that some approaches could better enhance the resilience of a system than others are mostly based on variables like yield. This often happens when assessing the response of a system to risks like drought or floods, that is, one system performed better than the other during such events. However, given its abstract and multifaceted nature, resilience could hardly be quantified (Cumming et al. 2005) and more so for agroecosystems which constitute both social and ecological elements (Cabell and Oelsfe, 2012). This difficulty stems from the fact that, resilience is context specific and depends on temporal and spatial scales and instead of measuring it, some general rules and principles could be identified that maybe a guide towards achieving resilience (Carpenter et al. 2001).

According to Cabell and Oelsfe (2012), such rules and principles, could be grouped and divided into different indicators that their presence in an agroecosystem may imply that it is resilient and possesses the capacity to adapt and transform when faced with shocks (climate change and variability). These indicators should be consistent with agroecosystems nature that is, physico-chemical (ecological), and socio-economic (social and economic). The goal for assessing resilience should therefore be to understand the drivers of vulnerability in order to identify some intervention options that can improve climate resilience of agroecosystems.

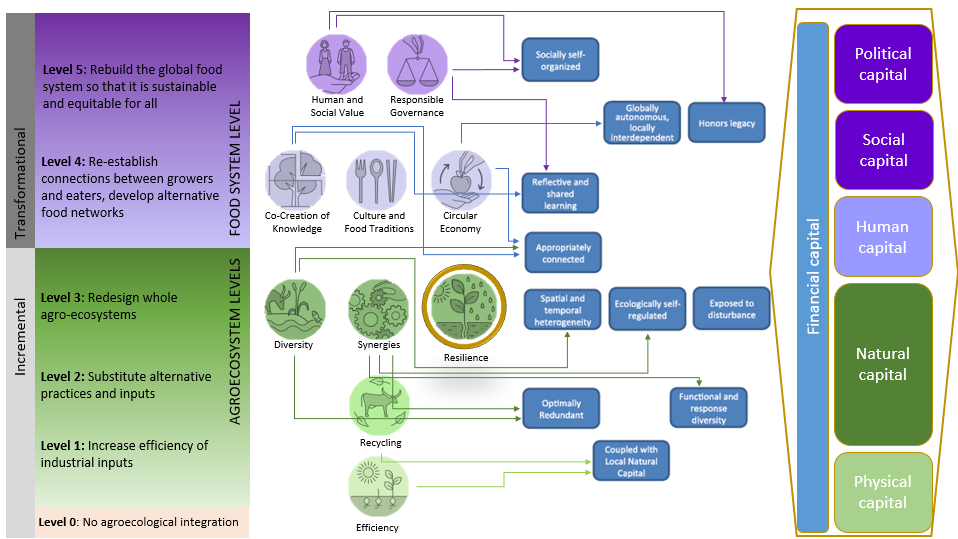


Figure 4: Linking FAO’s 10 elements of agroecology & Gliesmman’s 5 levels of food system transformation (inspired by HLPE report) with the 13 SHARP resilience indicators and the 6 SLF framework dimensions

# International policy potential

## Background on agroecology in the UNFCCC climate negotiations

### The long road to Koronivia: A brief history of agriculture in the international climate change policy debate

The **intrinsic connection between agriculture and climate change** was already explicitly recognized at the first World Climate Conference in 1979, both in terms of “human activities that affect climate” and in terms of impacts of climate change on agriculture and food security (WMO, 1979). Climate change was “firmly put on the agenda of politicians” (Gupta, 2010) in 1990, following the second World Climate Conference and the establishment of the Intergovernmental Panel on Climate Change (IPCC)[[5]](#footnote-6).

Two years later, **in 1992, the UNFCCC was adopted** in New York during a UN General Assembly and opened for signature at the “Rio Earth Summit”. It entered into force in 1994 with a mitigation objective, to "stabilize [greenhouse gas](https://en.wikipedia.org/wiki/Greenhouse_gas) concentrations in the atmosphere at a level that would prevent dangerous [anthropogenic interference](https://en.wikipedia.org/wiki/Human_impact_on_the_environment) with the [climate system](https://en.wikipedia.org/wiki/Climate_system)" (UN, 1992). The Convention specifies that such a level should be achieved, inter alia, to ensure food production is not threatened[[6]](#footnote-7).

At the early stages of climate change policy discussions, including in the UNFCCC, there was a **marked emphasis on mitigation**10. Adaptation and climate resilience of agriculture received little to no attention, but the IPCC response strategies pointed out potential co-benefits (e.g. erosion control, improved water management) of mitigation measures proposed for the agricultural sector (IPCC, 1990). These proposed mitigation options with potential co-benefits include some practices related to sustainable agriculture and agroecology such as minimum- or no-till systems, perennial cover crops, reducing nitrogen fertilizer use by applying animal manure, and silvopastoral systems.

The Kyoto Protocol, adopted in 1997 and entering into force in 2005, builds on the UNFCCC and does not contain any new long-term objectives or principles. It specifically mentions sustainable agriculture as a means for mitigation, yet provides no further details (Gupta, 2010). The Kyoto Protocol defined the Clean Development Mechanism (CDM) – one of the flexible mechanisms, designed to enable parties to achieve emission reductions – in a way that would allow for using climate mitigation funds for the payment for ecosystem services. While improved soil management has a large potential for carbon sequestration and some argued that such payments could provide farmers in developing countries with considerable supplementary income, soil carbon sequestration was eventually excluded from the international carbon offset markets. The opposition to its inclusion was partially based on “the argument that soil carbon offsets were a means of putting the mitigation burden on low income developing country farmers and that farmers were unlikely to see any benefit from participating in such markets, but rather could be exposed to losing rights to their land” (Lipper and Zilberman, 2017).

The second decade of the **new Millennium brought an end to the long-standing dichotomy between adaptation and mitigation**, broadened the discussion from agriculture to a more holistic food system approach and led to a proper “climatization of the debate on agriculture”[[7]](#footnote-8). To a large degree this was due to the systems perspective of [the 2030 Agenda for Sustainable Development](https://sustainabledevelopment.un.org/post2015/transformingourworld)[[8]](#footnote-9) and the [Paris Agreement on Climate Change](https://sustainabledevelopment.un.org/frameworks/parisagreement)[[9]](#footnote-10), the IPCC’s increasing references to “food systems” in its reports as well as several research initiatives[[10]](#footnote-11) bringing forward “win-win” solutions (highlighting synergies between adaptation and mitigation).

Since 2006, the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) held a number of workshops on issues related to agriculture. **Agriculture was formally incorporated as an agenda item under the SBSTA in 2011**. Between 2013 and 2016, five workshops on issues related to agriculture took place under the SBSTA. Finally, at COP23 in 2017, the two permanent subsidiary bodies (SBs) of the UNFCCC (SBSTA and SB for Implementation, SBI) were officially requested to jointly address issues related to agriculture[[11]](#footnote-12). This collaborative process, the Koronivia Joint Work on Agriculture (KJWA), was to include workshops and expert meetings, working with constituted bodies under the Convention and take into consideration the vulnerabilities of agriculture to climate change and approaches to addressing food security. The **decision to establish the KJWA was hailed as a breakthrough**, being the “first substantive outcome and COP decision in the history of the agenda item on agriculture” and giving unprecedented priority to the objective to “develop and implement new strategies for adaptation and mitigation within the agriculture sector”(St-Louis et al., 2018). The establishment of the KJWA was fruit of a long negotiation process, **ending the divide between technical knowledge and implementation** by bringing together the SBI and SBSTA.

### NDC 2015-2019 Analysis

#### Approach

The nationally determined contributions (NDCs) of 136 countries to achieving the mitigation and adaptation goals declared in the Paris Agreement were analyzed. The analysis was intended to identify the extent to which countries perceive or employ agroecology and related approaches as adaptation and/or mitigation strategy in the agricultural sectors. Agroecology was defined on the basis of FAO’s ten elements of agroecology (FAO, 2018).

Due to the heterogeneity of the NDCs, both in terms of length and content, each NDC document was assessed comprehensively to identify the overall coverage of agriculture then narrowing down to agroecology. The analysis was based on word count and on content analysis, recording the number of times that agroecology and related practices and principles were mentioned. Countries were classified according to their regional grouping – Sub- Saharan Africa, Asia and the Pacific, Latin America and the Caribbean and Near East and North Africa.

#### Results

A previous analysis of the NDCs carried out by FAO (2016) showed that **the agriculture sector features prominently in the NDCs**, with many countries highlighting the role of agriculture, forestry, fisheries and aquaculture in their economic development. Many also point to the vulnerabilities of these sectors to climate change. The agriculture sectors are able to deliver considerable adaptation and mitigation benefits and many NDCs recognize these adaptation-mitigation synergies.

Out of 136 NDCs analyzed, **17 countries[[12]](#footnote-13) (12.5 %) explicitly mention agroecology**. **Of these countries, 13 are from Sub Saharan Africa**, 2 from Latin America and Caribbean, 1 from Near East and North Africa and 1 from Asia Pacific. For these 17 countries, 15 of them see agroecology as an intended adaptation strategy while only 6 countries see it as contributing to mitigation. For the African countries that mention agroecology as one of the adaptation options, **the majority of them see it in the** **context of soil, land and water management.** For example, Burundi (Republic of Burundi, 2015) aims to develop an agroecology approach for soil fertility management and soil conservation. Rwanda (Republic of Rwanda, 2015) seeks to employ agroecology for nutrient cycling and water conservation in order to maximize sustainable food production, while Cote d’Ivoire (Cote d’Ivoire, 2015) intends to use agroecology for reforestation and restoration of degraded lands. Two countries in Latin America see agroecology as a transition towards sustainable agricultural systems. Honduras (Republic of Honduras, 2015) is aiming to promote the establishment of regional research centers and national outreach programs and development of sustainable systems based on agroecology while Venezuela (Republic of Venezuela, 2015) is promoting agroecological systems based on sustainability and respect for the natural ecosystem processes. In addition to the 17 countries explicitly mentioning agroecology as either an adaptation or mitigation strategy or both, many countries mention agroecological approaches by highlighting some of the elements of agroecology. **The elements of agroecology highlighted most prominently are related to production aspects** (diversity, efficiency, recycling, resilience and synergies)**; elements referring to the socio-economic and political dimension of agroecology** (circular and solidarity economy, co-creation and sharing of knowledge, culture and food tradition, human and social values and responsible governance) **are largerly neglected** (Figure 5).

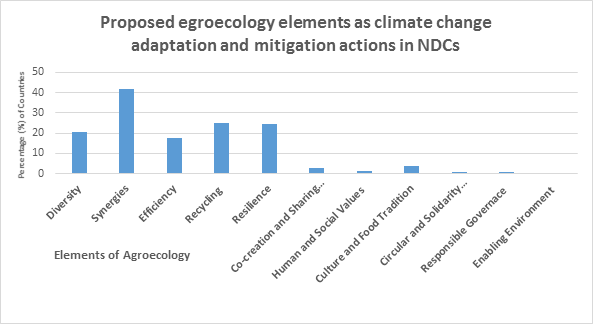


Figure 5: The degree to which countries highlighted different elements of agroecology as options contributing to both adaptation and mitigation in their NDCs. The majority of countries see agroecology mostly as an adaptation strategy. Mitigation is seen mostly through synergies with the use of agroforestry and efficiency through organic fertilizers.

The degree to which these agroecology elements are reflected in countries NDCs differ by regions (Figure 6). Synergies are very frequently referred to by countries in Sub- Saharan Africa (in 60% of NDCs) and Latin America (41%). The same regions also emphasize resilience. In NDCs from the Asia Pacific region, on the other hand, efficiency and recycling figure prominently. In the NDCs from Near East and North Africa region, none of the elements of agroecology play a notable role.

**Most of the regions put more emphasis on the production related elements of agroecology and less on the socio-economic related elements.** For example, out of the 136 NDCs analyzed, only 4 countries refer to the co-creation of knowledge, 5 countries to culture and food tradition and only 2 countries refer to human and social values. Countries referring to these socio-economic and political elements are mainly from Latin America and the Caribbean. With regard to co-creation of knowledge, Venezuela aims to mainstream agroecology into school curricula from pre-school to high school as well as the creation of training programs for bachelor and diploma. Some countries, including Guatemala and Bolivia, acknowledge the importance of indigenous and ancestral knowledge which will need to be remembered and revitalized.

Figure 6: Percentage of countries by regions in NDCs referring to different elements of agroecology as the intended adaptation options and or activities in agricultural sectors. NB: AE is agroecology, RAF is Sub-Saharan; RLC is Latin America and Caribbean; RAP is Asia and the Pacific and NENA is Near East and North Africa.

While there are apparent differences in the number of countries within regions referring to different elements of agroecology, the approaches and practices classified under each element are quite similar.

Under synergy, which is the most frequently identified agroecology element, the majority of the countries refer to agroforestry, silvopastoral and mixed crop-livestock systems. In regard to diversity, most countries are aiming to employ different crop varieties and livestock breeds with more emphasis on traditional crops and livestock, which are considered more stress tolerant and adapted to local conditions. For efficiency, most countries promote reducing the use of industrial inputs through the adoption of organic fertilizers integrated pest management. Recycling is mentioned mostly in reference to composting and crop residue reuse for soil cover and soil organic matter improvement. For the countries in Near East and North Africa aiming for recycling, all of them refer to wastewater reuse as a recycling approach to water management in agriculture. Resilience is seen mostly through a diversification perspective; i.e. diversifying agricultural activities will contribute to farmer’s resilience. In addition to diversity of activities, another aspect of resilience that most countries from the four analyzed regions envision, is the use of agricultural insurance and establishment of micro-credit financing to increase the resilience of producers.

## Current dynamics in the Koronivia negotiations: opportunities and challenges for agroecology to be supported by outcomes and mechanisms of the UNFCCC

### The Koronivia Joint Work on Agriculture (KJWA) process and initial submissions of parties and observers

The roadmap of the KJWA foresees in-session workshops on six topics from December 2018 to June 2020 (fig. 7). Parties were invited to submit their views ahead of the adoption of the roadmap in May 2018. FAO provides a detailed analysis of the initial submissions by 21 parties and 27 observers (Chiriacò et al., 2018). Here we provide a quick overview of this FAO analysis from an agroecology perspective.

Many of these **initial submissions focussed on the modalities of the KJWA process** and of issues related to assessment, monitoring and evaluation. A number of submissions express the view that the KJWA is above all a **great opportunity for sharing knowledge, experiences and best practices**. Thus, a number of submissions include specific showcases whereas others focus on needs and priorities for advancing on the respective workshop topic.

It is noteworthy that showcases and best practices are mostly included in the submissions of industrialized countries and the West African nation Benin. These “best practices” generally emphasize conventional agriculture, biotechnology and digital solutions but also include some agroecological practices (e.g. cover crops, no-till, recycling of drainage water, rotational grazing). On the other hand, submissions of developing countries (including AGN, LDCs, and the African states Benin, Burundi, Kenya and Malawi) usually include a list of priorities and needs to advance on the respective topics. These lists, in a considerable number of cases, make reference to practices or principles related to agroecology. Specific examples include capacity building for women and youth, conservation agriculture, cover crops, crop rotation, ecosystem-based grassland management, inclusive property land rights, integrated agro-silvo-zootechnical systems, integrated soil fertility management, optimized management of crop residues, organic fertilizer and organic farming in general, reforestation, restoration of degraded lands, and valorisation of animal waste). Finally, it is important to note that only the LDC group submission highlights the need to integrate traditional knowledge.

2(a) ***Five***

***in-session workshops***

**22 Oct 2018**

2(b) ***Adaptation,***

***adaptation co-benefits*** and ***resilience***

2(c) ***Soil, water management*** and ***integrated systems***

**6 May 2019**

2(d) ***Nutrient use***

and ***manure managment***

**30 Sept 2019**

2(e) ***Livestock***

***management***

and ***resilience***

2(f) ***Socioeconomic*** and ***food security dimensions***

**20 Apr 2020**

***Future topics*** and

views on the progress of the KJWA

**28 Sept 2020**

**SB49 / Dec 2018**

2(a) ***Five in-session***

***workshops***

**SB50 / Jun 2019**

2(b) ***Adaptation, adaptation***

***co-benefits*** and ***resilience*** 2(c) ***Soil, water***

***management*** and

***integrated systems***

**SB51 / Nov 2019**

2(d) ***Nutrient use*** and ***manure managment***

**SB52 / Jun 2020**

2(e) ***Livestock management*** and ***resilience***

2(f) ***Socioeconomic*** and ***food security dimensions***

**Nov 2020**

*Report to COP26 on progress and outcomes of work, including on potential future topics*

Submissions

Workshops

Figure 7: Roadmap of the Koronivia Joint Work on Agriculture (KJWA) from St-Louis et al. (2018). FAO, Rome.

Parties and observers to the UNFCCC are invited to submit their views ahead of each of the workshops on the six topics agreed upon in the roadmap of the KJWA. We present in the following sections, an individual and systematic review of all of the submissions (as well as the official workshop reports) on topics 2(a), 2(b), 2(c), and 2(d) from an agroecological perspective. The conceptual framework for this review builds on FAO´s ten elements AE (FAO, 2018). In order to determine, whether or not a specific point raised in any one of the submissions can be considered to address one of these ten elements, the indicators of Biovision´s Agroecology Criteria Tool (ACT) are applied (Biovision, n.d.).

### Topic 2(a)

**Modalities for implementation of the outcomes of the five in-session workshops on issues related to agriculture and other future topics that may arise from this work**

As the workshop title suggests, the majority of submissions and discussions focussed on modalities and processes with an emphasis on sharing of knowledge and experiences as well as support for implementation (Chiriacò et al., 2019; UNFCCC, 2019a). Concrete **practices and technologies received little attention but a couple of submissions called explicitly for systemic and transformational approaches as well as enhanced inclusiveness, equity and participation**.

Agroecology is specifically mentioned only in the submission by the Climate Action Network (CAN). CAN refers to agroecology in three instances, including this statement: “KJWA presentations and discussions should reflect on and direct work towards holistic efforts, including the progressive transition towards agroecology to ensure the long-term viability of agricultural systems within the natural world that they depend upon.” (Climate Action Network International, 2018). Additionally, several submissions mention sustainable agriculture and the need for approaches to adaptation that create co-benefits for sustainable development. Further, individual elements of agroecology are mentioned in 53% (9 out of 17) party submissions and in 54% (7 out of 13) observer submissions (fig. 8). The submission of Vietnam is the most concrete, pointing out good experiences with integrated crop-livestock-aquaculture systems, referring to this as climate smart agriculture (CSA).

Figure 8: Percentage of party (n=17) and observer (n=13) submissions to the KJWA workshop, on topic 2(a), at SB49 making specific reference to any of the 10 elements of agroecology.

### Topic 2(b)

**Methods and approaches for assessing adaptation, adaptation co-benefits and resilience and Topic 2(c): Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management**

As both topics were addressed at the same session (SB50) and there was a single call for submissions on both topics, a number of submissions do not clearly separate the two topics and are therefore discussed jointly here as well.

**Elements of agroecology figure quite prominently in many submissions** to SB50 (fig 2.3). Submissions specifically on topic 2(b) often include references to socio-political aspects of agroecology (e.g. co-creation and sharing of knowledge, human and social values and responsible governance). Views on topic 2(c) often highlight the adaptation and mitigation co-benefit potential of agroecological farm- to landscape level approaches corresponding to the elements efficiency, diversity, recycling, resilience and synergies. Culture and food traditions as well as circular and solidarity economy are the only two elements rarely addressed in party as well as observer submissions, as both are mentioned in just a single observer submission each.

Most party submissions consist of rather general statements with little concrete measures mentioned. Frequently, the emphasis is on sharing the relevant experiences, lessons learned and best practices of the respective submitting party. While **agroecology is rarely mentioned specifically**, some party submissions contain **various references to agroecological practices** (e.g. Indonesia, Uruguay, Brazil, Vietnam, Kenya). However, **usually these are mentioned as singular approaches** (especially agroforestry, cover crops, crop rotation, organic fertilizers and reduced tillage) **and not as part of a systemic transformation of production systems**. Two out of 17 party submissions (Kenya and EU) refer to agroecology by name. While Kenya describes it as a CSA measure, the EU mentions agroecology as a transformational approach as well as an example of “sustainable land/soil management practices” (Romania and the European Commission on behalf of the European Union and its member states, 2019).

**Agroecology is mentioned explicitly in 22% of observer submissions** (5 out of 23) on topics 2(b) and (c) (Biovision & FiBL, Climate Action Network, GenderCC, GIZ, YOUNGO). In all of these, agroecology plays a rather **central role and is decisively endorsed**. Additionally, nearly all other observer submissions (all but the World Business Council for Sustainable Development) include at least one element of agroecology, without mentioning it by name.

The **enhanced interest in agroecology and other transformative approaches is also demonstrated by the workshop reports drafted by the UNFCCC secretariat**. The report on topic 2(b) states that “it is generally accepted that successful adaptation to climate change requires transformation and paradigm shifts” and specifically mentions agroecology two times (UNFCCC, 2019b). The report on topic 2(c) even refers eight times explicitly to agroecology, including thrice in the section “Summary of discussions and the way forward” (UNFCCC, 2019c).

Figure 9: Percentage of party (n=17) and observer (n=23) submissions to the KJWA workshops, on topics 2(b) and (c), at SB50 making specific reference to any of the 10 elements of agroecology.

### Topic 2(d)

**Improved nutrient use and manure management towards sustainable and resilient agricultural systems**

Still to be added by Matthias Geck once all submissionson 2(d) are uploaded)

## Opinions of key stakeholders on the current discussion on the agriculture and climate change nexus in the UNFCCC processes (including the KJWA)

Using a guideline for semi-structured interviews (Annex 7.1), 15 selected individuals (Annex 7.1) from key positions in governmental, multilateral, civil society, research and farmers’ organizations were interviewed. The objective was to better understand stakeholders’ opinions and perceptions on **the role of agroecology in the international climate change policy debate**, particularly within the UNFCCC processes (including the KJWA).

This first part addresses stakeholders’ perceptions of the **current dynamics and critical points** of the debate in the UNFCCC processes in general and specifically regarding the KJWA. The subsequent section (2.4) brings forward opinions regarding the future **outlook** on the links between agroecology and other sustainable agriculture approaches and climate change.

All interviewed partners agree, that the discussion on the agriculture-climate change nexus was delayed for too long and that even now discussions at the UNFCCC processes are not yet about which agricultural model to promote. Thus, **neither conventional agriculture nor agroecology or other transformative approaches are emphasized**. The current debate seems to be really on the general modalities of implementation (rather on the who and how; responsibilities and financing) and usually do not go to sufficiently in depth and detail regarding approaches (the what; appropriate technologies). Several interviewees feel that **“discussions in the UNFCCC often remain vague and not precise”.**

Nevertheless, many interviewees perceive that **transformational approaches are becoming increasingly important** for both parties and observers, “at least in the wording although the reality usually remains at essentially a business usual model”. Hence, it seems that *de facto* **most parties still aim for incremental change within conventional agricultural systems**. Interviewees often explained this by the fact that countries strive to protect their own interests and to have a competitive edge on the global market. The majority of interviewees agree that a number of **observers are a lot more demanding regarding the promotion of transformative approaches**, such as agroecology.

Different debates co-exist regarding how the topic of agriculture-climate change nexus should be approaches, highly related to technical, economic or political interests and positions.

Table 1: The role of agroecology in the international climate change policy debate

|  |  |  |  |
| --- | --- | --- | --- |
| Debate 1 | Soil Carbon | versus | Global, holistic vision |
| Debate 2 | Agriculture only | versus | Food system |
| Debate 3 | Not considering indirect effects | versus | Considering indirect effects |
| Debate 4 | Climate change only | versus | Broader interdisciplinary aspects (such as socio-economics, health and nutrition, etc.) |
| Debate 5 | Greenwashing | versus | Agroecological approach |

A number of interviewees highlight that **agroecology is “clearly gaining momentum”**, showing a growing interest, although it still **remains a controversial topic**. As a representative of FAO phrases it: agroecology is a “difficult agenda to move forward, with big powerful countries with dominant industrial agricultural systems” opposed to it in principal. Further, a negotiator reflected: “Agroecology is increasingly being mentioned but technological details etc. do not receive sufficient attention and detailed explanations are mostly lacking”. Generally, several interviewees mentioned they were **missing a stronger science-policy interface in the KJWA workshops** and feel that capacity-building and awareness raising is often missing for negotiators to be sufficiently equipped to tackle the different topics discussed.

Finally, different interviewees expressed **confusion or even frustration regarding the myriad of concepts and approaches without clear distinction** (e.g. agroecology, climate smart agriculture, conservation agriculture, ecosystem-based adaptation, nature-based solutions, and sustainable land management). Some see it as the mandate of UN institutions, such as FAO, to clarify, show evidence, and showcase different options, providing a global framework. On the other hand, speaking from a farmer perspective, an interviewee flags that **“it’s not about black or white but rather the diversity of options”** and “the core of the debate should focus on one factor these concepts should all have in common: profitability and the need for improving farmer’s wellbeing”.

## Outlook: Future potential of AE to be backed through UNFCCC (or other international processes)

“Koronivia gave soul to agriculture in the climate change discussions’’, interviewees all agree that as only active agenda focusing solely on agriculture, “the process itself is extremely valuable and important”. Yet some regret that "**discussions do not lead to any concrete decisions or actions**”. An interviewee highlights that the Koronivia process is currently missing the grasp of transformational change of the agricultural system as it limits itself to food security, not embracing the entire food system.There is a lot of hope for post-COP 25, as this is seen as “a big turning point for KJWA”, the “test phase for the KJWA to show it is useful” and make it a “trigger of change”.

**There are diverging views on the question whether agroecology has a chance to be promoted in the KJWA outcomes.** Some (especially national negotiators and researchers) feel it as “quite possible”, highlighting the numerous interventions on agroecology during workshops and in submissions (regarding soil related issues for example, as highlighted in the sections above) both by northern and southern countries as well as the inclusion of agroecology as a footnote in the IPCC special report on land. **If not promoted by name, many are sure that agroecological practices and principles will play an important role in any conclusions and outcomes**.

A majority (governments, researchers and NGOs) express more doubts and see it as “unlikely” for different reasons. A negotiator highlights that **agroecology is “still perceived as being too idealistic and dogmatic and most actors are obliged to balance the opinions and demands of different interest groups**”, a researcher mentions not expecting “such a level of detail on technologies and approaches but rather outcomes on modalities and processes”, an NGO representative mentions that “agroecology as a solution or system is not very prominent in the debates”.

Nevertheless, it is encouraging to note that many interviewees from different backgrounds insist on the “strong need of the engagement of people advocating on agroecology in this debate”. Many highlight that “any effort to have this on the agenda in the discussion is important”. Also, some mention that discussions on agroecology will shape and influence agricultural development activities of member states, through the promotion of country experiences and best practices. Examples of what worked in countries being the most convincing argument.

|  |
| --- |
| **Interviewees highlight several issues hindering the scaling-up of agroecology in the climate change discussions**, in particular:   * The wording often being very political * The absence of a common understanding, the lack of sensibilization, visibility and communication on agroeoclogy, in particular to some key stakeholders (i.e. key investers and donors are currently missing in the climate discussions) * Doubts prevail regarding scientific evidence for agroecology, thus the key importance of discussing technological details during side-events * The difficulty in having a proper spokesperson for agroecology in the climate discussions, due to stronge resistance by some influentialy stakeholders * There is still a lot of reluctance to consider the entire food system in its globality * The absence of international trade from the debate on CC and AE (only addressing “non-market approaches”), no questioning of the current trade form * The lack of common understanding of the boundaries between the multiplicity of different concepts (agroecology, climate smart agriculture, conservation agriculture, ecosystem-based adaptation, nature-based solutions etc.) * The focus on farm-level carbon and methane emissions in the climate change discussions, when a key entry-point for agroecology is land-use at a territorial scale. |

**All interviewees agree that the UNFCCC framework (including KJWA) is one of the right places to push for a more sustainable food system, including to scale up agroecology, but not the only one.** It is key to seize the opportunity of the climate agenda to open discussions on the transformation of the agricultural model to achieve environmental performance and to bring back complexity within agricultural systems. But, “climate alone is not enough, or else it will not be truly transformational”. It is also key to focus on other related issues, and therefore other arenas and fora as well, such as biodiversity (CBD, IPBES) and food security (CFS). This highlights the big challenge of the compartmentalization of the different topics and the need to build bridges between different existing conventions and fora (UNFCCC, CFS, CBD, IPBES).

**Currently, there is a lot of hope for the scaling-up of agroecology. This promising turning point is partially enabled by the IPCC special report on land, advocating for a transformation of the food system.**“Providing a framing of the answer”, with technical elements, this report provides a clear understanding of the convergence of different options, highlighting their co-benefits. It particularly focuses on solutions concerning soils and forests, for which agroecology integrates many of the solutions and tackles many of the challenges exposed. The IPCC special report on land “clearly promotes agroecological practices, without specifying the concept” and agroecology is included in the footnote of the definition of sustainable land management (SLM). Many interviewees highlight that this report is a very positive basis for scaling-up agroecology within the climate change discussions, as these reports have an outstanding weight in the climate change debates.

A combination of other elements brought forward by the interviewees show a promising road towards the scaling-up of agroecology. For instance, the accelerating convergence between scientific evidence and civil society mobilization was mentioned as key to making change happen. Further, it was pointed out that there is an increasing convergence between the three “Rio Conventions” (CBD, UNCCD and UNFCCC) creating momentum for integrative and systemic approaches. Finally, there is a growing emphasis on nature-based solutions as highlighted in the IPCC land report, the UNCCD-SPI report on carbon benefits of SLM (Chotte et al., 2019) and the global assessment report of IPBES (IPBES, 2019).

## Conclusions on the potential to integrate agroecology in international climate change policies

Only recently the link between agriculture and climate change began to be properly articulated on the international policy level and **finally the dichotomy between climate change mitigation and adaptation seems to have been largely overcome**. The establishment of the KJWA was a breakthrough as it brought unprecedented emphasis on the climate change – agriculture nexus and the **potential of agriculture to contribute to both mitigation and adaptation simultaneously**.

A detailed analysis of 136 NDCs and all submissions to the first three KJWA workshops demonstrate that a considerable number of **countries and stakeholders from different backgrounds see agroecology and related approaches as a promising means for reaching adaptation and mitigation targets** and at the same time increase the resilience of the agricultural sectors. Invidual elements of agroecology, **particularly in regard to soil health and natural resource cycles**, are perceived as auspicious approaches. The systemic nature of agroecology and especially its **socio-economic and political elements receive far less attention**. Submissions by observers to the UNFCCC, especially those of some civil society organizations (**CSOs), are much more demanding and call for fundamental transformation of the food system**. That such a transformation is necessary is also acknowledged by the UNFCCC secretariat, stating that “it is generally accepted that successful adaptation to climate change requires transformation and paradigm shifts” and by the European Union (EU) referring to agroecology as a transformational approach as well as an example of “sustainable land/soil management practices”. Also, recent reports by the IPCC, the UNCCD-SPI and the IPBES indicate an increasing convergence of the three “Rio Conventions” and demonstrate a shared focus on transformative approaches as well as nature-based solutions. Based on these findings, it is not surprising that many of our high-level interview partners from diverse institutions highlighted that **agroecology is gaining momentum**. However, given the complex political economy underlying decision-making under the UNFCCC and the still contentious nature of agroecology, **few believe that agroecology will be specifically promoted in an official outcome of the KJWA**. Much rather, it is likely **that individual elements or practices of agroecology will be promoted under a different umbrella term**, such as ecosystem-based adaptation, climate smart agriculture or nature-based solutions**. It is key to prevent the risk that an official outcome on agroecology gets stripped of its social, economic and political dimensions and hence of its core holistic, systemic and transformative nature, which is the exact reason of its potential to build resilience to climate change**. Indeed, only when agroecology is used to re-design agroecosystems on a landscape level and the socio-economic and political dimensions of agroecology are taken into account, can the multiple aspects of resilience be addressed.

# Meta-Analysis: Evidence on the potential of agroecology to adapt and increase resilience to climate change

## Introduction

While a huge number of case-studies and summarising reports illustrates the potential of agroecology for increased sustainability and climate change adaptation in particular (Côte, Poirier-Magona et al. 2019), the overall evidence-base lacks systematic scientific syntheses of the key indicators for agroecology as a comprehensive approach. This contrasts with the situation of organic agriculture, for example, where a number of recent meta-analyses on yields, financial performance, soil organic carbon and other environmental aspects is available (Gattinger, Muller et al. 2012; Crowder and Reganold 2015; Seufert and Ramankutty 2017; Sanders and Hess 2019; Seufert 2019). Such robust scientific evidence-base is however central for triggering any significant policy support for agroecology and farmer adoption, when stronger calls are voiced that agricultural policies should become more evidence- and results-based. This chapter aims at closing this knowledge gap on the performance of agroecology with regard to climate change adaptation by compiling and analyzing the scientific evidence from this rich body of existing knowledge on agroecology.

## Methodology

To synthesise this evidence, the analysis draws on two types of results.

First, there is a considerable number of case studies that assess the climate change adaptation potential of production systems, which are judged agroecological by the authors. An extensive literature search on those in English, Spanisch, French, Protuguese and Italian was undertaken, and only the studies that a) were peer-reviewed, b) contained information on an agroecological system in comparison to some baseline system, and c) provided quantitative evidence for the relative performance regarding at least one indicator for climate change adaptation and resilience (Chapter 1.3) were retained. These studies are referred to as **“Single system comparison studies”.**

Second, there is a huge number of case studies that analyze how agricultural production systems, practices and characteristics that strongly relate to agroecology or some of it’s key elements (but without referring explicitly to this term) correlate with indicators of climate change adaptation and resilience. Examples are comparisons of organic versus conventional production systems with respect to yield stability, comparisons of different levels of species richness in agro-ecosystems with respect to total biomass production, or comparisons of systems with organic fertilizers to such with mineral fertilizers with respect to soil fertility. These second type of case studies have repeatedly been synthesized in a number of meta-analyses and reviews on various topics. The search was thus not targeted at these underlying case studies specifically, but directly draw on the results from the corresponding meta-analyses and reviews. By this, the analysis also covers the knowledge based on case studies that do not explicitly refer to agroecology but to some of it’s key components as captured in the 10 elements of agroecology (FAO 2018) (for full description of the terms, see Annex 7.2.1).

This analysis employs the notion of agroecology used by the UN Food and Agriculture Organization (FAO), structuring it along the ten elements embracing agronomic, environmental, social, economic and institutional dimensions (FAO 2018) (see Chapter 1.3 and Figure 2). For the analysis of the performance regarding climate change adaptation, the analysis refers to the indicator framework implemented in the SHARP climate resilience assessment tool (Cabell and Oelofse 2012; FAO 2015) and the ten performance indicators proposed by the global analytical framework for the multi-dimensional assessment of agroecology (FAO 2019).

It is key to highlight that this approach may result in two types of bias. First, the review on the single case-studies does not cover any study that is not self-declared agroecological. The studies without reference to agroeocology are however covered in the meta-analyses and reviewes included, and this bias in the choice of the case studies does thus not result in a bias in the knowledge base covered. Second, the meta-analyses and reviews may cover some of the single agroecological case-studies as well. However, given the low number of the latter compared to the huge number of studies covered in these meta-analyses and reviews, this potential double-count will neither result in any relevant bias. For the detailed methodology, please see Annex 7.2.

## Results

During the literature search, it turned out that only few self-declared agroecological studies met our inclusion requirements. Furthermore, the studies retained covered a vast heterogeneity of cases. It has thus not been possible to do any formal synthesis of those. However, on the other hand, we found a considerable number of meta-analyses and reviews on production systems, practices and characteristics that closely relate to agroecology and hence decided to base our analysis primarily on those rather than on the agroecological case studies.

### Meta analyses and reviews

We identified 33 quantitative meta-analyses and 18 more descriptive reviews out of 185 identified in the first screening. From the meta-analyses, some clear patterns emerge (Figure 10).

First, key practices and characteristics of agroecological production systems, such as use of organic fertilizers, higer crop diversity, low-input systems, organic farming or agroforestry significantly correlate with good performance regarding a number of soil characteristics and biodiversity aspects (e.g. soil organic carbon content, soil biodviersity, soil microbial biomass and activity, nematode and earthworm abundance, and species richness), which are key central aspects of climate change adaptation (FAO 2015, IPCC 2019) (see Figure 4 – Elements vs. SHARP principles)

Second, most of the evidence relates to the performance of organic agriculture, agroforestry and practices related to increased crop diversity and organic fertilizer use. Not much evidence is provided on the performance of societal and social aspects of agroecology regarding indicators related to climate change adaptation. One exception is (Crowder and Reganold 2015) reporting on the profitability of organic agriculture, measured via gross returns, benefit/cost ratio and net present values.

Third, clear results can also be seen on mitigation co-benefits of the key practices and characteristics of agroecological production systems, which consistently report positive significant effects on soil carbon contents.

Fourth, yields often tend to be lower in low-input systems than in the conventional reference systems they are compared to. This is the case for organic agriculture, for example, which is an exemplary production system that in many agronomic aspects shows close similarities to agroecology, and for which more scientific evidence is available due to its clear definition. For organic agriculture, also yield stability is lower than in the conventional baseline. This can be traced back to overall lower nitrogen fertilization levels in organic than in conventional agriculture. Comparing studies with similar fertilization levels only, yield stability does not any longer differ significantly, while yields are still lower in organic production (albeit less so than with common conventional average, i.e. higher, fertilization levels) (Knapp and van der Heijden 2018). On the other hand, certain key characteristics of agroecology such as the different diversity aspects (e.g. agrobiodiversity; crop diversity in crop rotations, intercropping, grasslands, etc.; and partly also agroforestry, which is often a system with higher diversity) correlate with higher yields and higher yield stability through time. This may indicate that increased diversity in current organic systems cannot fully compensate for reduced nitrogen supply, as far as yields and yield stability are concerned, and diversity in organic agriculture thus should be further supported. It also indicates where agroecology with its much stronger focus on diversity often differs from organic agriculture.



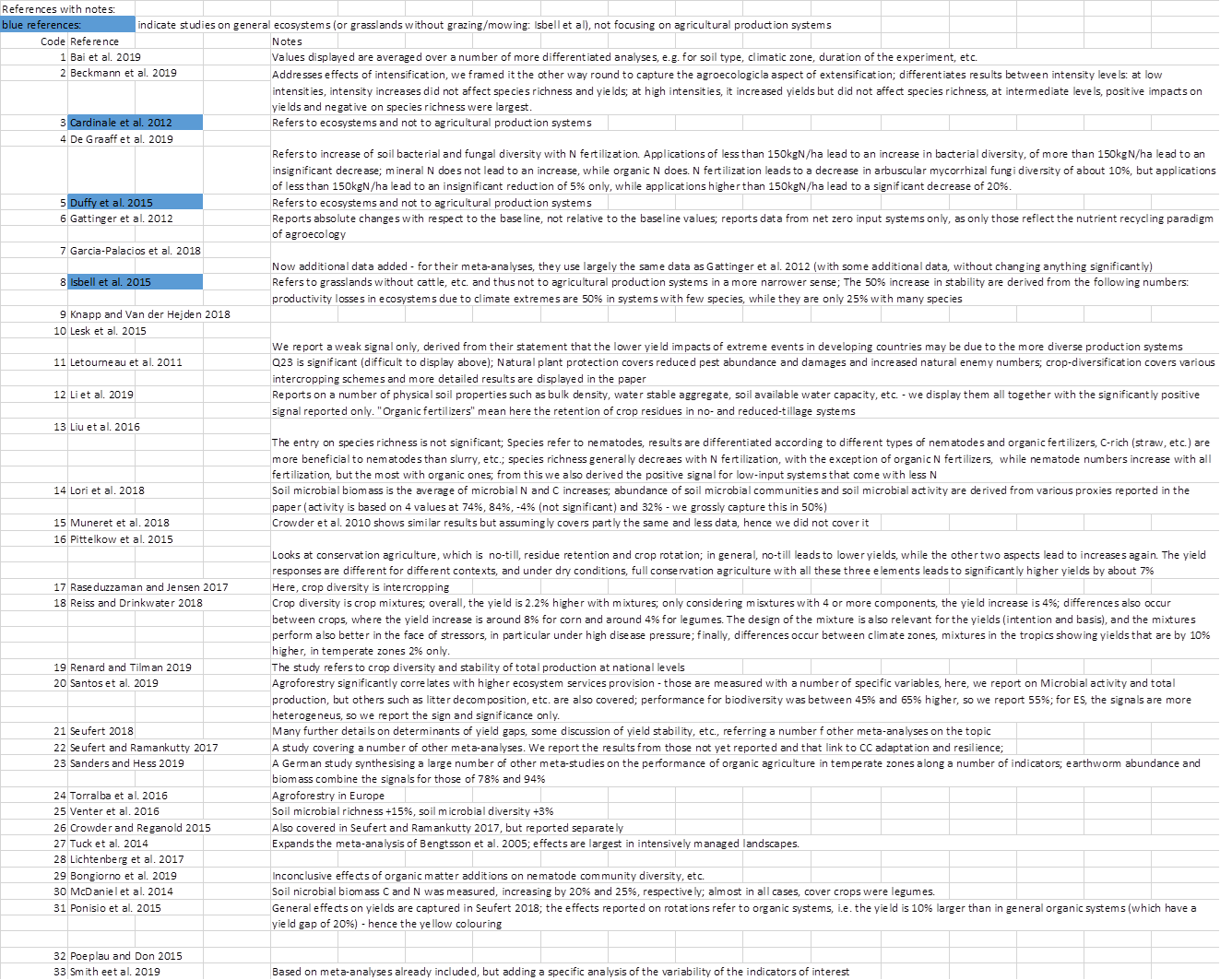


Figure 10: Compilation of the results from the Meta-analyses, values show change in comparison to baseline

For several results, further differentiation is warranted, e.g. regarding climate zones or soil types Thus, for example, more complex crop rotations in combination with crop residue retention and and no tillage leads to significantly higher yields in dry areas (by 7-8 %) while this is not the case in other contexts (Pittelkow, Liang et al. 2015). This study is from a context of conservation agriculture, though, which not always can be related to an agro ecological practice, depending on how plant protection and weed management is implemented.

The 18 qualitative reviews provide ample details on certain aspects that are also well-covered by the metaanalyses, such as the relation of organic amendments and soil fertility or diversity and production. Some address aspects not widely covered in the metaanalyses, such as the effect of agro-ecological practices on various indicators for financial capital INSERT REFERENCE DAnnolfo and many other economic aspects (INSERT REFERENCE van der ploeg), and some address aspects that are not covered at all in the meta-analyses such as water use, and present information on single crops, such as the System of Rice Intensification (SRI)[[13]](#footnote-14). The results generally point to good performance of agroecology and related practices and characteristics. These review results are however based on an informal assessment of a wealth of anecdotic evidence and not rooted in systematic reviews of meta-analyses or robust systems comparisons studies and we thus give them less weight relating the robustness of results. Besides providing further, topically broad and for each topic detailed, albeit not systematically and statistically compiled and analysed evidence, this highlights the research gaps in the current meta-analyses: firstly, on the issue of water use and water management in different agroecological contexts and how various practices and characteristics perform with regard to this; secondly, on single central crops when grown in different agroecological contexts, such as rice, cassava, soy or wheat.

### Single system comparison studies

The literature search resulted in 185 studies fitting the search terms (basically various forms and combinations of “agroecology” plus related terms such as “permaculture”, “regenerative agriculture” etc. and “climate change”; see Annex 7.2.2). From these, we identified only 17 single system comparison studies that fulfilled all selection criteria for inclusion in the analysis (peer reviewed, clear baseline, being the original source). These reported 83 cases of implementation of agroecological practices. These cases covered a huge heterogeneity in agricultural production systems, practices, crop types, geographic location, pedo-climatic characteristics, political, social and cultural contexts, etc., and also in the indicators covered. In consequence, this heterogeneity in combination with the low case numbers (many indicators were reported per study only, not for single practices) hindered a thorough systematic meta-analysis. We thus present a descriptive analysis of these results, which nevertheless allows to identify a number of noteworthy patterns.

First, the distribution of practices covered in the case studies shows a focus on “agroforestry”, and then also on “efficient water use”, “biomass recycling” and “crop rotations”, followed by “N-fixation”, “cover crops” and “adoption of organic and low-input systems” (Figure 11).

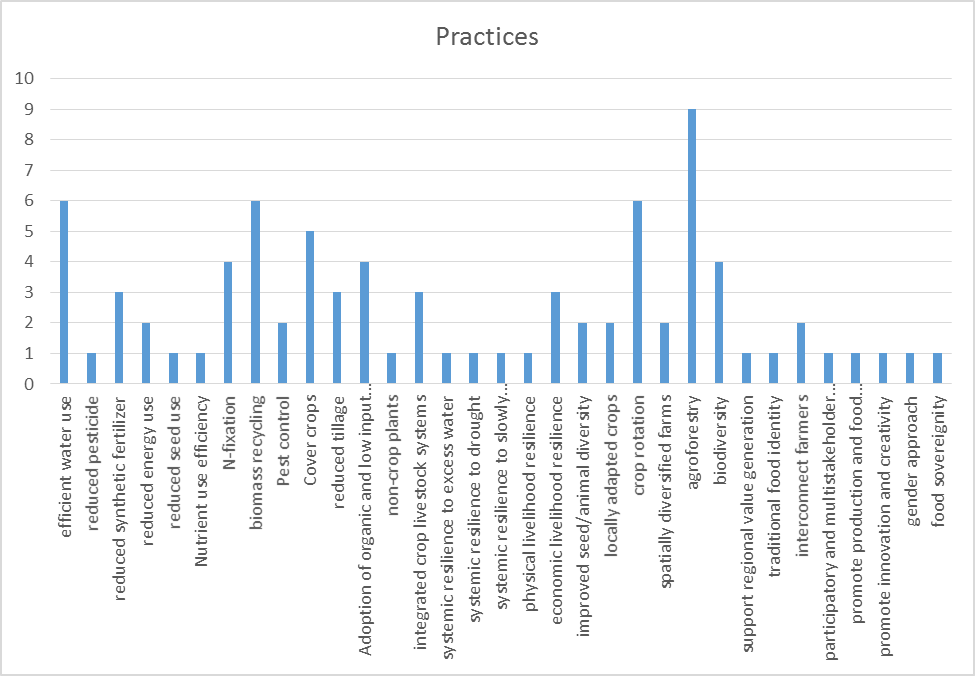


Figure 11: Distribution of agroecological practices in the single system comparison studies, ordered according to the 10 Elements of agroecology they refer to, from lower (left) to higher elements (right) (see Annex 7.5).

Second, on a more aggregate level, adopting the FAO 10 elements as lens to the analysis of the practices, we can notice a strong emphasis on the six “production related” elements of agroecology (i.e. efficiency, recycling, regulation, diversity, resilience, synergies, in total covering 90%), with a focus on diversity and efficiency (together 50%). The element “co-creation and sharing of knowledge” is reported 5 times (6%), while the other more encompassing elements, “circular and solidarity economy”, “culture and food traditions” and “human and social values” are almost missing (Figure 12).

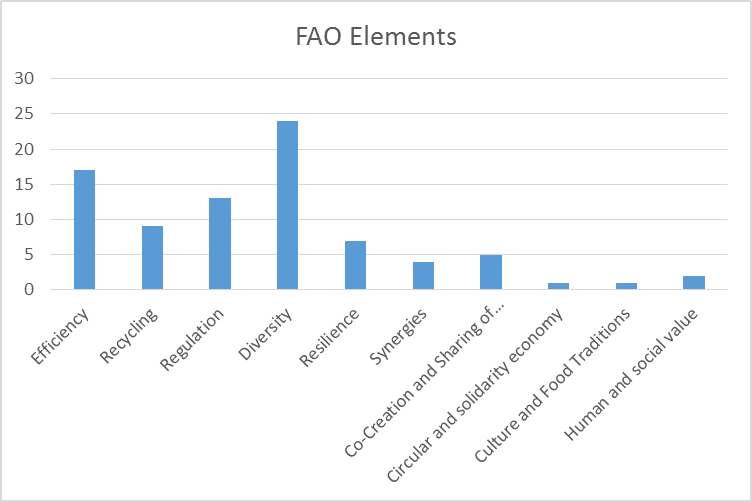


Figure 12: Distribution of FAO elements of agroecology in the single system comparison studies

This lack of coverage of systemic aspects is also reflected when relating the practices to the Gliessman levels (Figure 13). About 40% of the practices reported on in the studies refer to Gliessman level 3, i.e. to “Redesign the agroecosystem so that it functions on the basis of a new set of ecological processes” while almost 50% refer to the lower levels 1 and 2, where no re-design of production systems is taking place. Only about 10% of practices refer to level 4 (“Re-establish a more direct connection between those who grow our food and those who consume it.”) and two only relate to level 5 (“…build a new global food system…”).

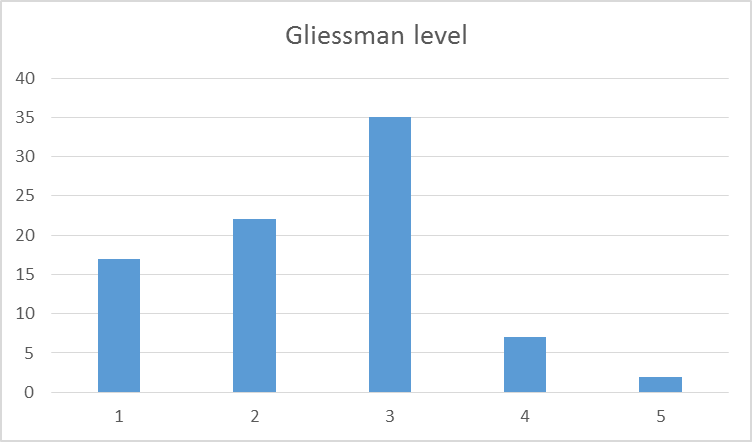


Figure 13: Distribution of Gliessman levels in the single system comparison studies

The analysis of these case studies thus show that there is incomplete coverage of the different aspects of agroecology. Most studies focus on practices that are relevant in agroecology but taken for themselves do not provide a holistic coverage of agroecology as they miss a whole food-system focus. Another aspect of restricted coverage relates to the production systems. The studies mainly focus on crop production and silvo-pastoral livestock systems, while non-timber forestry products and aquaculture are lacking, which also reflects that agroecology is not prominently discussed in these contexts.

Figure 14 illustrates the extent in which some of the 10 criteria of performance of agroecology of the Test version of the FAO Global Analytical Framework for Multi-Dimensional Assessment of Agroecology - (TAPE – Tool for Agroecology Performance Evaluation (FAO, 2019) are reported in the single system comparison studies. Some papers used different indicators than suggested by the FAO global analytical framework to capture some criteria, such as “wealth”, which we then subsumed under the corresponding criterion (here “income”) in the graph.

The studies focus mainly on “productivity” (i.e. yields, 27% of cases reported), “soil health” (21%) and “agricultural biodiversity” (17%), followed by “food security” and “income” (each at 12%). This captures 4 of the criteria from the economy, environment and health and nutrition dimensions of the framework, which most closely relate to climate change adaptation (criteria: soil health; agricultural biodiversity; income; productivity).

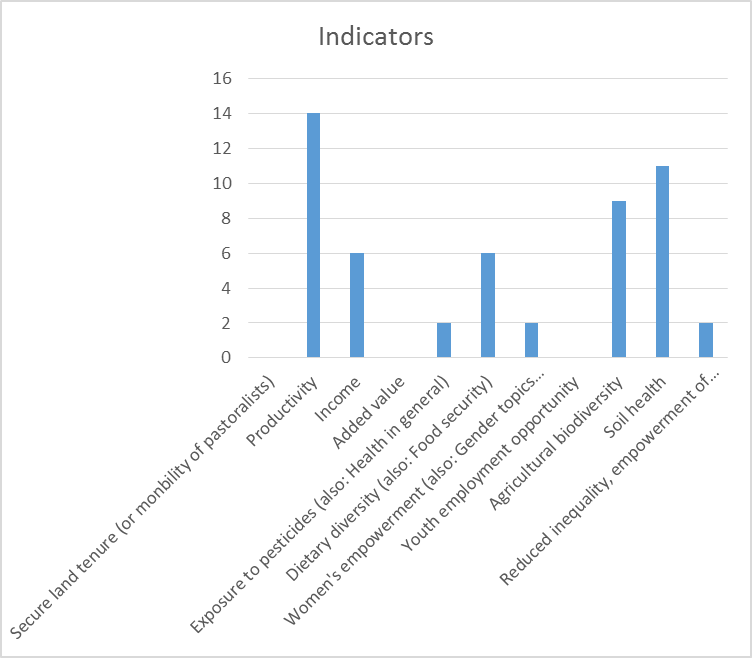


Figure 14: Number of reported cases that match the respective indicators in the single system comparison studies

The single system comparison studies generally report improved performance of the agroecological systems with respect to the respective baselines, i.e. the case-study location specific “average” (traditional, conventional) production system. Thus, they consistently report

* higher diversity and
* improved soil characteristics

with corresponding positive consequences for climate change adaptation, such as reduced erosion, increased water holding capacity and higher soil moisture conservation. In some cases, differences are not statistically significant, but in only one case worse performance is reported, namely in yields. Several important aspects are hardly or not covered, though, such as nutritional aspects of food security.

* Finally, a third of the studies explicitly report climate change mitigation co-benefits from carbon sequestration in soils and living biomass as well as from reduced fertilizer use.
* About 50% of the single system comparison studies highlight the role of institutional aspects, such as the enabling environment for the adoption of agroecological practices, knowledge transfer and exchange, co-creation of knowledge, (participatory) extension and advisory services and access to financial and other livelihood capital. The studies emphasize that without these enabling environment elements, agroecological practices would not have been adopted and their adaptation and mitigation benefits could thus not have been realised.

The evidence from these studies on the climate change adaptation related performance criteria of agroecology is mainly based on cases where specific agronomic aspects such as, for example, alternative production in agroforestry systems or more efficient water use are addressed. There is however a general lack of holistic systemic assessments addressing most or all aspects in one consistent approach (about a third of the studies analysed follow such an approach). It thus remains open whether the good performance reported in these studies relates to agroecology in an encompassing way or merely to these specific aspects (i.e. being agroforestry, adopting a specific water management regime, etc.) of it. Furthermore, as none of these studies specifically test for the role of institutional aspects, it remains open how much of the good performance is owed to well-organized knowledge transfer, extension and co-creation of knowledge, etc. and how much is owed to these cases being “agroecological”.

### Reviews on advisory services knowledge co-creation and knowledge transfer

The central role of knowledge transfer for the adoption of agroecological practices and the fact that knowledge co-creation is an integral part and knowledge intensity a main barrier to adoption of agroecology motivated a specific search for meta-analyses and reviews for those (see Annex 7.2.1). (Knook, Eory et al. 2018) present a systematic review of evaluations of participatory extension programmes, to better understand and provide **evidence on the effectiveness of capacity development interventions that are based on farmer demand and participatio**n. They find a strong positive effect for this, with the scientific robustness of evaluations being variable, though. A similar pattern of largely positive effects on mostly economic indicators can be seen in the review of (Davis, Nkonya et al. 2012) of farmer field school (FFS) impact evaluations. A third review is (Pamuk, Bulte et al. 2014), investigating Innovation Platform (IP) effectiveness in supporting the adoption of innovations across eight African countries using primary data. They found robust positive impact on the adoption of crop management innovations, but not so much for other areas of innovation, such as related to soils and fertility management and other more complex agro-ecological practices such as crop rotations. Importantly, the success of IPs seems to strongly depend on the presence and type of social capital and the relevance of specific context characteristics for innovation delivery. This is generally widely acknowledged (Dror, Cadilhon et al. 2016, Schut, Kamanda et al. 2018) and can inform agroecology related programmes and policies.

## Discussion of potential of agroecology to tackle Climate change

### Increasing adaptive capacity, reducing vulnerability, and mitigation co-benefits

With the wealth of significant and positive results as synthesized in Figure 14, our analysis provides robust evidence on the performance of agroecological practices and key elements of agroecological agroecosystems with respect to central aspects of climate change adaptation and resilience, in particular on soil health and biodiversity, but also on income and productivity. Furthermore, the improved soil health correlates with higher soil organic carbon levels, with corresponding mitigation co-benefits.

These findings provide a robust basis for supporting agroecological production systems and practices as promising approaches for climate change adaptation in agriculture, with mitigation co-benefits. Such support is however faced with the challenge of not having a clear cut definition of agroecology that can be certified as organic agriculture. Thus, it is central to identify clear characteristics and indicators that would trigger such support, which is the main goal of the TAPE (Tool for Agroecology Performance Evaluation) still undergoing field testing.

The TAPE could be organized results-based, i.e. conditional on good performance in key indicators that correlate with climate change adaptation such as indicators for soil health and diversity. Or it could be linked to application of certain practices that in general show good climate change adaptation performance, such as optimized diverse crop rotations, use of organic fertilizers, or agroforestry, to name just a few.

Furthermore, we emphasize the central role of institution related aspects, such as knowledge co-creation and dissemination via advisory services and farmer-to-farmer approaches, etc. to support development, improvement and uptake of agroecological practices. When supporting agroecology and fostering climate resilience, it is thus important to establish and strengthen functional knowledge and innovation systems. This also comprises adequate investments in research and development which currently is hardly targeted at agroecological and related production systems that are chronically underfunded. Of particular importance is the question of how to reach out to the broader farm population and bring such “knowledge intensive” production systems to scale. This is corroborated by the High Level Panel of Experts of the Committee on Food Security and Nutrition report on agroecology (HLPE, 2019), highlighting that there is fewer investment in research on agroecological approaches when compared to other innovative approaches, in particular regarding the economic and social impacts of adopting agroecological approaches, the extent to which agroecological practices increase resilience in the face of climate, relative yields and performance of agroecological practices compared to other alternatives across contexts, and how to link agroecology to public policy (HLPE, 2019).

Another group of important findings from the meta-studies analysed are those on productivity and yields. Agriculture has to ensure food security and this is linked to the ability to provide decent output per hectare. From the meta-analyses we learn, that low-input systems such as organic agriculture show lower yields than high-input systems. On the other hand, higher diversity tends to correlate with increased productivity and stability. Single crop yields are however not the best measure to assess the productive potential of an agricultural production system. It is more adequate to average production over space and time by using more aggregate measures such as total income or total calories or human edible protein provided from a certain area over a certain period, or even more encompassing, the “land equivalent ratio” as suggested in (HLPE 2019). Such measures are better suited to capture the relevant aspects of productivity, resilience, and adequate nutrient supply in relation to food security. The assessment of the performance and stability of such more encompassing productivity indicators, in particular in the face of ever more challenging climatic conditions, should become standard when assessing the climate change adaptation potential of agricultural production systems. Furthermore, yields have to be seen in relation to what they are used for and reducing areas cropped to produce feed or output that is then lost or wasted would reduce the pressure to achieve ever higher yields on given areas. Finally, agriculture is multifunctional and in an encompassing sustainability assessment, yields are only one indicator among many others. Sustainable future food systems depend on agriculture performing optimal on many indicators and not maximal on one and worse on others.

### Challenges with the data

While there is much robust evidence from meta-analyses and reviews, our search did not result in many case studies that provide specific and robust evidence for the relative performance of agroecology with respect to some baseline production systems regarding climate change adaptation and resilience. The case-study based evidence on agroecology and climate change adaptation with a clear agroecology focus and a reference scenario thus remains scattered and anecdotic. This is also due to our aim to provide a most robust scientific knowledge basis for the climate change adaptation performance of agroecology, which resulted in many case studies not being included in our review (only 17 out of 185). There is a huge number of civil society organization testimonials and reports on agroecological case studies available, reporting their good performance, but hardly any of those met our selection criteria for the case study review. Furthermore, in this data, there may be a bias due to the self-declaration of being agro-ecological and the fact that most agroecological work is still done by institutions that are in favor of this approach. The self-declaration bias is somewhat mitigated by our complementing research based on other key-words than agroecology (Annex 7.2.3). We can however not judge on the importance of or control for the bias resulting from an institutional inclinations towards agroecology.

A big challenge for the work on agroecology and climate change adaptation is the need for truly encompassing studies to capture agroecology and for long-term studies to truly assess adaptation. Furthermore, there is a need for much more well-designed comparative studies ((Côte, Poirier-Magona et al. 2019)), with optimal sample design, where e.g. {Bezner Kerr, 2019} may serve as an example. If done in the context of extreme events such as droughts, hurricanes, etc., such assessments of the relative performance of agroecological versus some baseline farms in the face of these shocks could provide key insights into adaptive capacity and resilience, as they would avoid the challenge of long-term observations to see some signals from adaptation activities. More research of this kind would be needed to be able to assess the adaptation potential of agroecology in its full complexity and to identify which aspects may be most important for successful adaptation.

### Submission for Koronivia joint work on agriculture

**Elements to be included in topics 2(b), 2(c) and 2(d)**

Based on the results of this review on the potential of agroecology for climate change adaptation, the authors have submitted inputs to the Koronivia joint work on agriculture (KJWA). A first submission has been prepared between Biovision and FiBL, targeted at the topics 2(b) “Methods and approaches for assessing adaptation, adaptation co-benefits and resilience”, and 2(c) “Improved soil carbon, soil health and soil fertility under grassland and cropland as well as integrated systems, including water management”, for the SBI/SBSTA50 in June 2019. A second submission has been prepared between IFOAM Organics International, IFOAM EU, Biovision and FiBL, targeted at topic 2(d) “improved nutrient use and manure management towards sustainable and resilient agricultural systems”.

## Conclusions

First, albeit working with proxies, correlations and plausibility arguments, and having made explicit the potential challenges that come with such an approach and the underlying data we used, our results clearly allow to conclude that

* agroecology builds on key practices and characteristics that are performing well with respect to indicators that strongly correlate with climate change adaptation and resilience, such as various indicators related to soil health and biodiversity, but also productivity and yield stability
* Furthermore, these key practices and characteristics correlate with indicators for mitigation co-benefits, mainly related to soil organic matter, but also via reduced input use.

Hence, we can argue for increased support for those practices and characteristics which are central in agroecology, for supporting approaches that build on them, and for more investments in research and implementation of those, as they provide promising alternatives to the currently dominant approaches that come with a number of known drawbacks.

The results also allow to further refine some findings. An example would be the fact that organic agriculture shows lower yield stability, while increased diversity strongly correlates with more stable production. This suggests that organic agriculture may not fully implement and build on its diversity potential and in this also differs significantly from agroecological approaches. This would be an important area for further research to improve organic agriculture as a well-defined exemplary system that is closely related to agroecology, and also to gain further insights on the relation between productivity, stability and diversity in agro-ecosystems. Several aspects are also missing in the meta-analysis, e.g. water management and water use, and also the role of seed availability and seed diversity

Second, the central role of knowledge transfer, co-creation of knowledge, etc. warrants a specific emphasis on this topic. This central role has been recently reemphasized in the High Level Panel of Experts of the Committee on Food Security and Nutrition report on agroecology (HLPE 2019), which highlights the key importance of enabling policies and instruments, as well as investments for transition pathways. NGOs and other institutions often play a central role as facilitators of these processes, in particular by providing funding and organizing exchange with relevant institutions. This is clearly illustrated for the innovation platforms, for example, where success seems to strongly depend on the presence and type of social capital and the relevance of specific context characteristics for innovation delivery.

# Country case studies on policy and technical potential of AE

## Methodology

### Methodology for assessing the Political Potential for agroecology

This analysis seeks to understand the enabling political conditions and barriers for adoption of agroecology approaches and principles in Kenya and Senegal.

#### Definition of political potential:

The political potential indicates to what degree the political context (in a country) provides an enabling environment through its polity, policies and politics that fosters the awareness, acceptance and implementation support for agroecology approaches.

* Polity: political system, institutions and norms;
* Policies: visions, strategies, implementation plans and regulations;
* Politics: policy making processes, interactions of stakeholders and power relations among them.

#### Objective:

Assess the policy potential of, and identify opportunities for agroecology to be considered and recommended as a relevant approach in national policies, respective plans and their roll-out in the countries. It will particularly focus on:

1. the current political situation with regards to the NDC implementation, and overall climate-related policy processes in the agriculture sectors

2. the level of awareness of the agroecology principles among stakeholders within the climate-related policy processes in the agriculture sectors

3. potential entry points for political support to scale-up agroecology approaches (types of suitable policies, entry point topics such as water, biodiversity, soil, ecosystem based adaptation, circular economy, etc.).

#### Analytical lens:

The overall political potential will be assessed through the following three lenses:

1. Polity: design of political system. Assessment of governmental structures, institutions, communication channels and norms that could put agroecology high on the decision maker’s agenda.

2. Policy: formalized visions, strategies, implementation plans and regulations. Mapping of existing and currently developed policies for NDC implementation in the agriculture sector.

3. Politics: policy making and political commitment. Mapping and analysis of decision makers, their awareness and perception of agroecology and political will/actions to foster it.

For assessing the political potential, firstly a **reference analysis** is conducted that reflects what the current overall political situation is and whether/how agroecology is framed and embodied by such. This allows for a first assessment to what degree agroecology is considered in the current political setting. Secondly and based on this reference, a hypothetical “**ideal scenario”** is defined, that describes an enabling environment for agroecology to be politically considered (political awareness), accepted (political will) and effectively fostered (political commitment/action). The difference between these two situations defines the bandwidth of the future political potential for agroecology. To specify for this, finally a **gap analysis** between these two settings will identify opportunities and challenges for a transition from the reference to the ideal scenario and thus validate the existing political potential.

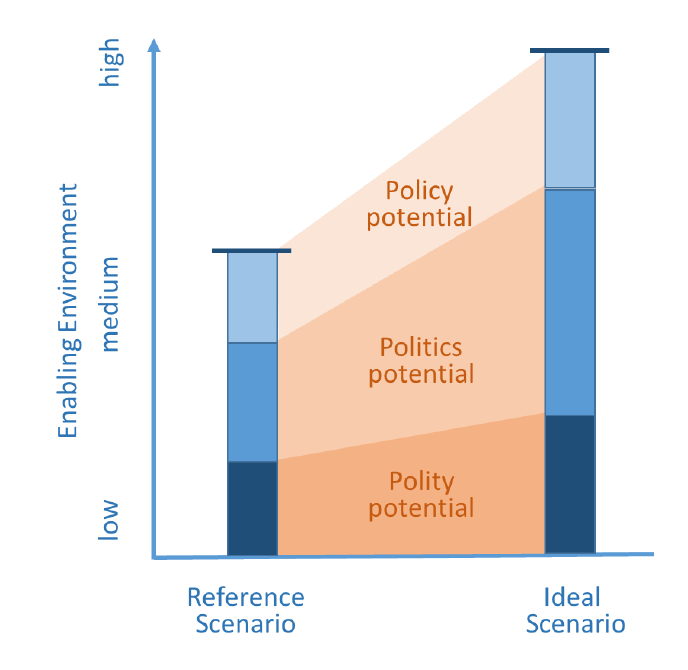


Figure 15: Potential scenarios depending on enabling environment

The assessment focusses on national level political systems (country state level). Where political systems are devolved to sub national levels (or in the process for such), the potential and challenges from such setting is discussed in the reference and gap analysis. The reference scenario refers to current political status quo, the ideal scenario to a situation in 2025.

**Research questions.**

To determine the political potential, for this study we assess the following three research questions:

1. Reference analysis: What is the current political status of, and political will for fostering agroecology or closely related concepts?

2. Ideal scenario: What does a desired enabling political environment for the agroecology approach look like in 2025?

3. Political potential analysis: What developments, trends and opportunities could bridge or widen the gap between the current political status and an enabling political environment for the agroecology approach until 2025?

**Research methods:**

The assessment of the research questions will require a set of research methods: literature review, semi-quantitative word analysis, questionnaire guided interviews and focus group discussion. Through interviews and focus group discussions multiple aspects of the methodology below can be covered at the same time.

For the **reference analysis** to assess the current political status of, and political will for fostering agroecology we analyze the following three lenses and apply respective research methods:

1. **Polity lens:** overall setting of the political system with regards to the climate-agriculture nexus and how agroecology is embedded in this discourse (how does the polity frame the climate challenge in the agriculture sector?)

Literature review: assess the political system, functioning of institutions in charge, existing visions and long-term strategies, priorities and major current programs in agriculture.

Focal group discussion:

* Discuss the functionality of institutions and the status of visions/long term strategies when compared to actions in reality.
* discuss success and sustainability of implementation of policies and enforcement of regulations; assess the overall normative framing of agriculture (recognition, expectations) by the government
* discuss the overall synergies and trade-offs between food security, social justice, economic development and environmental aspects in the context of climate change and agriculture.

2. **Politics lens:** awareness, understanding and acceptance of the agroecology approach among power vested stakeholders engaged in the policy making process

Focal group discussion and bilateral interviews :

* + exchange with policy affine actors from research, private sector, NGO’s, consultancy, international agencies and the government.
  + Identify agendas of key actors that are dominating the policy making, priority setting and funding
  + assess the degree of their commitment: are they aware of agroecology, do they understand its approach and how it differs from other concepts, do they accept it as a valuable approach, are they willing to support and promote it in their policy work?

3. **Policy lens**: degree to which agroecology approaches are already addressed, fostered or hindered through existing or planned policies in the climate change context (Policy)

**Literature review :**

* Collect and analyze current key policies related to agriculture, climate change, natural resource management and/or economic development
* Identify and assess policies that don’t explicitly mention agroecology but address selected elements
* Conduct semi-quantitative word count analysis

**Bilateral interviews:**

* Assess what new policies are currently in the making or planned that could have implications for the agriculture sector in the climate context

Finally based on the above approach a qualitative rating for each lens is conducted that will identify whether an overall low, mid or high enabling political environment exists in the country for agroecology.

**Ideal scenario:**

To specify what a desired enabling political environment for the agroecology approach would look like, the following aspects are specified:

* Identify a hypothetical setting within the political system in 2025 that provides a solid bedrock for the agroecology approach in the country
* Characterize and discuss the structural, institutional and normative dimensions of such scenario (polity).
* Specify which policy actors would need to take what position and actions to facilitate the development or implementation of policies that foster agroecology (politics and political commitment).
* Describe realistic and lasting policies/regulations that would foster agroecology in compliance with the current polity and other policies.

The method applied is using focal group discussions.

***Political potential analysis:***

Finally, the overall political potential analysis identifies realistic and conceivable developments, trends and opportunities in the country that could bridge or widen the gap between the current political status and an ideal enabling political environment for the agroecology approach until 2025.

Method: Focal groups and interviews

### Methodology technical potential

The technical potential analysis is done through a 2 step approach.

1. Sampling of smallholder farmers, based on partner orgnisation’s assessement. Grouping into “Agroecological intervention group” and “control group” (Farmers not being part of an agro-ecological group/movement.)
2. Tests with the characterization of the level of the agroecological transition based10 criteria of performance of agroecology of the Test version of the FAO Global Analytical Framework for Multi-Dimensional Assessment of Agroecology - (TAPE – Tool for Agroecology Performance Evaluation (FAO, 2019): this will provide a typology of the targeted farms, specifying those which are considered as agroecological or “in transition” or not agroecological (“control group”).
3. Assess the resilience of these farms using SHARP and compare the two groups.

In detail these steps consisted of:

#### Sampling desing:

The agroecological system sampling was based on farmer’s associations in long lasting relations with Non-Governmental Organizations (NGOs) and Community Based Organizations (CBOs). These NGOs and CBOs are supporting agroecology and use of indigenous knowledge systems for food production and provide insight into sustainable agricultural technologies for management of soils, water, crops, animals and pests. For purposes of the case study, the pursuance of sustainable agriculture through these pathways was taken as a representation of “agroecological transition”. The sampling approach was based on spatial distribution and randomized sampling of farmers, identifying the “intervention group” of agroecological farmers based on the following criteria:

* Farmers who are part of such Agroecology projects for at least five years
* Exposura to climate variability
* Closeby control groups available
* Mixed cropping systems and animal-crop integration

Non-agroecological farmers were randomly selected from the same regions (“control group”) to closely match the agroecological/climatic conditions, livelihood strategies and land holding patterns of the agroecological producers (“intervention group”).

#### TAPE

The results from these TAPE characterizations tests (Test version of the FAO Global Analytical Framework for Multi-Dimensional Assessment of Agroecology - (TAPE – Tool for Agroecology Performance Evaluation (FAO, 2019)) serve now as inputs for FAO’s Agroecology team and have been compiled in a separate feedback document for FAO, not being part of this report anymore.

#### SHARP

The collection of SHARP field data in both case studies was carried out through face-to-face interviews using a structured survey developed by FAO, Self-evaluation and Holistic Assessment of climate Resilience of farmers and Pastoralists (SHARP) Tool app version 0.13.18

SHARP focuses on identifying the areas of vulnerability and strength of the farm systems and agriculture-based households, while building on flexibility, learning and knowledge of farmers (Choptiany et al. 2015). It considers resilience as an intrinsic aspect of the system and farmers themselves.

Consistent with the overall SHARP tool methodology, the collection of data on different farm system components was done in the form of 39 modules, broadly covering 5 domains i.e. agronomic practices, environmental aspects, social interactions, economic components and governance. However, the modules on governance and energy conservation practices were omitted in the survey exercise. Furthermore, since the module on general information doesn’t result with the scoring, this brought the number of modules used for resilience assessment to a total of 36.

The SHARP assessment is based on the combination of quantifiable (objective) and qualitative (subjective) questions spanning across the above mentioned domains. Regarding the objective information, each module was divided into subcomponents defining different aspects of that farm component e.g. module 22 on Trees assessed i) diversity of tree species ii) number of trees and iii) use of tree products etc., each subcomponent was scored independently.

To translate into a resilience measurement tool, SHARP gives each subcomponent a score to identify the resilience levels of the farm systems. SHARP tool automatically generates three scores for each module: technical (objective), adequacy and importance score (subjective). The scores for the objective component (i.e. technical scores) are grounded on an academic and expert knowledge and they range from 0 for low resilience to 10 for high resilience. The subjective information (self-assessed adequacy and importance) is based on the perceived and expressed needs of farmers aimed to capture the perceptions of farmers regarding the adequacy/sufficiency levels of a given farm component or resource, as well as the priority of given elements in the farms. Both are measured through a Likert scale: the self-assessed adequacy score ranges from 0 to 10, with 10 corresponding to a high adequacy, while the score for the self-assessed importance is an inverse scale ranging from 10 to 0, where 0 is a self-reported high priority/importance.

The aggregate of the subcomponent scores, as described above, resulted in the technical score for each module, which provides an objective estimation of the resilience of the farm system.

Only considering the technical scores, the SHARP modules are compiled into sub-indicators and are aggregated in a manner that the 13 agroecosystem resilience indicators can be measured as defined by Cabell & Oelofse (2012)**.** Table 2 below shows how the technical score of different sub-indicators are translated into resilience sores for different indicators of resilience.

Table 2: An extract of SHARP scoring of agroesystem resilience indicators based on modules and sub-indicators.

|  |  |  |  |
| --- | --- | --- | --- |
| **SHARP agro system resilience indicator** | **SHARP sub-indicators** | **SHARP Module Theme** | **SHARP Module sub-components (Questions)** |
| 1. **Socially self-organized** | 1.1 Group Membership | 36. Group Membership | 36. Participation level |
| 36. Initiation of the group |
| 1.2 Access to local farmer’s markets | 30.Access to markets | 30.Sell of produce in local markets/cooperatives/associations |
| 30.Access to information on market prices |
| 1.3 Previous collective action | 35. Community cooperation | 35. Joint problem solving by community members |
| 35.Mechanisms in place for problem solving |
| 1.4 Access to communal resources | 5. Land access | 5. Area of communal land accessible |
| 1.5 Financial support | 33. Access to financial services | 33. Financial support received when needed |
| 5. Optimally redundant | **5.1 Varietal Diversity** | 13. Animal Production | 13. Number of Breeds |
| 6.Crop Production | 6. Number of crop species |

Resilience indicator score (Socially self-organized) is an aggregate of sub-indicator scores (1.1 group membership, 1.2 access to local farmer’s markets etc.). The sub-indicator scores are obtained from the SHARP module subcomponents. Sub-indicator, 5.1 (Varietal Diversity) is an aggregate score obtained from both the animal and crop production module.

In this study, the 13 agroecosystem indicator scores were based on 92 sub-indicator scores. The sub-indicator score was assessed from the subcomponent (question) scores of the modules as shown in Table 2. For example, socially self-organized indicator assesses the farmer’s ability to organize into grassroots networks and institutions such as cooperation and farmer’s markets. Therefore, the final score will be an aggregate sum of scores from sub-indicators of 1.1) group membership, 1.2) access to local farmer’s markets etc. derived from the sub-components of group membership and access to market modules respectively (Table 2).

In some instances, the sub-indicator was assessed through scores of subcomponents from multiple modules. For example, the sub-indicator score for varietal diversity was dependant on two subcomponents, number of animal breeds reared (from animal breeding practices module) and the number of crop varieties cultivated (from crop production module). The final scores were standardized on a scale of 0 -100%, classified as low-level (0 – 35%), mid-level (36-70%) or high-level (71-100%) resilience.

Aside from providing resilience scores, the module scores were used to identify areas of **priority intervention** based on the summation of technical, adequacy and importance scores. This means that interventions scoring low on the technical and adequacy score and high on the importance would be those with lowest total scores and thus highest priorities by the farmers. Therefore lowest scores were considered to be areas of high priority.

A two-tailed sample t-test was used to assess differences for SHARP scores between agroecological and non-agroecological at the agroecosystem resilience indicator level (1. Socially self-organized, 2. Ecologically self-regulated etc.), the sub-indicator level (1.1 Group Membership, 1.2 Access to local farmer markets, etc.), module-level (2. Households, 3. Production activities, 4. Non-farm income generating activities, etc.) and at the domain-level (Agronomic practices, Environmental aspects, Social interactions and Economic components) (Table 2).

Prior to applying the t-test, suitability of the dataset was assessed for normality (using Shapiro-Wilk normality test) and homogeneity of variance (Levene Statistic). For non-normal distribution datasets, a non-parametric test (Wilcoxon rank sum test) was applied. For non-homogeneity of variance, a Welch two-sample t-test was applied. All tests were performed in R version 3.6.1.

## Results case study Kenya

### Context Kenya

Climate risks pose serious threats to Kenya’s sustainable development goals. With the largest economy in East Africa and a population of 48.5 million, Kenya serves as the regions’ financial, trade and communications hub. The country’s economy is largely dependent on rain-fed agriculture susceptible to climate variability and change and extreme weather events. Increasing inter-seasonal variability and declining rainfall in the main rainy season have impacted cereal production in recent years. Recurrent droughts and floods—likely to be exacerbated by increasing temperatures, heavy rainfall events and sea level rise—lead to severe crop and livestock losses, famine and displacement. The 2008–2011 drought caused $12.1 billion in losses and damage. As Kenya is deficient in its major staple crops and therefore has to import a substantial amount of food, further climate change perturbations will only increase this dependency.

Models estimate that by 2030 climate variability and extremes will lead to losses equivalent to 2.6 percent of GDP annually.(5, 7, 8, 12, 13, 18, 23) (USAID 2018).

### Political potential in Kenya

#### Introduction: relevance of agroecology in the context of climate change in Kenya

Millions of Kenyans suffer from food insecurity, which is worsened with the unpredictable rainfall patterns and unsustainable farming practices that use expensive farm inputs such as seed, fertilizer and pesticides that farmers cannot afford and disrupt local biodiversity and ecosystems. Transforming agriculture productivity to deliver on food Security and nutrition, build resilience to impacts of climate change, eliminate social inequality and minimizing biodiversity loss is at the heart of Kenya’s Big Four Agenda, national climate change response strategy and other economic and social development strategies. This recognition is embodied in various policies that aims to transition Kenya into a sustainable food and agriculture system. Through implementation of the Big Four Agenda, Kenya aims to reduce the number of food insecure people by 50% and achieve a 27% reduction in malnutrition among children under the age of five years (MALF, 2017). However,

In addition to address extreme weather events, the government developed and is implementing a number of agriculture and climate change related policies and strategies. One of these policy frameworks is the Climate Smart Agriculture Strategy (CSAS) developed in 2017 complemented by a CSA Implementation Framework (2018) that was developed through a multi-stakeholder process. The two documents are comprehensive enough to identify challenges and opportunities for CSA to hedge against climate impacts in the agriculture sector in Kenya (GoK, 2017 and 2018). However, there is a feeling that the concept of CSA could be inclusive of “business as usual” approaches to agriculture (Osumba, 2018). Given these deficits, there is a need to leverage sustainable, climate resilient food systems on the agenda of national and county decision makers to facilitate the upscaling of good agricultural practices. One promising entry point is advocacy work for systemic approaches that build on agroecological practices in the agriculture sector to strengthen resilience of farmers while contributing to climate change mitigation or through incorporation of these practices in the CSA as it well established in Kenya. Amongst others, systemic ecologic agriculture (based on the principles of agroecology) offer such an approach. However, despite the evidenced positive effects of systemic ecological measures to combat climate change, in numerous pilot-projects they often remain singular and small-scale interventions with limited opportunities to go to scale (Wankuru et al., 2019; Wigboldus et al., 2016). Factors limiting scaling up and out of agroecological approaches include low awareness, poor perception on the potential of these approaches. Others relate to knowledge intensive nature of agroecology, its context-specificity and absence of supporting political frameworks, and technical or economical barriers such as initial or transaction costs.

Another important thing to note is that, despite the importance of agriculture in Kenya, the sector does not receive high priority in terms of budget allocation compared to other sectors such as infrastructure and energy. This is reflected in lower agricultural growth and therefore, a framework or strategy for adapting to climate change and mitigation is required within which there is increased investments in agriculture, supportive policy and use of climate resilient technologies appropriate to mixed farming conditions involving crops and animals.

#### Research approach

Building on the above described context in Kenya, this case study aims to explore the policy potential of agroecology in Kenya, specifically to assess how the current agriculture and climate change related policies and strategies can be support the uptake and upscaling of agroecology. The policy potential indicates to what degree the political context in a country provides an enabling environment through its polity, policies and politics[[14]](#footnote-15) that fosters the awareness, acceptance and implementation support for agroecology approaches (see Chapter 4.1).

This case study used qualitative research methods, including literature review, semi-structured interviews and focus group discussions (FGD). During the literature review, a number of government policies, strategy and implementation documents were reviewed with an agroecology lens, specifically identifying agroecology principles and practices (Annex 7.2). For this study, we searched for terms related to agroecology principles and practices. Principles such as resilience, efficiency, diversity, biodiversity, synergies, co-creating and knowledge sharing, recycling and governance that define agroecology were searched in policies and strategies (Wezel et al. 2014). An analytical assessment of current agriculture, climate change and other related policies and strategies was undertaken to provide an overview and understanding on how much and how far agroecology is embedded within them. We analyzed policies related to agriculture, climate change, forestry and water. In absence of a national policy specifically on agroecology, agroecology principles could be embedded in such existing related policies at least.

21 policies and strategies related to agriculture, environment, water and forestry from past 20 years were reviewed (Annex 7.2). An integrated two-step framework analysis focused on policy content was adopted. Step one and two involved analysis of agroecology principles and practices, respectively. The principles and practices are drawn from FAO (Annex 7.2) that can be applied across ecological, economic and social-cultural environments.

Semi-structured interviews were conducted with fourteen participants from various organizations that are active in agriculture sector. These are government institutions, policy makers, CSOs, NGOs, and national research organizations. The interviews focused on exploring the understanding of agroecology and the current political situation with regards to the agroecology? We assessed the integration of agroecology and its principles within agriculture, environment, water, forestry policies. Finally we asked for potential entry points and political support to scale-up agroecology approaches.

In addition two Focus Group Discussions (FGD) were held. The first FGD comprised government officials from different sectors and departments. The second one comprised CSOs and NGOs representatives. Some of the issues discussed during the FGD included how agroecology is embedded in the agriculture discourse in Kenya, what current policies are related to agroecology and what is needed to move the agroecology agenda forward in Kenya.

#### Results and Analysis

##### Analysis of policies in Kenya (policy lens)

Kenya’s vision 2030 and implementation of the Big 4 Agenda aims to move its economy away from over-reliance on agriculture by transforming itself into a hi-tech service hub that will generate innovative and entrepreneurial potentials. Despite that, Kenya has developed and is implementing several agricultural and climate change policies aimed at increasing food security and nutrition. The overarching goal of the agricultural sector in Kenya is to contribute to improvements in food and nutrition security and income generation through promotion of improved management of natural resources and practices compatible with sustainable and climate-resilient agricultural production (GoK, 2018). On the other hand, the goals of climate change policies and strategies is to enhance adaptive capacity and resilience while promoting low carbon development. According to Osumba (2018), Kenya’s agricultural policy environment is influenced by political economy of agriculture that is influenced by country political system which generates the policy incentives (strong or weak) to promote agricultural development and/or private sector and donor vested interests. The existing agricultural policies are neither farmer nor community driven to responds to the local context.

The analysis revealed that no policy related to agroecology exists within the current national agriculture and climate change policy arena even though there are some closely related frameworks such as CSA strategy. Nonetheless, devolution has provided a chance for counties to develop policies based on the prevailing circumstances and a county like Kiambu already adopted a law on agroecology as the first one among the 47 counties. This seems to have had an influence on other counties such as Meru currently elaborates interventions aimed at promoting agroecology (Osumba 2018).

###### Agroecology principles in existing policies in Kenya

The review of Kenya policies indicates that despite not directly mentioning the word “agroecology’, there is consideration of agroecology principles and practices aiming at increasing agricultural productivity and building resilience. Most of the policies mention or infer on two to three out of the 10 agroecology principles. The principles of human and social values, culture and food traditions and circular and solidarity economy however are not mentioned nor inferred.

Taking a closer look at the agroecology elements mentioned within these policies, reveals that the goal is to improve food security and nutrition, build **resilience** of Kenya’s agricultural systems and, enhance adaptive capacity of farmers. For example, Kenya’s NDC emphasis on increasing resilience of systems and enhancing adaptive capacity through enhanced coordination of climate change action, public participation and inclusiveness. To build resilience, it will be done through improving **efficiency** in the use of resource in all agricultural production systems (including supporting sectors such as water and energy) and in implementation of polices that will lower cost of production and hence increase productivity. The element of **diversity** is mentioned in terms of increasing crop, livestock, plant and soil biodiversity, which is threatened by the changing climate and related effects such as pests and diseases.

**Example of an existing policy referring to agroecology principles:**

The national CSA Strategy and a CSA Implementation Framework outlines climate resilient agricultural principles and institutional arrangements to circumvent climate impacts in agriculture sector in Kenya. Some transformative elements of agroecology do overlap and divergent within the CSA strategy and implementation framework. Of the 10 agroecology principles, **resilience, efficiency, diversity and synergies** are clearly articulated in the strategy and framework. Other elements such as **culture and food traditions, co-creation and sharing of knowledge, recycling and responsible governance** can be inferred. However, principles of **human and social values and circular and solidarity economy** as an impetus for transformative agroecology that can lead to food security and sovereignty are not considered.

Identifying and reinforcing synergies between objectives of food security and, poverty reduction, adaptation and mitigation actions in agricultural sector is another element considered within the policies. The policies will also integrate cross-sectoral approaches to enhance synergies and promote efficiency within implementing institutions and stakeholder. Agroforestry is one of the agroecology practices highlighted and seen as having the potential to provide this synergy and to offer resilience benefits and reduce emissions in agricultural systems (GoK, 2018).

Despite not clearly mentioning co-creating and knowledge sharing within the policies, stakeholders including farmers will be involved in communication and awareness, education, advocacy, public participation, public access to information on priority climate resilient crops and livestock and, adaptation actions in agriculture sector such as water conservation and recycling, indigenous knowledge, efficient use of water and energy, early warning systems and agroforestry (KCSAS, 2017; 2018).

“ASDS recognizes Kenya’s agro-ecological diversity and aims to improve **diversity** of food to meet dietary and nutritional requirements, increase agro-biodiversity to include traditional sources of food and support use of organic methods for **sustainable** food production systems” [Reference]

Governance frameworks based on the principles of accountability, transparency, rule of law and participation are applicable at national level and will be cascaded down to county levels and provides a clear system on what is expected to be done at each stage. However, good governance mechanisms such as equity and inclusiveness and, community and traditional level governance (see FAO, 2011) that can support different actors to transform their practices to be climate resilient and sustainable and maximize synergies along agricultural value chains are missing within the policies.

Recycling in agricultural systems is not directly proposed in the policies except in the water sector whereby public awareness on water conservation and recycling is indicated as efficient water use practice. Accordingly there is potential for further streamlining this principle in other policies.

###### Agroecology principles in climate specific policies in Kenya

Agroecology is indirectly addressed in selected climate change policies and strategies in Kenya. Kenya passed the Climate Change Act (2016) which provides a regulatory framework to guide National and County governments to enhance response actions to address climate risks and to strengthen climate resilience in the country. The Act provides an elaborate mechanism to guide the mainstreaming of climate change into sectoral policies, including monitoring implementation. The National Climate Change Response Strategy (NCCRS, 2010) is the framework that guides integration of climate concerns into development priorities. The NCCRS is translated into National Climate Change Action Plans (NCCAP) through the Climate Change Act of 2016. Implementation of the Climate Change Act is through the National Climate Change Action Plan (NCCAP) 2018-2022.

Several climate actions are proposed within the NCCAP among which sustainable land management (SLM). The specific activities planned under SLM reflect agroecology principles and practices such as promoting integrated soil–crop–water management and integrated agroforestry and agro-silvo-pastoral systems; managing soil organic matter for soil carbon sequestration; and prevent and mitigate land degradation and restore degraded soils and lands (NCCAP, 2018).

In addition the agricultural sector developed Kenya’s Climate Smart Agriculture Strategy (KCSAS) 2017-2026 whose objective is to adapt to climate change, build resilience of agricultural systems while minimizing emissions for enhanced food and nutritional security and improved livelihoods (KCSAS, 2017). KCSAS outlined some of the agricultural problems facing farmers in Kenya including; Unsustainable agricultural land management practices; Inefficient crop and livestock production systems; poor management of fertilizers/ manures and agricultural wastes and use of fossil fuel in the agriculture sector. To implement the KCSAS and provide guidance in mainstreaming Climate Smart Agriculture, the Climate Smart Agriculture Implementation Framework (2018-2027) was developed. Agroecology principles are not explicitly inferred to. However, agroecology practices are indirectly mentioned. This include diversified and improved crop varieties (high yielding, short duration, disease and pest tolerant, high nutritive value, flood tolerant), including indigenous varieties; use of integrated soil fertility management practices, production of indigenous fruits and vegetables, and introduce improved indigenous/local adapted breeds.

###### Agroecology practices in Kenyan policies

The key policies reviewed are to some extent consistent with agroecology principles and practices of achieving a balanced and sustainable agricultural system in socio-economic, ecological, political and environmental spheres. Despite Kenya government promising a policy and institutional environment that is conducive to increasing agricultural productivity and resilience, the agricultural landscape is heavily penetrated and controlled by input supply agribusinesses especially for fertilizer, seed, pesticides, veterinary drugs including vaccines and animal feed (ASDS, 2010). This has created uniformity across farming landscape exposing crops and livestock to emerging pests and diseases. Most of the policies and strategies propose to increase finances for external inputs and create awareness campaigns for their use. For example, the ASDS aims to bulk purchase and supply external inputs for smallholder farmers. This is in contrast to agroecology practices that encourage use of integrated and traditional soil and, diseases and pest management practices that builds farm, crop and livestock diversity. Nonetheless, also agroecology related practices are identified few and far between policy documents that refer to conservation agriculture, agroforestry, sustainable land management conservation tillage, and cultivation of drought-tolerant crops, water harvesting, use of indigenous crops, livestock management and integrated soil fertility management among others.

**Agroforestry** is most popular agroecology practice mentioned in most documents to increase tree cover in farmland, improve nutrition and incomes, preserve and maintain the environment and, enhance carbon stocks.

Almost all agriculture and related policies recognize increasing crop-, livestock-, fishery- and soil- diversity as one of the main practices for adapting, mitigating and building resilience against climate change.

BOX:

The Kenya CSA strategy and framework selectively incorporated agro-ecological practices and combined them with adaptive, traditional and environmentally sound technologies such as provision of weather and agro-advisory information along value chains for decision-making and insurance, efficient water use including irrigation, conservation and propagation of adaptive crop and livestock germplasm. Some of the CSA and agroecology practices that overlap with the CSA strategy are: integrated pest management that minimize the use of pesticides on emerging pests and pathogens brought by temperature rises; agroforestry to bridge agricultural development and forest protection; integrated soil fertility management.

###### Reasons for lack of agroecology policy in Kenya

During interviews and FGDs, various reasons were outlined by the respondents for a lack of agroecology policy in Kenya. These include:

1. The current priority for the government is achieving maximum yield for economic benefit as well as provide enough food for the population. Despite the focus on production, there might not be enough the consideration of the entire food system. While agroecology might be successfully employed at a small-scale/local level, it may have limitations in implementing it at a national scale hence hinder the government from meeting its objectives. CSA is thus seen as a more viable option towards achieving food security for the country.
2. Agroecology is relatively a recent concept in Kenya and its principles has not yet been well understood among the policy makers hence the need to invest more on research and sensitization so that its benefits can be well understood amongst stakeholders.
3. Agroecology practices are being employed by farmers throughout the country even though they call it differently. However, it is only necessary to strengthen the existing policies and implement them which is usually the challenge. If the government opts to develop strategies for every new approach that comes up, then there will be thousands of strategies which will be not only confusing but difficult to implement.
4. For those who are somewhat familiar with agroecology, they consider it part of CSA with a lot of synergies between them and no clear line can be drawn to distinguish the two especially on the definition perspective. The two principles underlying agroecology and CSA, have to be contextualized until the overlaps between the two are clearly defined.
5. If Kenya is to promote agroecology, there might be conflicting interests e.g. by policy makers that have vested interests in conventional agriculture or by profiteers of other opposing policies.

The issue of lack of understanding of agroecology amongst policy makers influences its inclusion in climate change policies and strategies. According to one interviewee,

*“Agroecology has a space in climate policy dialogues but very few people who design policies know or even understand it. Additionally, agroecology is not being discussed or advocated for like climate change. No one is talking about it, no one is teaching the policy makers about it and information is not being shared. The perception is that if they are aware of the practice and understand how it works, then it might be an issue for discussion but this, however, may take a long time”.*

##### Analysis of the politics setting in Kenya (Politics lens)

This chapter analyses the role, awareness, understanding and acceptance of the agroecology approach among key stakeholders engaged in the policy making process. We assessed whether they understand the agroecology approach and how it differs from other concepts, whether they accept it as a valuable approach and whether they would be willing to support and promote it in their policy work.

###### Actors involved in agriculture and related policy making and implementation process in Kenya

During FGD, state and non-state actors were identified as the main actors in agriculture and climate related policy making and implementation. State actors identified were Ministry of Agriculture (MoA), specifically the Policy Directorate. In some cases, the Engineering department within the MoA can initiate a policy development. County government are also expected to identify policy gap and initiate policy at the County level.

Non-state actors identified were donor organizations, international non-governmental organizations (INGO), national non-governmental organizations (NNGO), universities, research institutions, development partners, private sector and CSOs. Non-state actors such as donor and INGO contribute through policy gap identification, funding, providing scientific evidence to support the need for policy and technical support during development of policy. CSO and NNGO are usually involved in development and validation of the policy and lobbying policy makers to support the policy.

Table 3: Actors engaged in the Kenya policy making process and their roles

|  |  |
| --- | --- |
| **Actors** | **Roles** |
| **State actors** |  |
| Policy Directorate and Engineering Dept. at MoA | * Identify policy gap * Main actor to develop policy |
| County Government | * Identify policy gap * Once a policy has been developed, domesticate the policy to suit their context * Implement policy |
| Members of Parliament | * Pass or reject the policy |
| **Non-State Actors** |  |
| Donor Organization | * Provide funding for the policy development and/or implementation * Provide technical expertise |
| International non-governmental organizations | * Provide funding for policy development and/or implementation * Provide scientific evidence to identify the extent and nature of the problem that the policy will address * Provide technical expertise |
| Universities | * Provide scientific evidence to identify the extent and nature of the problem that the policy will address * Provide technical expertise |
| Research institutions | * Provide scientific evidence to identify the extent and nature of the problem that the policy will address |
| CSOs | * Involved in policy validation processes * lobbying policy makers * Summarizing the policy into a text that is easily undertook by farmers and consumers * Policy implementation at grassroot level * Policy gap identification? NO? |
| Private sector | * Policy gap identification * Funding for policy development |
| Farmer organizations[[15]](#footnote-16) | * Policy development and implementation |

Despite the various roles of different actors outlined in Table 3 above, during development of a specific policy, the agendas of the actors are highly dependent on the policy being developed. Furthermore insights that were given by FGD participants were:

*Kenya lacks a strong consumer movement that can participate in agriculture policy design and implementation,*

*and*

*The policy directorate in the Ministry of Agriculture does a lot of moderation in policy development. They do not want every actor to start proposing policy development (Government Official).*

###### Overall perception of agroecology among stakeholders

The interviews and FGDs revealed that the term agroecology is a conflicting, not commonly used word amongst stakeholders in Kenya. In situations where it is used, it is interchangeably used with Climate Smart Agriculture (CSA). However, given examples of agroecology practices that were mentioned by respondents during interviews and FGDs, it becomes clear that this is not a new concept in Kenyan context. Agroecology is being perceived as an approach that is partly practiced by farmers already and only referred now differently. For many actors there is not a clear line that sets agroecology apart from CSA.

Only stakeholders who are directly involved in promoting agroecology (mostly CSOs) are able to define what it entails and draw the differences with CSA. For most of these stakeholders, agroecology is seen as a holistic farming process that involves a number of practices such as soil/ water management, crop diversification, use of nature/ natural inputs in crop/livestock production and considers the sustainability of biodiversity and health of the people. It is considered as an approach that can help communities adapt to the effects of climate change while at the same time building their resilience and hence a means of feeding the population especially at a time of changing weather patterns.

Most of the respondents felt that agroecology still needs to be researched on in terms of its potential benefits, unpacked in a way that will be clearly understood and the practices well explained before thinking of developing a policy; and even then, not all of them agreed there is need to have an agroecology policy. There is a diverse of opinion among the stakeholders in terms of accepting agroecology approaches for food production in Kenya. One government official responded by saying:

*“The ministry supports technologies that give farmers food, we do not have a blanket that this (agroecology) is the only thing to support. We support strategies which ensures farmers grow food and much as we would support agroecology. We still have to support the usage of conventional fertilizers for maximum yield’.*

While another respondent representing a CSO reiterated that;

*“Agroecology is probably the only option to address climate change as it is a holistic approach to ecosystem protection”.*

The general agreement is that indeed climate change is making it impossible to grow food under the ‘business as usual’ scenario and therefore climate smart strategies should be incorporated. This will ensure farmers are able to produce food which can feed the population but at the same time caution should be taken to ensure that biodiversity is not hampered since it supports the functioning of agroecosystems which include adaptation to climate change.

###### Perception of agroecology in the context of climate change

Osumba (2018) states that there is a high potential for CSA policies to support systemic and sustainable agriculture, through e.g. agroecology. This is supported by the stakeholders who participated in the interviews and FGDs who concur that agroecology has a space in climate change policy dialogues. However, their perception is that addressing climate change in agricultural sector does not have a single solution to it. It needs a number of strategies and agroecology is one of them. According to a respondent,

*‘Some of the agroecology practices are already practiced by farmers such as crop rotation, soil and water conservation among others to fight the effects of climate change. While it is not a new concept, it is still not being discussed during climate change meetings”*

Changing the mindset of Kenyan farmers and other agricultural vested stakeholders to embrace agroecology in the face of the changing climate might be difficult. According to another respondent;

*“Kenyans including farmers and policymakers don’t like to change easily and so they are stuck at what they know. Therefore, introducing agroecology to Kenyans implies to change their mindset so that they are not only thinking about chemicals and new seeds, but they see things from a different perspective”*

Increasing awareness on the potential of agroecology might change the perceptions of the wider population. Devolution of agriculture is a positive aspect in this case, since each County can be engaged in promoting agroecology principles and practices. Furthermore, the County government can develop their own agroecology polices or strategy that are embedded within or linked to climate change policies and use them to influence the national government. Unfortunately, this might take a long time to implement as one respondent stated:

*“The mindset of policy making people at the national level is focused only on what they learned in college years ago and new ideas such as agroecology are not easily embraced. Additionally, a lot of funding/scholarships in agriculture are funded by donors who have an interest in something they want to promote (e.g. genetic modifications etc.) and hence trying to change the mindset of people trained in such a system is hard’*

According to another respondent,

*Agroecology has a great potential to be included in climate dialogues because agroecology pushes for sustainable agriculture which considers the economic, ecological and social aspects of agriculture, important elements to consider when developing strategies for climate change mitigation. However, the challenge of agroecology is that of quantification. One critical question to ask is, what are the benefits vs loses when practicing agroecology? Agroecology should be unpacked in terms of what are the special practices which then need to be quantified. In climate change cycles, one should be able to report, that practicing agroecology to mitigate against climate change, it reduced X amount of GHG emissions, or it makes farmers more resilient by X percent etc. Unfortunately, what is currently being done is simply the promotion of agroecology without hard data to back its contribution to mitigation against climate change”.*

Finally, another respondent mentioned that;

*Agroecology has space in climate change dialogues, but it should not be the main agenda. There can be an agricultural/ climate change policy in place and agroecology to be part of one of the approaches towards mitigating impacts of climate change. For example, CSA strategy can be amended to adopt agroecology”*

##### Institutional framework and coordination mechanism in Kenya (polity lens)

Policy formulation and implementation in Kenya:

Kenya’s Constitution of 2010 introduced the devolved system of governance whose main aim is to bring services closer to the people at the grassroots level. The devolved system introduced two levels of governance, the National and the County governments. One of the services to be devolved is agriculture and County Governments have put forth efforts and programs geared towards improvement of agriculture in their various Counties. The County governments are equally expected to be involved in agricultural policy development. However, despite agriculture being devolved from the national government, the Ministry of Agriculture, Livestock and Fisheries (MALF) at the national level is still playing a key role in identifying policy gaps and initiating policy development. Within the MALF, the sub-sector of Policy Directorate (PD) identifies a policy gap, without involving the County government and go all the way to policy development. Other stakeholders at the national level can also identify a policy gap and spearhead development of a policy.

According to FGD discussant,

*Development partners including donor organizations can identify a policy gap and engage the Ministry of Agriculture in development of the policy. Since such policies are not country driven, implementation is usually a problem. This has led to several policies being written and shelved.*

During policy gap identification, the Policy Directorate at the MALF have to address the following questions: What is the nature and magnitude of the problem? What groups in the population suffer from the identified problem? How did the problem come about and why does it continue? What are the immediate and underlying causes? What should be done about the problem? (KIPPRA, 2015)

The ability to successfully implement agricultural policies requires a keen knowledge of the policy implementation plan to effect change amongst farmers and other affected stakeholders such as consumers. However, in Kenya the policy makers who are at the national level are often removed from the institutions that implement. Policy implementation is the jurisdiction of County government. Once a policy has been developed, it is devolved down to Counties, who might alter it to suit their county context. CSOs are also expected to implement the policy at grassroots level.

This was echoed by an FGD respondent:

*The work of the government is to develop policy and its implementation framework. However, actual implementation is left to the other players on the ground such as CSOs, farmers’ organizations, development organizations etc.*

###### Embedding agroecology in the institutional setting of Kenya first (ideal scenario)

From the interviews and FGDs it has become evident that agroecology is facing a set of challenges for being taken up in the Kenyan policy domain, including perception of the approach and alignment of policies. To overcome these hurdles, agroecology would also need to be embedded in the institutional setting in Kenya. Ideally the following institutional dimensions should encompass the agroecology principles:

1. Agroecology clearly embedded or mainstreamed within agriculture and other related policies: agroecology should be mainstreamed within other agricultural policies so that when implementation and budgetary allocations are made for them, agroecology can also be part of it.
2. Agroecology embedded into school and college curriculum: promoting agroecology in schools and hence a shift from the monotone of conventional farming teaching by incorporating agroecology into school curriculums as a subject/ discipline. With the concept embedded in school going children from a younger age, it becomes easy to adapt it later in life.
3. Social and political movement on agroecology driven by consumers: strong consumer movements to advocate for certain types of farming methods that is healthy. Consumers should have a voice concerning what type of food is grown and how it is grown.
4. Agroecology embedded into extension systems and agro-advisory services: extension workers should be capacity build on agroecology so that extension services they give to farmers should be well-rounded to also include agro-ecological concepts and farming practices.
5. Private sector investing in agroecology inputs and practices: The private sector can be incentivized by the government to invest in large scale organic inputs such as fertilizers, animal feeds, seeds etc. that can be sold to farmers nationwide. If they are able to make profits, then they will support the agroecology initiative.
6. Subsidies/ incentives to support farmers to invest in agroecology practices: government subsidies/ incentives can also be extended to farmers to entice them to invest in agro-ecological farming methods e.g. a fee given to them for converting part of their farms to grow trees which may be viewed as ‘unproductive’.
7. Marketing/labelling of agroecology products in markets and grocery stores: most consumers are conscious about what they consume and are willing to pay extra for healthy and good quality products. Therefore clearly indicating agroecology products in the market ensures the consumers are able to access them and the farmers get better prices for these products.

###### Options for stakeholders to render the agroecology ideal scenario reality

From the FGD visioning exercise, multiple entry points for mainstreaming agroecology in Kenya have been identified and their number might increase as policy makers, farmers, and other stakeholders become more aware of the opportunities and potentials that agroecology practices will provide in face of the climatic challenges. In order for agroecology to reach its full potential by 2025, there are several issues that the various stakeholders can address to achieve the ideal institutional setting as outlined in 3.3.2 above:

* Review existing agricultural policies and develop guidelines on agroecology. This can be done by government officials in conjunction with CSOs and NGOs.
* Using local based community/farmer groups working with farmers to teach them on the concept of agroecology and setting up demo-farms for farmers to learn.
* Capacity building, awareness creation and sensitization for farmers, government officials, CSOs, consumers and private sector
* Conduct research and provide evidence to show that AE can contribute to increasing food security
* Introduce agroecology and agriculture in the new school curriculum
* Extension education – train agricultural extension workers and other agro-advisory service providers on agroecology
* Provide incentives to private sector to invest in agroecology
* Labelling of agroecology products and promoted in the markets. Additionally, create demand for agroecology products - working closely with the media to market AE products.
* Promote biodiversity on the plate, this will ensure more crop varieties will be grown. Kenyans should be encouraged to explore other varieties of food in order to improve their nutrition, diversify their consumption hence reduce over-reliance on one food crop and increase the demand for other crops varieties.
* Influence donor and development partners to set it as an agenda so that the government can easily adapt it.
* Encourage agroecology as a social political movement: bring people on board to help convince conventional systems e.g. fertilizer and seed industries.
* Piloting and testing of agroecology practices in different agro-ecological zones and culturally diverse community in Kenya. The country has diverse climatic conditions that can support different agroecology practices. The potential for each area should be identified tested and promoted for maximum efficiency rather than engaging in uniform farming activities which are not sustainable for some area.
* Unpack and explain agroecology so that farmers and every stakeholder can understand it. Farmers do not get excited about terminologies. They need simple practices that they can easily use on their farms

Table 4: Summary: political potential of agroecology in Kenya. The policy potential is characterized by the following challenges and current opportunities to design and implement agroecology policies and strategies to hedge against climate change in Kenya:

|  |  |
| --- | --- |
| ***Challenges*** | ***Opportunities put forward by respondents*** |
| **Capacities and knowledge** |  |
| * Lack of capacity at the national level to develop appropriate/ country specific agro-ecological policies and at the county level to domesticate such policies * Knowledge of agroecology in relation to climate change is a major obstacle. * There can be limited staff capacity at County level to implement agroecology. Many are not clear what agroecology means. | * Integrating agroecology into CSA strategy and implementation plan * Build capacities at national and county levels on agroecology and its importance in building resilience (training awareness). * Engage civil society institutions or academic institutions who are knowledgeable about agroecology issues and climate change action to help sensitize on agroecology. * Development of agroecology curriculum |
| **Prioritization of agroecology** |  |
| * The prioritizing of agroecology is non-existent at the national level * A lack of knowledge amongst policy makers at national level with regard to the importance of agroecology in addressing in climate change in agriculture sector. | * Provide evidence-based examples or develop case studies on why agroecology is important in addressing climate change * Communicate the evidence carefully to policy makers explaining why agroecology is important for building resilience * Demystify ‘agroecology’ – using advocacy strategies, highlight the practices and benefits of agroecology for farmers |
| **Institutional structures and platforms to support agroecology** |  |
| * Currently, there are no institutional structures or platforms for supporting agroecology. * Since CSA strategy and implementation plan are in place, introduction of agroecology might create coordination confusion. * Harnessing the private sector and working with non-state actors in agroecology can be an issue. * Weak monitoring and evaluation system of policies. Therefore if an agroecology policy is developed, it will be shelved and never implemented. * Agroecology has not been promoted / incentivized to a point where it can be adopted at a large scale farming and therefore it is left to be practised by only small-scale farmers | * Sensitization on agroecology is needed so that stakeholders, especially farmers are aware of agroecology. * Engage CSOs and other non-state actors in advocating for agroecology * Mobilize or engage the private sector involved in agriculture in agroecology dialogues * Start advocacy and creating of platforms at County level especially Counties that are already accepting of agroecology and then cascade from there to other Counties. * Embed agroecology in existing policies that already have implementation strategies |
| **Financial and time resources** |  |
| * It is too costly/ lack of resources to develop and implement a policy in Kenya. * Time consuming: the process involved in designing an agroecology policy will be long e.g. researching, information gathering, testing of the practices, documentation etc. | * Embed agroecology policy within existing policy or strategy such as KCSA and KCSAIF * Use a pilot County such as Kiambu where agroecology policy is already understood to showcase what can be done with limited resources |

#### Conclusion

This study reveals several insights on the political potential of agroecology in Kenya and fleshes out the existing opportunities and challenges to institutionalize agroecology principles and practices. It is clear from the literature review, semi-structured interviews and the FGDs that the concept of agroecology is not yet clearly understood by stakeholders, including government officials, policy makers, CSO, NGOs, and private sector actors. The stakeholders that are somewhat aware of agroecology have not embraced it as an agricultural practice that can contribute to food security and build resilience to climate change impacts in Kenya. Nonetheless government officials recommend mainstreaming agroecology within existing policies and/or strategies such as the Kenya CSA strategy and its accompanying implementation strategy and the new agricultural policy. They also propose providing subsidies and incentives to support farmers to invest in agroecology practices. Private sector as a critical stakeholder is not willing to invest in organic agricultural practices such as mass production of organic fertilizers and pesticides, and the government does not have incentives to entice them. Furthermore, according to government officials who have an understating of agroecology, they all agree that farmers as the implementers of agroecology will not embrace it since it is labour and resource intensive. These two constraints can be addressed by providing subsidies and incentives to encourage farmers to adopt agroecology practices.

The current agricultural and other related policies will not contribute to sustainable food systems that enhance community and socio-ecological resilience to climate change. Additionally, in terms of achieving transformative visions of agroecology of food sovereignty that is people driven and supported by principles of human and social values and circular and solidarity economy, the current Kenya CSA and other agricultural policies and practices are not well suited to farmers and other stakeholders along agricultural value chains. Therefore, looking towards the year 2025, the stakeholders would like to envision increased use of agroecology principles and practices within Kenya’s farming system and these can be achieved by:

Climate change is becoming a critical concern in Kenya since it is deterring development efforts especially in agricultural sector. Societal awareness and political will about the impacts of climate change is growing and as such potential and importance of functioning agricultural systems is growing. This is exemplified in various agricultural and climate change policies and plans that the government has developed. However, agroecology as a practice that can help alleviate the impacts of climate change within agriculture sector is not well known or understood.

Engaging multiple stakeholders that have an interest in agriculture can help to improve understanding and hence adoption of agroecology by identifying how and where we should focus efforts to promote positive change towards agroecology practices. The efforts can be used to inform food security and nutrition strategies at different levels, national and county. The interviews and FGDs with government officials identified combined steps that can be addressed within the country to engage agroecology. This report recommends some potential entry points for mainstreaming agroecology in agricultural sector and deliver on food and nutritional security as well as build on resilience to climate change impacts. These include:

* Mainstreaming or alignment or of policy processes related agriculture and climate change towards agroecology principles and practices.
* As Kenya is currently formulating its agriculture policy, this presents a great opportunity to re-evaluate the policy to ensure that agroecology is included.
* Develop agroecology guidelines to guide and inform different stakeholders, especially policy makers. This can also include capacity building, awareness creation and sensitization for all stakeholders on agroecology.
* Provide scientific evidence that shows that agroecology can contribute to increasing food security and nutrition in Kenya and share this evidence with policy makers.

For the longer term the following programmatic activities are recommended to ensure a sustained embedding of agroecology principles in Kenya:

1. Development of agroecology strategy and implementation plan that is anchored to an existing agricultural policy. Currently Kenya is drafting its agricultural policy 2019 and the Ecological Organic Agriculture Initiative. Both are a great opportunity to anchor agroecology. Agroecology can also be mainstreamed into existing CSA strategy and implementation mechanisms that is being promoted across the country. Sectorial strategies such as Sector Transformation and Growth Strategy could one of the entry points for agroecology to be embedded on this strategy, depending on the priorities and since it already has an implementation framework. Agroecology can be taken as a component of this strategy.
2. Include agroecology in education curriculum at high school and college level. Kenya is currently reviewing its primary and secondary education curriculum and agroecology can be anchored into agricultural studies
3. Support stronger farmer organizations that can foster adoption of agroecology practices in different agro-ecological zones of Kenya.
4. Use the devolved County system to integrate agroecology practices. Some of the Counties, for example, Kiambu, Kitui, Embu and Tharaka Nithi Counties are already receptive of agroecology. The Counties need a little push to integrate agroecology into their agricultural policy or make it a stand-alone policy.
5. Training of agricultural extension workers on agroecology
6. Establish labelling of agroecology products and commodities: Labelling of agroecology products and commodities will ensure premium prices above other products. This will be similar to the current Organic Agriculture Certification. This will transform small holder farmers practicing agroecology from subsistence into successful agribusinesses.

### Technical potential in Kenya

#### Methodology

##### Defining Agroecological Systems for the Kenyan Context

Two institutions, Sustainable Income Generating Investment Group (SINGI) and The Institute for Culture and Ecology (ICE), were noted to support farmer groups in adoption of sustainable agriculture practices in Western (Busia County) and Eastern (Meru & Tharaka-Nithi County) Kenya respectively, as described below and therefore selected for this agroecology assessment.

Busia county is in the Western part of the country where agriculture is the main economic activity of the region. The land holdings range from 0.4 Ha for small-scale farmers to 6 ha for large-scale farming, 84% of the crop output is for subsistence use (USAID, 2014). Approximately, 36% of the total arable land in the area is under maize, whereas sorghum, cassava, cash crops occupy 10% ,14% and 10% respectively. The observed climate extremities include increased frequency of drought occurrence from 10 years to every 2-3 years adversely affecting productivity which is mainly rain-fed. Agricultural productivity is further affected by declining soil fertility (MoALF, 2016).

In Busia County, SINGI CBO is recognized as one of the institutions promoting biodiversification through growth of African Leafy Vegetables (ALV) to enhance sustainability and the reclamation of once diminishing nutritious genetic resources. Aside from promoting diversification, SINGI also equips farmers with knowledge on i) integrated management of soil fertility and pest through production of own compost and intercropping and ii) input substitution using manure, crop residues, compost and biopesticides. Farmers with acidic soils are encouraged to use manure and wood ash to increase the availability of nutrients to the crops. Other practices taught include water and soil conservation techniques (raised beds, semi-circular bunds/*mandalas and* keyhole gardens). The transfer of technology is through farmer-to-farmer training and demonstration farms set up by farmer groups in different locations within the county. SINGI was established in 2005 and has grown to a membership of over 50 groups with an average of 20 farmers per group.

Tharaka-Nithi and Meru County is located in the Eastern part of Kenya where agriculture is the main economic activity. The projected changes in climate include an increase in moderate temperatures which may lead to future moisture stress (MoALF, 2017). The main cultivated crops include green grams, millet, sorghum, cowpeas, pigeon peas, maize and beans (Recha et al.</i>, 2017).

In Eastern Kenya, the Institute for culture and ecology (ICE) promotes agro-ecological farming practices such as the use of indigenous crop varieties, agroforestry, organic farming and livelihood diversification among smallholder farmers. ICE has successfully conducted training programmes geared towards food sovereignty with impacts including: i) the revived use of twelve (12) varieties of indigenous seeds, ii) erection of effective cereal storage structures for over 100 households, iii) equipping 470 households with water harvesting and storage tanks and iv) the adoption of agroecological practices such as agro-forestry, terracing, water and soil conservation techniques by at least 800 farmers.

The reduction of industrial input usage can be regarded as level 1 agroecology while the substitution of conventional practices with agroecological practices can be regarded as level 2 agroecology (Gliessman, 2016; Mier y Terán Giménez Cacho *et al*>, 2018) . Based on the training and eventual adoption of the practices farmers were trained on (to varying degrees), farmer affiliation with SINGI and ICE for more than 5 years was considered to be in “agroecological transition” or “agroecological”.

##### Sampling Design

The sampling approach was based on spatial distribution and randomized sampling of farmers. The spatial sampling focused on 88 farmers from 4 agroecological zones (AEZ), spanning 3 county regions in Kenya namely Busia, Meru and Tharaka-Nithi. The distribution across county regions was to enable maximum heterogeneity of the sample in terms of gender, age and wealth. Farmers sampled were further categorized as agroecological (*N = 44*) and non-agroecological (*N = 44*) (Table 5).

The agroecological farmers (N = 23) from AEZ LM1 and LM2 were randomly selected from SINGI’S membership list while the rest of agroecological farmers (N = 21) located in AEZ LM5 and IL 5 were randomly selected from a membership list of farmer groups affiliated with ICE (Table 5).

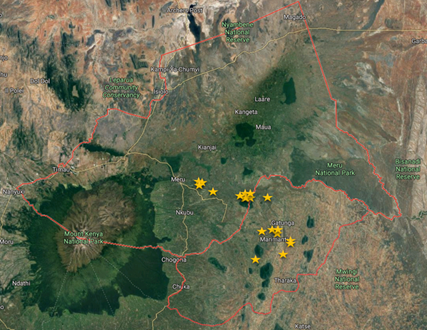


Figure 16: Maps of the three Kenyan counties (Meru, Tharaka-Nithi and Busia (from left) and the sampling sites

For comparison purposes, non-agroecological farmers (*N* = 44) were randomly selected from the same regions (Busia, Meru and Tharaka-Nithi) to closely match the agroecological/climatic conditions, livelihood strategies and land holding patterns of the agroecological producers. Key trained personnel (extension officers) of SINGI and ICE, identified a list of non-agroecological farmers within their areas of operation who were later picked randomly for participation in the survey.

The data collection through survey was conducted beginning of July, typically end of the wet season or harvesting for the cropping season. Based on the Kenya Meteorological Department review of the long rain season of 2019 (March-April-May), the seasonal rainfall was characterized by late-onset and poor (below average) temporal and spatial distribution (KMD, 2019).

Table 5: No. of farmers sampled from four agroecological zones in Kenya

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Zone** | **Characteristics of zones** | | **No. of Farmers in each zone** | |
| **Altitude (m)** | **Min. Annual Rainfall (mm)** | **Agroecological Farmers** | **Non-agroecological Farmers** |
| LM1 | 1200 -1440 | 1800-2000 | 23 | 23 |
| LM2 | 1200-1350 | 1550-1800 |
| LM5 | <900-1800 | 500-900 | 21 | 21 |
| IL 5 | <900m | 500-900 |
| Total | | | 44 | 44 |

Characteristics of the AEZ: Western Kenya, AEZ Zones LM1 – Lower Midland Sugar Cane Zone (sub-counties sampled Nambale, Matayos and Butula); LM2 – Marginal Sugar Cane Zone (sub-counties sampled Teso North), the main staple crop grown in the sampled sub-counties is maize. Eastern Kenya, AEZ LM5 – Lower Midland Livestock – Millet Zone (sub-counties sampled Tharaka-Nithi), AEZ IL 5 – Inner Lowland Livestock – Millet Zone (sub-county sampled – Imenti North) (Jaetzold *et al*>, 2011).

##### Specifities for the Kenyan SHARP survey:

* administered via SAMSUNG Galaxy Tab A).
* Four enumerators with minimum a BSc degree, received training on SHARP Tool from 17th to 20th of June 2019 and conducted the survey between 1st and 14th of July under the supervision of a research consultant.

#### Overall Findings SHARP resilience assessment.

There was no statistically relevant difference between the three counties in regard to their performance in SHARP even though they were located in different agroecological zones. Due to the homogeneity of the results, the differences in SHARP performance were analysed wholly as either agroecological or non-agroecological systems without regard for the agroecological zones.

Statistical analysis **indicated a significant difference *(P* < 0.001) between the average mean overall SHARP scores for the agroecological and control group farmers.** The agroecological farmer mean score was 5.2% higher than the non-agroecological farmer (Table 6).

The resilience scores of both the agroecological (59.9%) and non-agroecological farmers (54.7%) characterises the systems as mid-level climate resilience which implies that the farmers have certain abilities and knowledge to withstand unexpected shocks and climate variability, however, there is still a need to further strengthen their capacity to adapt to climate change (Hernandez-Lagana, Nakwang & Muhamad, 2018).

For the **agroecosystem resilience indicators, significant statistical differences were observed for 7 of the 13 agroecosystem indicators whereby the scores for the agroecological farmers were higher than for the conventional farmers (*P* < 0.05**) (Figure 17).

Table 6: Summary of SHARP dataset scores for sampled farmers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Type of Farmer** | **Sample No.** | **Mean (%)** | **Min (%)** | **Max (%)** | **Standard deviation** | **Coefficient of Variation (%)** |
| SHARP SCORES | Agroecological | 44 | 59.9 | 43.8 | 75.9 | ±7.1 | 10.7 |
| Conventional | 44 | 54.7 | 40.2 | 67.7 | ±6.6 | 10.3 |

Figure 17: Agroecological and non-agroecological mean scores for 13 agroecosystem indicators for climate resilience. Significant differences were observed in 7 of 13 resilience indicators determined by t-test and indicated as \*P < 0.05, \*\* P < 0.01 \*\*\*P > 0.001. Agroecological mean scores were higher compared to the non-agroecological farm system for all the resilience indicators that are statistically different.

At the sub-indicator level, significant differences in mean scores were observed in 12 of 92 sub-indicators (*P* < 0.05). Agroecological farmers had higher mean scores in 11 of these 12 sub-indicators.

At the module level, mean scores for 6 of 36 modules were significantly higher for the agroecological farmers than the non-agroecological farmers (Annex 7.3).

**Priority ranking**

Based on the priority ranking assessment (SHARP’s self-assessed importance from the technical, adequacy and importance scores of each module as generated by SHARP tool) as shown in Table 7 and Annex 7.5, both the agroecological and non-agroecological farmers identified similar modules as priorities, sharing 15 of the top 20 modules for intervention.

Table 7: Priority ranking assessment (Greatest priorities and least priorities) for agroecological and non-agroecological farm systems based on technical, adequacy and importance scores of each SHARP module. The lowest scoring modules are considered of the highest priority and requiring intervention.

| **Sharp farm system module** | **Agroecological farm system** | **Non-agroecological farm system** |
| --- | --- | --- |
| Insurance | 1 | 1a |
| Animal Breeding Practices | 2 | 2a |
| Non-Farm Income Generating Activities | 3 | 7a |
| Water Access | 4 | 4a |
| Land Access | 5 | 8a |
| Leguminous Plants and Trees | 30 | 32 |
| Animal Nutrition and Health | 31 | 30 |
| Decision Making (Household Level) | 32 | 33 |
| Access to financial Services | 33 | 36 |
| Major Productive Assets | 34 | 31 |
| Information and Communication Technologies (ICTs) | 35 | 34 |
| Decision Making (Farm Management) | 36 | 35 |

**Domain results**

SHARP results were also assessed on the four domain level of agronomic practises, environmental aspects, social interactions and economic components as shown in Figure 18. Based on the technical scores (4.3 – 5.9), the farmers indicate a mid-level resilience.

A **significant difference was observed in the agronomic practises domain** (P < 0.001) which covered modules on agricultural production, crop production, intercropping, pest management, animal production, animal health and nutrition, new varieties and breeds, trees and information access.

Figure 18: Average technical scores for the four domains

#### Detailed Results: Agroecosystem resilience indicators

This chapter provides a detailed analysis of the agroecosystem resilience indicators results

##### Socially self-organized

The socially self-organized indicator assesses the farmers’ ability to organize into grassroots networks and institutions such as co-ops, farmer’s markets and community sustainability associations. There were no significant differences between the two farm systems. Agroecological and non-agroecological farmers showed a similar access to communal land resource and financial support.

To assess this organization regarding access to local farm markets the two measurable variables considered for this indicator were i) household to market distance and ii) access to market price information; however, it is important to highlight that a multiplicity of indicators can be used (Chamberlin and Jayne, 2013) to proxy this.

Most farmers indicated having access to a local market within a 10 km radius. The findings are consistent with a study by Chamberlin & Jayne (2013), indicating household to market distances of roughly 0.85 km which implied that even “remote” villages which lacked physical access to infrastructure such as all-weather roads and electricity, still had i) a large number of small traders competing for local purchases and ii) many villagers are able to and choose to sell their grain surpluses at the farm gate. The proximity to markets signifies a local food movement which is smaller and easily adaptable to changing conditions of the local groups when compared to larger groups at a regional or national level hence more resilient (Cabell & Oelofse, 2012).

A slight difference was observed with market pricing decisions as 48% of agroecological farmers compared to 58% of non-agroecological farmers set produce prices based on market prices. According to Alene et al., (2008), price information in Kenya is mostly published in newspapers and only for the major markets which are not accessible to majority of the farmers. This results in the farmers relying on physically gathering information from local assembly markets or by letting main dealers/buyers to set the price. The farmers reported that market prices tend to be volatile yielding lower returns during surplus harvest seasons, which has a direct impact on their income and indirect impact on the resilience of the farmer. Cooperatives have the benefit of organizing farmers into strong producer and marketing associations; however, only 3 of the 88 farmers sampled (all agroecological farmers), declared to have relied on cooperative organizations to set the market prices for their agricultural produce.

The priority ranking assessment indicates that both farmer groups deemed group membership as a priority of near-equal importance, priority No.21 and No.17 respectively for the agroecological and non-agroecological farm systems (Annex 7.5).

##### Ecologically self-regulated

There were no significant differences observed for the agroecological and non-agroecological farming systems for the ecologically self-regulated indicator. According to Cabelll & Oelofse (2012), a self-regulating agroecosystem is governed by the feedback mechanisms created through ecosystem services such as the hydrological cycle, biodiversity and soil resources.

Self - regulation was assessed using sub-indicators such as soil health, environmental-friendly energy sources, presence of ecosystem engineers (buffer zones), biodiversity (perennials and trees), utilization of local animal breeds and crop varieties, fertilizer practices and leguminous plants. There were no significant differences between the farming systems at the sub-indicator level, e.g. the majority of the agroecological (90%) and non-agroecological farmers (88%) were observed to utilize local animal breeds and local crop varieties. Likewise, 100% and 95% of the agroecological and non-agroecological farmers (respectively) grew perennial crops while both farming systems appeared to incorporate agroforestry based on the presence of trees on their farms. Traditional varieties offer great defences / buffer capacity against vulnerability and enhance harvest security in the midst of diseases, pests, drought and other stresses (Altieri, 2009) .

Due to lack of waste management services in the areas sampled, farmers utilizing synthetic pesticides were noted to dispose of their containers through burning, burying in soil or throwing in pit latrines. Poor disposal methods for pesticide waste may result in biodiversity loss, soil pollution and health risks. Based on the priority ranking assessment (Annex 7.5) both farm systems indicated a high importance, (ranked as priority 11) for farm inputs.

##### Appropriately connected

Significant statistical differences (*P* < 0.01) were evident between the agroecological and non-agroecological systems with a higher mean score (6.1%) for agroecological farmers (Figure 18). As one of the resilience indicator agro-ecosystems, appropriately connected is a measure of the dynamic relationships and collaborations within the agro system over a spatial and temporal scale (Cabelll & Oelofse, 2012).

The relationships at the farm/field level cover aspects of biological interactions e.g. vegetation growth through nutrient cycling, predator/prey interactions, competition, commensalism and successional changes (Altieri, 2002). Connectedness outside the farm level reviewed existing networks between the farmers, suppliers, fellow farmers and consumers. Ties with multiple suppliers, outlets and fellow farmers ensures non-essentiality and continued functionality within an agro system in case one of the ties is cut off (Cabelll & Oelofse, 2012). The sub-indicators reviewed to verify these collaborations included access to information (market prices, weather forecast and climate adaptation practices), the existence of multiple suppliers for farm inputs, access to markets and veterinary services and the level of trust among community members.

The sub-indicators used to measure farm-level relationships are: ….

One of the farm-level relationships were assessed through the sub-indicator of intercropping, there were no significant differences between the farm systems. This may imply that non-agroecological farming for smallholder farmers in Kenya is not strictly a monoculture. According to Adamtey et al., (2016), non-agroecological farming for smallholder farmers in sub-Saharan Africa consists of maize-mixed farming where farmers grow more than one crop species for subsistent and commercial purposes. The agroecological farmers were observed to incorporate intercropping practices as a means of crop diversification.

For the exogenous relationships (ties outside the farm level), significant differences were observed for access to information and access to market between the two types of farming systems. The agroecological farmers indicated higher access to information to climate adaptation practices and weather patterns.

The information pathways for climate change adaptation and weather patterns could be most likely due to extension services provided through NGOs such as ICE/SINGI. According to past research on sources of agricultural information in Kenya (Goldberger, 2008), NGOs are the most important source of agricultural information for sustainable methods such agroecology and organic farming. The information is disseminated through formal workshops, exposure visits, demonstration farms and conversations with NGO staff. Some of the organic techniques taught and practised by the agroecological farmers included *mazimbuko* trenches, *mandala*, raised beds and key hole kitchens which are paramount for water conservation and consequently, climate adaptation. Access to these extension services increases the probability of adopting different climate smart/adaptation practices which would hedge the farmer against climate change (Belay *et al.*, 2017).

Access to markets for the appropriately connected indicator was assessed through the ability of the farmers to sell their produce when desired and the use of certification schemes to increase product value. Based on the mean scores, the agroecological farmers had higher chances of selling their produce when desired compared to non-agroecological farmers. However, only 7 % of all farmers were observed to participate in certification schemes. The farmers cited various reasons for the lack of participation in the schemes, the main one being non-existence of these within their reach.

Based on the priority scores, agroecological farmers indicated community cooperation as of greater priority (ranked 16) compared to non-agroecological farm systems (ranked 28) (Annex 7.5). This is in line with the agroecology principles in which the links to the members of the community for knowledge sharing and problem solving are key to strengthen sustainability and resilience.

##### Functional and response diversity

Significant differences were observed between the mean scores of the agroecological and non-agroecological systems (*P* < 0.01) for this indicator. Functional and response diversity was assessed using sub-indicators such as diversity in crop species, tree species, animal species, agricultural production activities, food, landscape and fertilizer inputs; assets owned; non-farm income generating activities; membership in groups; pest and disease management practices**.** Significant differences were observed in species diversity (*P* < 0.001) and group membership (*P* < 0.01).

Higher diversity in crop production was evident with 69% of agroecological farmers, as they tend to mix both seasonal and perennial crops in the same system (usually more than 5 seasonal and perennial species), compared to only 48% of the non-agroecological farmers (Figure 19).According to Folke, (2006), biological diversity is essential to a system’s ability to attain resilience as it improves the capacity for a system to self-organize both in absorbing disturbance, regenerating and re-organizing. As biological diversity, economic and social diversity are important for climate resilience as they serve as buffer when certain aspects of the farm system are jeopardised.

The practise of crop diversification for the agroecological farmers was likely due to capacitating through NGO’s and CBO groups and to spreading of climate related risks. Thus, agroecological farmers appear to have higher adaptive capacity than non-agroecological famers.

Figure 19: Number of crop species grown

The agroecological farmers were also noted to have active membership in multiple groups compared to non-agroecological farmers. Both farmer groups regarded additional and diversified income from non-farm activities as one of the top 10 priorities to enable household food security and enhanced resilience (Annex 7.5).

##### Optimally redundant

Optimal redundancy serves to ensure elements perform multiple functions as multiple elements could perform a single function in an agroecosystem (Cabelll & Oelofse, 2012). In essence, ecosystem’s redundancy serves as the backup and ensures functioning should any element fail in the case of shock. There were significant differences between the agroecological farmers and non-agroecological farmers (*P* < 0.01) (Figure 19). Redundancy was marked by access to multiple sources of water, energy, nutrients, seeds, financial sources; access to land; multiple varieties of crops and animal breeds; animal nutrition; food stocks and presence of cereal banks. Of particular importance on these sub-indicators was the varietal diversity, which captured the number of breeds owned and the number of varieties cultivated (*P* < 0.01). Similar to crop diversification, agroecological farmers had a higher reliance on multiple traditional crop and animal varieties.

The average private land area owned for the sampled farmers was 1.47 ha. Access to communal land resources for pasture and other agricultural activities was low, where only 17% of all farmers had access to communal agricultural land and 23% had access to pasture land. Increased farm size has a positive influence on adaptation strategies as it increases the probability of planting numerous fodder trees and integrating crop with livestock production and therefore allowing for the ecological redundancy which contributes to resilience building of agroecosystems. It also provides an opportunity for crop diversification thereby distributing risks associated with climate variabilityThis corrobrates, Alen *et al.,* (2008) who hypothesised that a minor increase in access to land per capita (1%) would boost market participation of farmers by 11%. Improved market participation will strengthen the multiple networks of the local food movement as well as increased income for the individual farmer positively contributing to their resilience levels.

Based on the priority ranking assessment (Annex 7.5), both farmer groups indicated access to land as a major priority (ranked 5 and 8 for agroecological and non-agroecological farmers respectively).

**BOX 1. Cereal Bank**

Seed granary for the “Agroecological” farmers in AEZ IL 5. a) The equipment was provided by Biovision Foundation and ICE NGO. Farmer testimonial: The equipment allows the farmers to store their seeds for up to upto a period of 3 years, which is more effective than storing seeds in the (b) gunny bags. The seed granary is useful to farmers who were able to not only store seed for food during the failed long rains, but they were also able to store seeds for the next cropping season. The farmers were not actively involved in cereal banks however they pointed to the potential of cereal banks to stabilize prices/as a source of credit. If cereal banks were set-up as feature within their farmer’s group, during periods of urgent need one could have an option of borrowing money from the farmer groups against his/her seeds instead of selling them at extremely low prices due to urgent and unexpected needs.

*Spatial and temporal heterogeneity*

This indicator looks into the patchiness of the farm system and across the landscape. As such, it comprises aspects related to the diversity of across and within agricultural activities, practices uses for resources management and landscape diversification.

Agroecological farmers were observed to have a significantly higher degree of spatial and temporal heterogeneity *(P* < 0.01). At the sub-indicator level, these differences were evident in temporal heterogeneity (*P* < 0.01) as intercropping, and a mix of crop cultivation (*P* < 0.01).

Agroecological farmers more commonly used land management practices such as agroforestry, crop rotation and manure/composting to increase the temporal and spatial heterogeneity when compared to their non-agroecological counterparts.

This can be attributed to the higher access of agroecological farmers to technological know-how through farmer to farmer training that allowed their diffusion and adoption of such techniques. The adoption of the techniques increases the adaptive management within the Agroecological systems when compared to the Non-agroecological systems. Based on the priority ranking assessment, non-agroecological farm systems had a higher priority to learn land management practices (ranked 12) compared to agroecological farm systems (ranked 28) (Annex 7.5).

The agroecological farmers also indicated a higher mix of crops through planting more perennial and seasonal crop species.

##### Exposed to disturbance

There were no significant differences between the agroecological and non-agroecological farmers with regard to this indicator; implying a similar level of exposure to disturbances. At the sub-indicator level, exposure to disturbance was denoted by the presence and management of weeds; climate-related relate shocks experienced; presence of buffer zones; use of pest management practices; presence of animal diseases; water and soil quality and external financial support received. Due to the similar geographic setting, the farmers reported experiencing comparable disturbances in climate-related events such as rainfall variability and other shocks hence the lack of differences for this resilience indicator. These findings were similar to a study by Heckelman et al., (2018) who found no significant differences between organic and non-agroecological rice systems due to both systems experiencing comparable levels of multiple small-scale disturbances.

##### Coupled with local and natural capital

Coupled with local and natural capital indicator is an assessment of the system’s ability to recycle and reuse waste and encouraging the system to live within its own means (Heckelman, Smukler and Wittman, 2018).

It was measured in terms of land improving practices (use of techniques improving the spatial and temporal heterogeneity, presence of leguminous plants and trees, use of natural fertilizers), energy and water conservation practices, water quality, pest management practices, the presence and increase/decrease trend of trees within the farm. Although there were significant differences reported for the use of land improving management practices, there were no statistical differences observed in the fertilization practices, growth of leguminous trees and pest management practices. **Ultimately, due to the differences in land management,** significant differences were observed (*P* < 0.05) in the coupled with local and natural capital indicator.

Further assessment of the types of inputs used in the farm systems revealed that approximately 50% of the agroecological farmers relied on natural fertilizers compared to 18% of non-agroecological farmers. Non-agroecological farmers mostly applied a mix of natural and synthetic fertilizers (57%) compared to agroecological farmers (41%) (Figure 20). Overall, more agroecological farmers relied on crop and farm residues, compost and manure for fertilization developing a higher adaptive capacity of converting waste to resource which contribute to the preservation of the natural resource base, increasing climate resilience and sustainability of the farm systems..

Figure 20: A comparison of the synthetic and natural input use between agroecological and non-agroecological farmers. Approximately, 55% of the agroecological farmers relied on natural fertilizers compared to 18% of the non-agroecological farmers.

For the agroecological farmers, 30% applied synthetic pesticides when compared to 45% of the conventional farmers. The use of bio pesticides was comparable between the two farm systems (9% and 7% respectively for agroecological and conventional). The lower use of synthetic pesticides and higher use of Bio pesticide and other methods for pest control among agroecological farmers is reflective of the level of awareness of environmental quality and soil health effects. Input substitution is not only a maker of agroecological transition (Gliessman, 2016) but it also denotes the reliance of natural systems to self-regulate making it more resilient (Cabell & Oelofse, 2012). Based on the ranking assessment, pest management practices emerged as one of the top priorities of near equal importance for both agroecological (No.12) and non-agroecological (No.13) farmers (Annex 7.5).

##### Reflective and shared learning

Active membership in agricultural groups provides a platform for reflection and shared learning leading to an increase in the adaptive capacity of the actors in the agro system. The actors (farmers) are able to anticipate the future based on experiences rather than the present conditions. The adaptive capacity will, therefore, trickle down to the system (farm) itself (Cabelll & Oelofse, 2012). SHARP methodology attempts to capture this through the inclusion of questions related to group membership, access to information and changed behaviour after expected and unexpected shocks are experienced.

Significant differences were observed between the two farm systems for the reflective and shared learning indicator (*P <* 0.01). At the sub-indicator level, agroecological farmers showed a significantly higher participation (*P* <0.001) in agri-related groups compared to non-agroecological farmers

Agroecological farmers also indicated better access to information on the weather forecast (*P* < 0.05). The access to weather information by agroecological farmers means they are better able to plan their agricultural activities which leads to informed adaptation planning and higher resilience level.

##### Globally autonomous and locally interdependent

No significant differences were observed between the two farm systems for the globally autonomous and locally interdependent indicator. Reliance on exogenous controls such as global markets, regulations and subsidies on agricultural production tends to reduce resilience and adaptive capacity of the agro system (Cabell & Oelofse, 2012; Milestad, Westberg, Geber, & Bjorklund, 2010). Therefore, resilient systems are globally autonomous however, they also establish effective collaborations and interlinkages at a local level.

At the sub-indicator level there were no significant differences. Global autonomy was assessed using the ability of farmers to breed at local level, reliance on local species, access to local markets, reliance on local energy sources, locally sourced food, purpose of production (for selling/on-farm production).

##### Honour’s legacy

Honour’s legacy is a measure of the preservation and use of traditional and indigenous knowledge in the management of the farm. Assessment of the indicator was based on sub-indicators such as the engagement of elders in the community, preservation of traditional knowledge, customary mechanisms, tree products, disease management and use of new varieties.

Agroecological farmers scored significantly higher in the honour’s legacy indicator (*P <* 0.01). At the sub-indicator level, agroecological farmers were observed to have a higher integration of tree products for agricultural production as well as anthropogenic use. Due to the transfer of traditional knowledge through their associative groups, the farmers were more likely to use trees for natural remedies, pesticide and soil fertilizer.

##### Builds human capital

With regard to this indicator, “A system that builds human capital mobilizes social relationships and resources that improve household well-being, economic activity; technology, infrastructure, individual skills and abilities and facilitates social organization and norms, as well as formal and informal networks” (Cabell & Oelofse, 2012; Heckelman et al., 2018).

There were no significant differences between the agroecological and non-agroecological farmers. At the sub-indicator level, human capital was assessed through social capital, animal care, education, household equality, ownership of ICT devices and household health. The non-agroecological farm system had significantly higher scores than the agroecological farmers for social capital which was evident for the farmers in AEZ LM 2 (*P* < 0.05). Social capital was assessed through community organization of festivals linked to key moments of their season (e.g. coinciding with harvest, planting, flowering). Non-agroecological farmers in AEZ LM 2 reported festival celebrations during harvest season, closely linked to religious festivities in the area.

##### Reasonably profitable

This indicator aims to assess the extent to which farmers and farm workers can earn a liveable wage through agriculture and other non-farm activities, and capture whether the agriculture sector is not relying on distortionary subsidies to be profitable. Profitability was assessed through financial support, income sources, access to markets, assets owned, insurance, savings and post – harvest handling.

Through the analysis, it was found that there were no significant differences between agroecological and non-agroecological farmers for the reasonably profitable indicator.

At the module level and sub-indicator level insurance had the lowest average scores for both farm systems (Annex 7.3) and ranking as the highest priority for farmers (Table 7). The farmers expressed having no access to insurance.

An assessment of the productive assets owned indicated no significant differences for the number of assets owned per farmer (Figure 21a) as well as the type of assets owned (Figure 21b) between the agroecological and non-agroecological farmers. The most commonly owned assets in both farm systems was land and livestock animals.

Figure 21: a) Number of productive assets owned by agroecological and non-agroecological farmers, 86% and 80% of the agroecological and non-agroecological farmers owned more than 3 assets respectively b) Types of productive assets owned by the farmers, most common assets owned by both agroecological and non-agroecological farmers included: - land, livestock animals, infrastructure (house and barn granary)

Higher income per hectare has been observed in different markets e.g. in the United States, 2 ha farms exhibit higher yields and income than non-agroecological large-scale farms. Polycultures exhibit higher productivity in the form of harvestable products per unit area which results in yield advantages ranging from 20% to 60%, compared to monocultures, due to reduced losses by weeds, insects and diseases (because of the presence of multiple species) and more efficient utilization of available resources of water, light and nutrients. However, higher profitability arises from farmer-to-consumer solidarity (direct linkages between farmer and markets) as well as payment of premium prices for their local and organic products (Altieri, 2009).

Despite higher harvestable products, agroecological farmers were observed to attain similar profitability/income levels with non-agroecological farmers. Hindrances to higher income per hectare arise could be arising from the lack of farmer to market solidarity and the reliance on volatile market prices. Policies supporting farmer to farmer networks which would set/stabilize product prices will result in fair trade and higher incomes for the farmers which will hedge in resilience. This also shows that there is a need to promote circular and short circuit markets that brings consumers closer to farmers. Different NGOs working with Agroecological farmers will need also to sensitize consumers on the importance of agroecological produced products.

Farmers also expressed the need for value addition in order to fetch higher prices for their products. Simple infrastructure such as posho mills within the communities would allow a farmer to grind their products fetching higher prices in the market.

evels by thematic area (technical score)

#### Conclusions

Our comparative assessment between agroecological and non-agroecological farm systems using FAO’s SHARP methodology indicated a difference in climate resilience. In general, the agroecological farmers were more resilient with 5.2% higher mean score. The assessment was based on 13 agroecosystem resilience indicators for socio-ecological systems (Cabell & Oelofse, 2012). **Out of these 13 indicators, agroecological systems were hedged as more resilient than the non-agroecological farm system on 7 indicators.**

**Agroecological farmers indicated a higher significant statistical difference for the appropriately connected indicator**. The farmers had better access to information on climate adaptation practises and weather forecast and better access to markets which was indicated by the Agroecological farmer’s ability to sell produce when desired as well as higher participation in certification schemes relative to their non-agroecological counterparts. Access of information was mostly from NGO’S.

Significant differences were observed between the mean scores of the agroecological and non-agroecological systems for the **function and diversity redundancy indicator**. Agroecological performed better in this indicator in particular due higher species diversity with at least 69% of the agroecological farmers growing more than 5 crop species compared to only 47% of the non-agroecological farmers. The agroecological farmers also had a higher participation in agro-related groups.

There were significant differences between the agroecological farmers and non-agroecological farmers (*P* < 0.01) for the **optimally redundant indicato**r. Optimal Redundancy was marked by multiple varieties of crop and animal breeds.

Agroecological farmers **had a higher reliance on multiple traditional crops,** averaging growing more than 1 crop variety for each crop species growing. Traditional varieties used were adapted to local conditions and therefore able to withstand shocksproduce relatively stable yields with minimum external inputs under changing environments (Altieri, 2009), therefore they are increasing resilience to shocks and changing climates.

However, access to communal land resources for pasture and other agricultural activities was low, where only 17% of all farmers had access to communal agricultural land and 23% had access to pasture land, thereby presenting a point of intervention, as also the priority ranking clearly shows (land access rankes on place 1). Holding (a larger extension of) land can also allow farmers to access the financial markets (e.g. requests for loans) as it serves as collateral. This might have positive effects on farmers’ incomes as with new income flow they can incur in higher-value investments at the farm level. Cereal banks were also not a common practise among the farmers, through a participatory approach, the setting-up of cereal banks will aid the farmers to maintain a continuous supply of food while preserving landraces for the next cropping season.

Agroecological farmers were observed to have a **significantly higher degree of spatial and temporal heterogeneity *(P* < 0.01)**. Agroecological farmers had a more diverse mix of crops also in terms of spatial distribution as well as a higher temporal heterogeneity on their farm system, due to the use of land management practises such as crop rotation, terracing and wind breaking. Heterogeneity in landscape also provides more diverse habitats and fosters diversity of plant and animal species which benefit from dynamic relationships and provide ecosystem services, creating a more resilient agro system against climatic changes.

Statistical differences were observed for the **coupled with local and natural capital indicator** due to differences observed in the land management practises between the agroecological and non-agroecological farmers. External Input substitution was evident among the agroecological farmers as 50% of the agroecological farmers relied on natural fertilizers compared to 18% of non-agroecological farmers while for synthetic pesticides, only 30% of the agroecological farmers used them compared to 45% of the non-agroecological farmers.

Nonetheless all farmers still expressed the strong need to have more guidance and assistance to produce their own top dressing and biopesticides to wean off their reliance on external inputs. Farmers in the drier AEZ zones also expressed the strong need for infrastructure such as irrigation or access to groundwater resources to enable continued harvest in the face of rainfall variability. In these dry areas, water seemed to be an extremely limiting factor, in particular in this year of below average rainfall. Fair and sustainable irrigation schemes would be needed, however water shouldn’t be sourced from river sources and thereby triggering water conflicts downstream, as happening now.

Significant differences were observed between the two farm systems for the **reflective and shared learning indicator (*P <* 0.01)** as the agroecological farmers were observed to have a higher participation in AP/FFS groups and better access to extension services availed by NGOs**.**

Agroecological farmers scored significantly higher in the **honour’s legacy indicator (*P <* 0.01).** At the sub-indicator level, agroecological farmers were observed to have a higher integration of tree products for agricultural production as well as anthropogenic use. Due to the transfer of traditional knowledge through their associative groups, the farmers were more likely to use trees for natural remedies, pesticide and soil fertilizer.

Some of the limitations and vulnerabilities according to the farmer’s priority ranking, include low access to communal land resource, financial services and insurance for both farmer groups.

### Social component: perception of farmer’s communities

To complement the findings from the SHARP survey, we provide additional information on the farmer’s and farmer communities’ perception of climatic change and their main coping strategies. The information is based on an participatory mapping exercise conducted by ICE (Mburu, no date). Participatory mapping is a simple visual tool used to engage the community in thinking about their ecosystem and building a common understanding, laying the foundation for improved community based governance of natural resources.

**Methodology**

The mapping involved One hundred and twenty (120) community members who comprise the Eight (8) communities that live along the Kathita River in the same area as the SHARP assessments took place. Assembled in groups, they were asked to come up with three maps; that of the past to reflect on tradition, the present to highlight the current challenges and their vision of the future in an ideal scenario (see Annex 7.6). They were led by the elders who are custodians of knowledge, especially in drawing the map of the past. These three maps help engage the community in critical thinking about the environmental changes and challenges facing them. They probed the elders that came before them for the map of the past; and probed each other on what they visualized as being the map of the future.

In order to put this mapping into a climate perspective for the current study, the main facilitators of the participatory mapping in 2014 where gathered in a extra climate focus group discussion. The questions asked, were priorly extracted and adapted from Merelyn, Mondoví and Phillips, (2018).

**Results**

The main insight of the exercise was the stark contrast between the maps and calendars of the past and those of the present. The map of the present reflected the reality of the destruction of ecosystem habitats that have happened over time, and all participants agreed that the river is faced with a serious threat of running out of water. Using the map of the future, they envisioned a future in which the river would undergo restoration back to a state analogous to the map of the past.

However, the group highlighted the possible tensions, especially with landowners who may view the restorative activities as trespass on their farms. They also identified the possibility of resistance by farmers who are flouting existing water abstraction guidelines as well as those who have installed illegal abstraction points.

The degradation of Kathita River begun with land adjudication when sacred sites were allocated to individuals instead of being designated as community land. Under such circumstances, community members would be denied access to such sacred sites for their rituals, which made the sites weak. This also weakened the traditional ecological law, which could not be enforced by the custodians on private property. The landowners then failed to protect the riparian reserves and opened their land to the banks of the river for agriculture and grazing, exposing the banks to severe soil erosion. The community also identified the weakened traditional initiation and clan governance system as the main culprits in differential integration of youth into the system for the subsequent protection of sacred sites. Also, The Water Resources Management Authority failed to enforce and enhance the policy guidelines on the abstraction of water from Kathita. Many illegal abstraction points were installed and those which are legal are not following the laid down regulations. The combined impacts of these failures have caused significant reduction of river water volumes increasing making the whole system more vulnerable to climatic changes.

The climate focus group discussion then stressed the prolonged drought that has persisted from 2018 to date, probably linked to climate change, which caused the complete failure of harvest for two years in a row in some parts. **The discussion affirming again that while all areas are affected by climatic shocks, protected and reforested areas like riverines and forests have retained some level of resilience against climate change induced draught since they manage to keep a good level of moisture.** (This is because they are in the valleys where the water converges, the water table is high and the trees work as hydraulic pumps. Further some of the present soils are not very vulnerable to erosion due to good protective vegetation cover and consequently have a higher water storage capacity. However, due to the overgrazing of other parts, agropastoralists tend to take their animals for grazing along the riverine, increasing pressure on these sites, resulting in degradation and pollution. Overgrazing in the uplands also threatens the rivers through contamination and increased erosion.

The mapping clearly shows that these communities’ livelihoods strongly depend on ecosystem services. In particular provision of (clean) water, medicinal herbs, building materials, fuelwood, grazing resources, pollination, and natural healing (traditional medicine prescribes going to the forest). However, these services are threatended and in particular soil erosion is rampant due to steep areas being overcultivated or overgrazed. To **tackle the root causes threatening the very foundation of their livelihoods, community conservation groups are spearheading the following measures to achieve their vision of the map of the future:**

Reforestation of degraded forests, riverine and communal lands. The communities are planting species like *Senna Siamea*, *Melia Volkensii*, *Azadiracta Indica* to control erosion. Further, they are terracing, making stone lines and trash lines out of crop residues to facilitate infiltration and minimize run-off of rainwater. **Also key is that elders are re-establishing local resource governance**, by reviving rituals to prevent unauthorised access and extraction of timber, sand and charcoal burning from sacred natural sites. A key outcome of the mapping exercise was the formation of a Coalition of Custodians, which was meant to consolidate and amplify the participant’s voice in campaigning for the protection and recognition of Kathita River as a sacred river.

**Conclusions:**

The comparison of the past and present maps shows the stark degradation of the ecosystems and the subsequent ecosystem service provision over the last decades. The climate focus group discussion stressed that the region has been affected by climatic shocks and continuous draught, but **the protected areas like riverine and forests have retained an increased level of resilience**. To achieve their visionary map of the future, lead communities and the partner organisation ICE came to the clear conclusion, “that only integrated agroecological measures can bridge the gap between these two maps” (‘Eco – Cultural Mapping Workshop Tharaka , Kenya’, 2011).

To tackle the root causes threatening the very foundation of their livelihood, community conservation groups need to push for agroecological measures which are very much in line with GKP and tend to ameliorate the 5 capitals of the sustainable livelihood framework and are determinats of the adaptive capacity as defined by the IPCC (Chapter 1.3). As the expected threats of climate change for Kenya include more frequent temporary droughts (Chapter 1.3) the **community approach of applying agroecological practices, in particular sustainable land management measures and reforestation as well as diversification (e.g. bee keeping), has shown to have the potential to increase the communities’ resilience to face these challenges.** Achieving this transformation and closing the knowledge gap towards integrated agroecology needs external facilitation and support, due to lack of finance and knowledge, as well as political support to improve resource governance..

## Results case study Senegal

Whole chapter delayed, to come

### Context Senegal

Desert climate prevails in Senegal with temperatures of more than 40C in summer and 16c in winter, increasing from the coast to the east. The wet season occurs during July- September, gradient with 200mm/ month in the south and 100mm in north. El Niño events are associated with drier conditions in the Sahel, la nina decreases temperatures (Food And Agriculture Organization of the United Nations, 2005b; C. McSweeney, New and Lizcano, 2010). Following climatic zones occur in Senegal semi-arid (BSh), arid (BWh) and tropical savannah (Aw) with developed biomes of grass savannah, tropical rainforest and tree savannah. Regions with a structural precipitation deficit are defined as arid zones with less than 50mm annual rainfall. Semi-arid climates receive less precipitation than potential evapotranspiration.

Seventy percent of the population work in the agricultural sector resulting in 17% of the GDP (*Agriculture, forestry, and fishing, value added (% of GDP) | Data*, no date). While forests cover about 43.8% , agriculture covers about 46% of the area of which more than 17% is arable (*FAOSTAT*, no date). Less than 5% of the agricultural land is irrigated. Main Land-uses are: Groundnuts 21%, millet 20% and livestock 29%. Rice is the main stable food but is mainly imported with 65% of the countries consumption (CIAT; USAID, 2016). Agriculture results in 49% of the greenhouse gas emissions.

#### CC impacts

Observed climate change effect:

* T increased 0.2C / decade :
* Climate change is already an undeniable reality for Senegal. In a report published on the State of the Environment by the Ecological Monitoring Centre (CSE), the following trends are noted:
* Mean annual temperature increased by 1.6 °C since 1950 with a stronger observed increase in the north of Senegal averaging 3 °C.
* A 30% reduction in rainfall between 1950 and 2000, with a strong variability from one year to another and from region to region. While precipitation trends have improved since 2000, it does not necessarily signal an end to the dry cycle.
* Higher frequency in flood events, particularly in the lower lying areas of Dakar and northwestern Senegal.
* Extreme droughts in 2002 and 2011 heightened food insecurity for over 200,000 and 800,000 people, respectively.
* Changes in the production of biomass, especially in the northern part of the country, reducing forage production for livestock activity. (CIAT; USAID, 2016)

Projected:

* Temperatures continue to increase by 1.1 to 1.8 °C by 2035, and up to 3 °C by the 2060s. Warming is faster in the interior of the country than compared to the coastal areas.
* While there is uncertainty in climate models for projections on precipitation, it is expected that similar trends will continue with higher rainfall events, but fewer rainfall events overall leading to dry spells. Some climate models show an increase in precipitation (50–100 mm) in the Casamance region and a severe decrease in eastern Senegal [28]. (CIAT; USAID, 2016)
* Stronger demand of evapotranspiration from plants. Saltwater intrusion affecting irrigated rice production and vegetable growing in Niayes. Sea-level rise by 1 meter by 2100 destroying over 6,000 km2 of land (approximately 8% of the territory), causing environmental degradation and soil erosion. (CIAT; USAID, 2016)
* Extreme events are expected, including prolonged droughts and more frequent flooding. The agriculture sector is sensitive to changes in temperature and precipitation and is likely to have adverse impacts on crop yields and livestock. Crop models show that groundnut yields may decrease by 5–25%, and maize and rainfed rice yields may gain by 5–25% in areas where they are currently grown [28]. Crops such as cowpeas and cassava have a strong resistance to drought and high temperatures and can be cultivated on poor soils, which represent an adaptation opportunity for farmers located in the Groundnut Basin [29]. Millet and sorghum are also more resilient to and have a higher tolerance level of drought, and crop models also indicate an increase in production for these crops. (CIAT; USAID, 2016)
* +3-6 C , precipitation remain similar, Regional model studies suggest an increase in the number of extreme rainfall days over West Africa and the Sahel during May and July ICCP (Niang *et al.*, no date), 2014.
* Despite the projected decreases in total rainfall, the proportion of total annual rainfall that falls in heavy events tends towards increases in the ensemble projections (C. McSweeney, New and Lizcano, 2010)
* Expected zonal change for Senegal is an increase of arid climate (Adhikari, Nejadhashemi and Woznicki, 2015).

#### Expected effects of climate change on major crops

The groundnut–millet rotation has traditionally been the dominant practice with more area devoted to groundnuts. However, in recent years, as groundnut yields have begun to decrease due to poor soil conditions and climatic factors, millet has increased in area (CIAT; USAID, 2016)

### Policy potential in Senegal

### Technical potential in Senegal

#### Findings

#### Social components

#### Analysis

#### Conclusions Senegal

# Conclusions and recommendations

The results of this study support the claim, that agroecology should be acknowledged as a truly powerful integrated approach to transform agriculture production systems into a more sustainable and climate resilient future, on various levels:

## Module Policy potential:

*(in italic: repetition from chapter’s conclusions)*

*Only recently the link between agriculture and climate change began to be properly articulated on the international policy level and finally the dichotomy between climate change mitigation and adaptation seems to have been largely overcome. The establishment of the KJWA was a breakthrough as it brought unprecedented emphasis on the climate change – agriculture nexus and the potential of agriculture to contribute to both mitigation and adaptation simultaneously.*

*A* ***detailed analysis of 136 NDCs an****d all submissions to the first three KJWA workshops demonstrate that a considerable number of countries and stakeholders from different backgrounds* ***see agroecology and related approaches as a promising means for reaching adaptation and mitigation targets and at the same time increase the resilience of the agricultural sectors****.*

*Invidual elements of agroecology, particularly in* ***regard to soil health and natural resource cycles****, are perceived as auspicious approaches. The systemic nature of agroecology and especially its socio-economic and political elements receive far less attention. Submissions by observers to the UNFCCC, especially those of some civil society organizations (****CSOs), are much more demanding and call for fundamental transformation of the food system****. That such a transformation is necessary is also acknowledged by the UNFCCC secretariat, stating that “it is generally accepted that successful adaptation to climate change requires transformation and paradigm shifts”38 and by the European Union (EU) referring to agroecology as a transformational approach as well as an example of “sustainable land/soil management practices”39. Also, recent reports by the IPCC, the UNCCD-SPI and the IPBES indicate an increasing convergence of the three “Rio Conventions” and demonstrate a shared* ***focus on transformative approaches as well as nature-based solutions.***

*Based on these findings, it is not surprising that many of our high-level interview partners from diverse institutions highlighted that* ***agroecology is gaining momentum****. However, given the complex political economy underlying decision-making under the UNFCCC and the still contentious nature of agroecology,* ***few believe that agroecology will be specifically promoted in an official outcome of the KJWA****. Much rather, it is likely that individual elements or practices of agroecology will be promoted under a different umbrella term, through another wording, such as ecosystem-based adaptation, climate smart agriculture or nature-based solutions.* ***It is key to prevent the risk that an official outcome on agroecology gets stripped of its social, economic and political dimensions and hence of its core holistic, systemic and transformative nature, which is the exact reason of its potential to build resilience to climate change. I****ndeed, only when agroecology is used to re-design agroecosystems on a landscape level and the socio-economic and political dimensions of agroecology are taken into account, can the multiple aspects of resilience (as specified also in the SHARP tool, see dedicated case studies parts) be addressed.*

In short:

* **Agroecology is gaining momentum**: A growing number of countries and stakeholders from different backgrounds see agroecology and related approaches as a promising means for reaching adaptation and mitigation targets and at the same time increase the resilience of the agricultural sectors.
* **Countries promote only indvidual agroecological practices,**…: Invidual elements of agroecology, particularly in regard to soil health and natural resource cycles, are perceived as auspicious approaches. The systemic nature of agroecology and especially its socio-economic and political elements receive far less attention.
* … **wheras** **observers call for an agroecological transformation**: Submissions by observers to the UNFCCC, especially those of some civil society organizations (CSOs), are much more demanding and call for a fundamental transformation of the food system. That such a transformation is necessary is also acknowledged by the UNFCCC secretariat and the European Union.
* **Agroecology likely to be promoted under a different umbrella term**: There are a number of partially overlapping concepts, which are not clearly differentiated (e.g. agroecology, climate smart agriculture, conservation agriculture, ecosystem-based adaptation, nature-based solutions, and sustainable land management ).
* Recent reports and opinions of key stakeholders indicate an increasing convergence of the three “Rio Conventions” and demonstrate a shared focus on transformative approaches as well as nature-based solutions. It is pivotal to remember that neither climate change nor agriculture are purely technological. A key strength of agroecology is its holistic nature, incorporating technological as well as socio-economic and political aspects.

## Module: Meta-analysis

*(in italic: repetition from chapter’s conclusions)*

*Albeit working with proxies, correlations and plausibility arguments, and having made explicit the potential challenges that come with such an approach and the underlying data we used, our results clearly allow to conclude that*

* *agroecology builds on key practices and characteristics that are performing well with respect to indicators that strongly correlate with climate change adaptation and resilience, such as various indicators related to s****oil health and biodiversity, but also productivity and yield stability***
* *Furthermore, these key practices and characteristics* ***correlate with indicators for mitigation co-benefits****, mainly related to soil organic matter, but also via reduced input use.*

*Hence, we can argue for* ***increased support*** *for those practices and characteristics which are central in agroecology, for supporting approaches that build on them, and for* ***more investments in research and implementation*** *of those, as they provide promising alternatives to the currently dominant approaches that come with a number of known drawbacks.*

*The results also allow to further refine some findings. An example would be the fact that organic agriculture shows lower yield stability, while increased diversity strongly correlates with more stable production. This suggests that organic agriculture may not fully implement and build on its diversity potential and in this also differs significantly from agroecological approaches. This would be an important area for further research to improve organic agriculture as a well-defined exemplary system that is closely related to agroecology, and also to gain further insights on the relation between productivity, stability and diversity in agro-ecosystems.*

*Second, the central role of knowledge transfer, co-creation of knowledge, etc. warrants a specific emphasis on this topic. This central role has been recently reemphasized in the High Level Panel of Experts of the Committee on Food Security and Nutrition report on agroecology (HLPE 2019), which highlights the key importance of enabling policies and instruments, as well as investments for transition pathways. NGOs and other institutions often play a central role as facilitators of these processes, in particular by providing funding and organizing exchange with relevant institutions. This is clearly illustrated for the innovation platforms, for example, where success seems to strongly depend on the presence and type of social capital and the relevance of specific context characteristics for innovation delivery.*

In a nutshell solid science can be found on:

* agroecology builds on key practices and characteristics that show strong positive impact on climate change adaptation and resilience, such as various indicators related to **soil health and biodiversity, but also productivity and yield stability**
* Also mitigation co-benefits, mainly related to **soil organic matter**, but also **via reduced input use**.

Most evidence on practices and elements are gliessmann levels 1 and 2, only a few single cases are on higher transformational Gliesmman level 4 and 5.

The analysis of these case studies thus **show an incomplete coverage of all the related aspects of agroecology**. Most studies focus on practices that are relevant in agroecology but taken for themselves do not provide a holistic coverage of Agroecology

Nothing is found in the meta-analysis on the role of seeds in climate adaptation, in particular the potential of locally adapted, traditional seeds, even tough from a biologic perspective and from numerous farmer’s and CSO’s testimionials, these could be a big asset in adaptation, providing more flexibility in their traits by being inherently more resilient and adaptive but also containing climate resilient traits in their germplasm. This aspect is totally lacking in the analysis

## Module: Case study Kenya

### Political potential:

*(in italic: repetition from chapter’s conclusions)*

*This study reveals several insights on the political potential of agroecology in Kenya and fleshes out the existing opportunities and challenges to institutionalize agroecology principles and practices. It is clear from the literature review, semi-structured interviews and the FGDs that the concept of agroecology is not yet clearly understood by stakeholders, including government officials, policy makers, CSO, NGOs, and private sector actors. The stakeholders that are somewhat aware of agroecology have not embraced it as an agricultural practice that can contribute to food security and build resilience to climate change impacts in Kenya. Nonetheless government officials recommend mainstreaming agroecology within existing policies and/or strategies such as the Kenya CSA strategy and its accompanying implementation strategy and the new agricultural policy. They also propose providing subsidies and incentives to support farmers to invest in agroecology practices. Private sector as a critical stakeholder is not willing to invest in organic agricultural practices such as mass production of organic fertilizers and pesticides, and the government does not have incentives to entice them. Furthermore, according to government officials who have an understating of agroecology, they all agree that farmers as the implementers of agroecology will not embrace it since it is labour and resource intensive. These two constraints can be addressed by providing subsidies and incentives to encourage farmers to adopt agroecology practices.*

*The current agricultural and other related* ***policies will not contribute to sustainable food systems that enhance community and socio-ecological resilience to climate change****. Additionally, in terms of achieving transformative visions of agroecology of food sovereignty that is people driven and supported by principles of human and social values and circular and solidarity economy, the current Kenya CSA and other agricultural policies and practices are not well suited to farmers and other stakeholders along agricultural value chains.* ***Therefore, looking towards the year 2025, the stakeholders would like to envision increased use of agroecology principles and practices within Kenya’s farming system*** *and these can be achieved by:*

*Climate change is becoming a critical concern in Kenya since it is deterring development efforts especially in agricultural sector. Societal awareness and political will about the impacts of climate change is growing and as such potential and importance of functioning agricultural systems is growing. This is exemplified in various agricultural and climate change policies and plans that the government has developed. However****, agroecology as a practice that can help alleviate the impacts of climate change within agriculture sector is not well known or understood****.*

*Engaging multiple stakeholders that have an interest in agriculture can help to improve understanding and hence adoption of agroecology by identifying how and where we should focus efforts to promote positive change towards agroecology practices. The efforts can be used to* ***inform food security and nutrition strategies at different levels, national and coun****ty. The interviews and FGDs with government officials identified combined steps that can be addressed within the country to engage agroecology. This report recommends some* ***potential entry points for mainstreaming agroecology in agricultural sector and deliver on food and nutritional security as well as build on resilience to climate change impacts****. These include:*

* *Mainstreaming or alignment or of policy processes related agriculture and climate change towards agroecology principles and practices.*
* *As Kenya is currently formulating its agriculture policy, this presents a great opportunity to re-evaluate the policy to ensure that agroecology is included.*
* *Develop agroecology guidelines to guide and inform different stakeholders, especially policy makers. This can also include capacity building, awareness creation and sensitization for all stakeholders on agroecology.*
* *Provide scientific evidence that shows that agroecology can contribute to increasing food security and nutrition in Kenya and share this evidence with policy makers.*

*For the longer term the following programmatic activities are recommended to ensure a sustained embedding of Agroecology principles in Kenya:*

1. *Development of agroecology strategy and implementation plan that is anchored to an existing agricultural policy. Currently Kenya is drafting its agricultural policy 2019 and the Ecological Organic Agriculture Initiative. Both are a great opportunity to anchor agroecology. Agroecology can also be mainstreamed into existing CSA strategy and implementation mechanisms that is being promoted across the country. Sectorial strategies such as Sector Transformation and Growth Strategy could one of the entry points for Agroecology to be embedded on this strategy, depending on the priorities and since it already has an implementation framework. Agroecology can be taken as a component of this strategy.*
2. *Include agroecology in education curriculum at high school and college level. Kenya is currently reviewing its primary and secondary education curriculum and agroecology can be anchored into agricultural studies*
3. *Support stronger farmer organizations that can foster adoption of agroecology practices in different agro-ecological zones of Kenya.*
4. *Use the devolved County system to integrate agroecology practices. Some of the Counties, for example, Kiambu, Kitui, Embu and Tharaka Nithi Counties are already receptive of agroecology. The Counties need a little push to integrate agroecology into their agricultural policy or make it a stand-alone policy.*
5. *Training of agricultural extension workers on agroecology*
6. *Establish labelling of agroecology products and commodities: Labelling of agroecology products and commodities will ensure premium prices above other products. This will be similar to the current Organic Agriculture Certification. This will transform small holder farmers practicing agroecology from subsistence into successful agribusinesses.*

In short:

* The current agricultural and other related policies will not contribute to sustainable food systems that enhance community and socio-ecological resilience to climate change
* Dominant policy narrative is CSA: Climate Smart Agriculture Strategy (CSAS) and Implementation Framework (2018) are comprehensive to identify challenges and opportunities to hedge against climate impacts in the agriculture sector in Kenya.
* There is a feeling that the concept of CSA could be inclusive of “business as usual” approaches to agriculture. However since CSA strategy and implementation plan are in place, introduction of agroecology might create coordination confusion.
* Agroecology principles are not explicitly inferred to. However, agroecology practices are indirectly mentioned in various policies (Figure 14: Number of reported cases that match the respective indicators in the single system comparison studiesTable 3).
* In Kenya the concept of agroecology is not yet clearly understood by stakeholders, including government officials, policy makers, CSO, NGOs, and private sector actors.
* It is difficult to grasp the idea of integrated measures and systemic thinking (for policy makers (in Kenya) and first of all training and awareness raising activities would be needed
* Government officials recommend mainstreaming agroecology **within existing policies** instead of creating a new policy
* Private sector as a critical stakeholder is not willing to invest in organic agricultural practices thus the government does not have incentives to entice them through policies (vicious cycle)
* Change of agriculture concepts is confusing actors in Kenya. The good thing is the new approach to have “principles” that can be embedded in existing approaches and policies such as CSA.
* There is potential to streamline and embed the AE principles in existing policies to improve their integrity
* Despite the importance of agriculture in Kenya, the sector does not receive high priority in terms of budget allocation compared to other sectors such as infrastructure and energy.

### Technical potential.

*(in italic: repetition from chapter’s conclusions)*

*Our comparative assessment between agroecological and conventional farm systems using FAO’s SHARP methodology indicated a difference in climate resilience. In general, the agroecological farmers were more resilient with 5.2% higher mean score. The assessment was based on 13 agroecosystem resilience indicators for socio-ecological systems (Cabell & Oelofse, 2012).* ***Out of these 13 indicators, agroecological systems were hedged as more resilient than the conventional farm system on 7 indicators.***

***Agroecological farmers indicated a higher significant statistical difference for the appropriately connected indicator****. The farmers had better access to information on climate adaptation practises and weather forecast and better access to markets which was indicated by the Agroecological farmer’s ability to sell produce when desired as well as higher participation in certification schemes relative to their conventional counterparts. Access of information was mostly from NGO’S.*

*Significant differences were observed between the mean scores of the agroecological and conventional systems for the* ***function and diversity redundancy indicator****. Agroecological performed better in this indicator in particular due higher species diversity with at least 69% of the agroecological farmers growing more than 5 crop species compared to only 47% of the conventional farmers. The agroecological farmers also had a higher participation in agro-related groups.*

*There were significant differences between the agroecological farmers and conventional farmers (P < 0.01) for the* ***optimally redundant indicato****r. Optimal Redundancy was marked by multiple varieties of crop and animal breeds.*

*Agroecological farmers* ***had a higher reliance on multiple traditional crops,*** *averaging growing more than 1 crop variety for each crop species growing. Traditional varieties used were adapted to local conditions and therefore able to withstand shocks**produce relatively stable yields with minimum external inputs under changing environments (Altieri, 2009), therefore they are increasing resilience to shocks and changing climates.*

*However, access to communal land resources for pasture and other agricultural activities was low, where only 17% of all farmers had access to communal agricultural land and 23% had access to pasture land, thereby presenting a point of intervention, as also the priority ranking clearly shows (land access rankes on place 1). Holding (a larger extension of) land can also allow farmers to access the financial markets (e.g. requests for loans) as it serves as collateral. This might have positive effects on farmers’ incomes as with new income flow they can incur in higher-value investments at the farm level. Cereal banks were also not a common practise among the farmers, through a participatory approach, the setting-up of cereal banks will aid the farmers to maintain a continuous supply of food while preserving landraces for the next cropping season.*

*Agroecological farmers were observed to have a* ***significantly higher degree of spatial and temporal heterogeneity (P < 0.01)****. Agroecological farmers had a more diverse mix of crops also in terms of spatial distribution as well as a higher temporal heterogeneity on their farm system, due to the use of land management practises such as crop rotation, terracing and wind breaking. Heterogeneity in landscape also provides more diverse habitats and fosters diversity of plant and animal species which benefit from dynamic relationships and provide ecosystem services, creating a more resilient agro system against climatic changes.*

*Statistical differences were observed for the* ***coupled with local and natural capital indicator*** *due to differences observed in the land management practises between the agroecological and conventional farmers. External Input substitution was evident among the agroecological farmers as 50% of the agroecological farmers relied on natural fertilizers compared to 18% of conventional farmers while for synthetic pesticides, only 30% of the agroecological farmers used them compared to 45% of the conventional farmers.*

*Nonetheless all farmers still expressed the strong need to have more guidance and assistance to produce their own top dressing and biopesticides to wean off their reliance on external inputs. Farmers in the drier AEZ zones also expressed the strong need for infrastructure such as irrigation or access to groundwater resources to enable continued harvest in the face of rainfall variability. In these dry areas, water seemed to be an extremely limiting factor, in particular in this year of below average rainfall. Fair and sustainable irrigation schemes would be needed, however water shouldn’t be sourced from river sources and thereby triggering water conflicts downstream, as happening now.*

*Significant differences were observed between the two farm systems for the* ***reflective and shared learning indicator (P < 0.01)*** *as the agroecological farmers were observed to have a higher participation in AP/FFS groups and better access to extension services availed by NGOs****.***

*Agroecological farmers scored significantly higher in the* ***honour’s legacy indicator (P < 0.01).*** *At the sub-indicator level, agroecological farmers were observed to have a higher integration of tree products for agricultural production as well as anthropogenic use. Due to the transfer of traditional knowledge through their associative groups, the farmers were more likely to use trees for natural remedies, pesticide and soil fertilizer.*

*Some of the limitations and vulnerabilities according to the farmer’s priority ranking, include low access to communal land resource, financial services and insurance for both farmer groups.*

In a nutshell:

* Statistical analysis indicated a significant difference *(P* < 0.001) between the average mean overall SHARP scores for the “agroecological” (N=50) and “control group” farmers groups (N=50).
* The agroecological farmer mean score was 5.2% higher than the “control group” farmer.
* Out of **13 agroecosystem resilience indicators for socio-ecological systems (Cabel & Oelofse, 2012), agroecological systems were found to perform better on 7 indicators** (\*P < 0.05, \*\* P < 0.01 \*\*\*P > 0.001) (Figure 22). Agroecological farmers exhibited a higher adaptive capacity and resilience due to higher spatial and temporal heterogeneity, varietal diversity, species diversity and higher input substitution (more reliance on natural inputs) compared to conventional farmers.
* On domain level, a significant difference was observed in the agronomic practises domain (P < 0.001), with AE farmers scoring better in the averages of three of four domains.
* The detailed analysis shows that agroecological farmers **exhibited a higher adaptive capacity and resilience** due to the following agroecosystem resilience sub-indicators:

**Social:**

* + \*\*Appropriately connected (access to information, forecasts, markets, PGS)
  + \*\*Reflective and shared learning indicator (higher farmer group participation & access to extension)
  + \*honour’s legacy indicator (higher tree inclusion)

**Ecologic:**

**Diversity:**

* + \*\* Redundancy (functional and species diversity (N crops).
  + \*\* Optimally redundant (variety diversity)
  + \*\* Higher spatial and temporal heterogeneity

**Efficiency:**

* + \*Coupled with local and natural capital (substitution of ext. inputs)

**Economic**:

* None

Though both farm systems are characterized as mid-level climate resilient, **the agroecological systems have higher scores hence possess higher capacity to absorb, cope, adapt to climate change and variability** and are thus more resilient comparatively.

* Priority ranking of what farmers want and need most shows: Both the agroecological and conventional farmers identified similar modules as priorities, sharing 15 of the top 20 modules for intervention: Insurance, Animal breeding, non-farm income generating activities, water and land access. (see table XX)

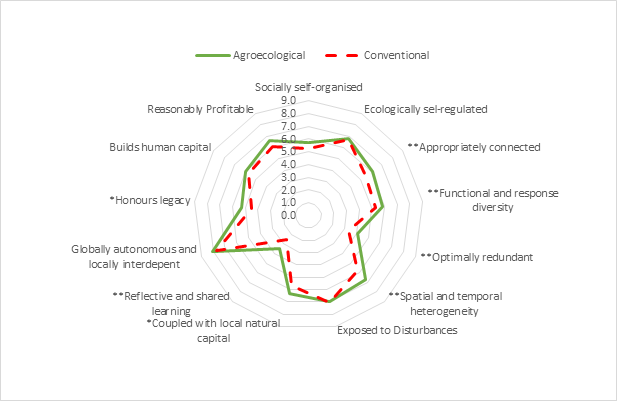


Figure 22

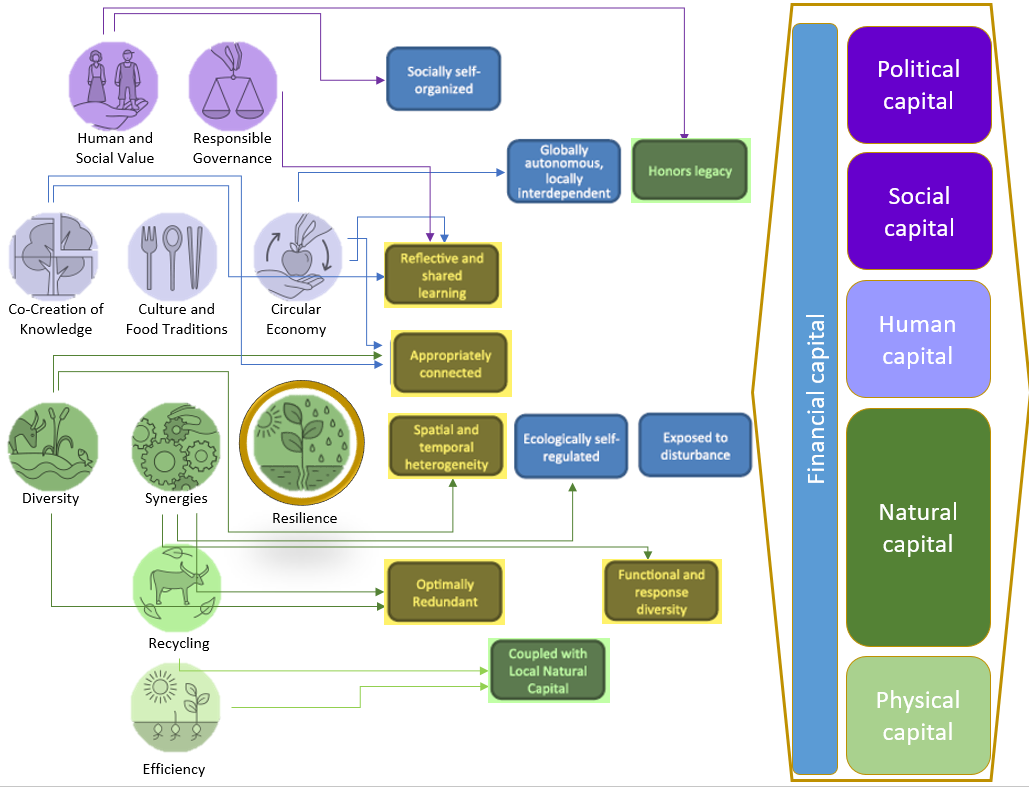


Figure 23: : Linking FAO’s 10 elements of agroecology with the 13 SHARP resilience indicators and the 6 SLF framework dimensions (Yellowish background \*\*significance, greenish background \* significance)

->to be developed as a structure for recommendations, only draft, see also Figure 4

## Recommendations

To come

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## List of the literature analysed in the meta-analysis (chapter 2)

### Single System comparison studies (#17)

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Oakland Institute, Biointense Agriculture training programm in Kenya,

Oakland Institute, RESTORING ECOLOGICAL BALANCE AND BOLSTERING SOCIAL AND ECONOMIC DEVELOPMENT IN NIGER CHALLENGE.

### Meta-analyses (#33)

(Bai, Huang et al. 2019)

(Beckmann, Gerstner et al. 2019)

(Bongiorno, Bodenhausen et al. 2019)

(Cardinale, Duffy et al. 2012)

(Crowder and Reganold 2015)

(de Graaff, Hornslein et al. 2019)

(Duffy, Godwin et al. 2017)

(Gattinger, Muller et al. 2012)

(García-Palacios, Gattinger et al. 2018)

(Isbell, Craven et al. 2015)

(Knapp and van der Heijden 2018)

(Lesk, Rowhani et al. 2016)

(Letourneau, Armbrecht et al. 2011)

(Li, Li et al. 2019)

(Lichtenberg, Kennedy et al. 2017)

(Liu, Chen et al. 2016)

(Lori, Symnaczik et al. 2017)

(McDaniel, Tiemann et al. 2014)

(Muneret, Mitchell et al. 2018)

(Pittelkow, Liang et al. 2015)

(Poeplau and Don 2015)

(Ponisio, M'Gonigle et al. 2015)

(Raseduzzaman and Jensen 2017)

(Reiss and Drinkwater 2018)

(Renard and Tilman 2019)

(Santos, Crouzeilles et al. 2019)

(Seufert 2018)

(Seufert and Ramankutty 2017)

(Sanders and Hess 2019)

(Smith, Cohen et al. 2019)

(Torralba, Fagerholm et al. 2016)

(Tuck, Winqvist et al. 2014)

(Venter, Jacobs et al. 2016)

### Reviews (#19)

(Adidja, Mwine et al. 2019)

(Altieri, Nicholls et al. 2015)

(Côte, Poirier-Magona et al. 2019)

(D'Annolfo, Gemmill-Herren et al. 2017)

(Debray, Wezel et al. 2019)

(Diacono and Montemurro 2011)

(IPCC 2019)

(Lichtfouse 2012)

(Manns and Martin 2018)

(Murgueitio, Calle et al. 2011)

(Pamuk, Bulte et al. 2014)

(Partey, Zougmoré et al. 2018)

(Pretty and Hine 2001)

(Rossing, Modernel et al. 2014)

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# Annex

## List of stakeholders interviewed (for parts 2.2 and 2.3)

|  |  |  |  |
| --- | --- | --- | --- |
| Involved/not involved in Koronivia | Category pf interviewee |  | Name |
| Involved | **Government (4)** | Senegal Negotiator | M. Lamine Diatta |
| Involved |  | French Negotiator | Mrs. Valerie Dermaux |
| Involved |  | Kenya Negotiator | *To be completed by Biovision* |
| Involved |  | Swiss Negotiator | *To be completed by Biovision* |
| Involved | **UN organization (2)** | Climate Change, Natural Resources Officer | M. Martial Bernoux |
| Involved |  | Climate Change, Natural Resources Officer | Mrs. Julia Wolf |
| *To be completed by Biovision* |  | CCAFS | *To be completed by Biovision* |
| Involved | **Research (5)** | INRA | M. Jean-Francois Soussana |
| not directly involved |  | INRA | Mme. Claire Weill |
| not involved |  | INRA | Ms. Allison Loconto |
| Involved |  | IDDRI | M. Sébastien Treyer |
| not involved | **CSOs and environmental organizations (3)** | IPES-Food | M. Emile A. Frison |
| Involved |  | Secours Catholique | Mrs. Sarah Lickel |
| not involved |  | Le Gret | M. Laurent Levard |
| Involved | **Farmers organizations (1)** | *To be completed by Molefi* | M. Ceris Jones |

## Literature review

### Meta-analyses and reviews

We searched for meta-analyses on 1) the performance (with respect of a number of agronomic, environmental or social indicators) of agricultural practices or production systems that are part of or closely related to agroecological production systems, such as organic agriculture or agroforestry; 2) the relation between a number of sustainability indicators to the characteristics of agricultural production systems or ecosystems in general that closely relate with characteristics of agroecological production systems and with climate change adaptation; an example is the relation between diversity and productivity. We identified the meta-analyses by web-searches in Google Scholar and discussion with experts.

Search terms were “meta analysis”, “meta review” and “review” combined with search terms for production systems: “agroecology”, “agroforestry”, “organic agriculture”, “organic farming”, “permaculture”, “reduced tillage”, or for system characteristics (“diversity”), and with search terms for indicators related to climate change impacts and adaptation (“productivity”, “yield”, “performance”, “income”, “stability”, “resilience”, “extreme events”, “drought”, “pests”, “diseases”) – and variations of these terms. These search terms cover key aspects of climate change adaptation and resilience as framed in (FAO 2015).

While compiling this literature data base, we also added related literature which we occasionally identified while scrolling through the studies, e.g. from the reference list, or which have been pointed out to us by other researchers directly.

This search resulted in 51 review articles, whereof 33 were statistical meta-analyses, and 18 more descriptive literature reviews.

Part of the single system comparison studies identified above are also covered in these meta-analyses and reviews. This is however no problem, as the search for and analysis of the single system comparison studies aimed at identifying and synthesizing the evidence on “agroecology” (and some closely related systems) and “climate change adaptation”, while the meta-analyses are designed to address single specific aspects and characteristics of these two topics only.

### Single system comparison studies

We did a literature review searching for peer-reviewed studies that compare agroecological production systems with some baseline and provide qualitative or quantitative evidence for the difference in performance regarding climate change adaptation (“Single system comparison studies”). Thereby, we considered studies only that termed themselves to be assessing agroecology or agroecological practices. We thus neglect studies whose authors did not explicitly frame them in the context of agroecology. Given the inclusion criteria we used for them, these other case studies without explicit reference to agroecology are however to a large part already covered in the meta-analyses and reviews we searched for as described in the previous sub-section.

For the single system comparison studies, we used the following search terms in two search engines, completed in April 2019:

1. Web of Science:
   * TOPIC: “climate change” AND TOPIC: “agroecology”, scrolling through all results
2. Google Scholar:
   * “agroecolog\*” AND “climate change”, scrolling through the first 200 results

As this search only captures articles that are self-declared to somehow refer to agroecology by the authors, we expanded the search to terms closely related to agroecology as follows

* + “permaculture” AND “climate change”, scrolling through the first 100 results
  + “regenerative agriculture” AND “climate change”, scrolling through the first 100 results
  + “silvopast\*” AND “climate change”, scrolling through the first 100 results
  + “Zero budget natural farming” AND “climate change”, scrolling through the first 100 results

We complemented this search with a search for Spanish, French, Italian and Portuguese literature in June 2019 using the following search terms in Google Scholar, scrolling the first 100 results (in many cases much less were found):

* + “agroecolog\*” AND “cambio climatico”
  + “permacultura” AND “cambio climatico”
  + “agricultura regenerativa” AND “cambio climatico”
  + “CSA” AND “cambio climatico”
  + “agroecolog\*” AND “changement climatique”
  + “permaculture” AND “changement climatique”
  + ”agriculture regeneratrice” AND “changement climatique”
  + “CSA” AND “changement climatique”
  + “agroecolog\*” AND “cambiamento climatico”
  + “permacultura” AND “cambiamento climatico”
  + “agricoltura regenerativa” AND “cambiamento climatico”
  + “CSA” AND “cambiamento climatico”

For the literature in Portuguese, we approached Dayana Andrade, a PhD student in agroecology in Brazil; this did however not result in any additional studies.

While compiling this literature data base, we also added related literature which we occasionally identified while scrolling through the studies, e.g. from the reference list, or which have been pointed out to us by other researchers directly.

This primary search resulted in 185 studies (120 E; 35 F; 23 ES; 4 I; 3P)

We then screened all studies for

* + Being peer-reviewed or “close to it” (such as PhD theses)
  + Addressing climate change adaptation or related aspects (and not purely focusing on mitigation)
  + whether they indeed analyse agroecology. This was determined by identifying whether practices from the framework from Biovision were analysed or not (cf. above). Only those articles referring to such practices have been retained for further analysis.
  + whether they compare an “agroecological” to a “conventional” baseline situation. Studies reporting on agroecological situations without reference to a baseline with which to compare the performance to have been excluded from further analysis.
  + whether they report quantitative or qualitative indicators for the differences in performance. Articles without such data have been excluded from the analysis.

This left us with 17 studies. Many studies had to be dropped because of lack of evidence, lack of a baseline for comparison, or because they represented reports from NGOs, research institutes, etc. without being peer-reviewed. In particular the latter provide interesting information, but adopting a conservative approach, we could not include them in the analysis. Some of them are listed under the header “Examples of anecdotic evidence” in the data base file “Review\_AgroecAndCCAdapt\_LiteratureAnalysed.docx”.

For all these studies, we then reported

* + the agroecological practices implemented
  + the performance indicators used
  + the country, region, continent, where the study is located
  + the agroecological zone, in which the study is located
  + the scale of implementation of the practices (1 local; 2 regional; 3 national; 4 international)
  + the FAO element the agroecological case refers to
  + the Gliessman level the agroecological practices refer to
  + Whether the practices also show climate change mitigation potential or not (only qualitative evidence needed, coded as a binary indicator: 1 yes; 0 no).
  + Whether the study referred to a specific extreme event such as a storm or drought where adaptation or resilience become very well visible and can be observed on the ground in short time periods
  + Whether the study adopted a holistic approach attempting to covering agroecology in its whole complexity in its empirical approach.

### Potential bias in the data

Besides the case studies that are self-declared agroecological, the data basis we compile also covers the huge number of case studies that analyze how agricultural production systems, practices and characteristics that strongly relate to agroecology (but without referring explicitly to this term) correlate with indicators of climate change adaptation and resilience. Examples are comparisons of organic versus conventional production systems with respect to yield stability, comparisons of different levels of species richness in agro-ecosystems with respect to total biomass production, or comparisons of systems with organic fertilizers to such with mineral fertilizers with respect to soil fertility. As these second type of case studies have repeatedly been synthesized in a number of meta-analyses and reviews on various topics, we do not search for these case studies specifically, but directly draw on the results from the corresponding meta-analyses and reviews. By this, we cover the knowledge based on case studies that do not explicitly refer to agroecology as well.

This approach may result in two types of bias, though. First, the review on the single case-studies does not cover any study that is not self-declared agroecological. The studies without reference to agroeocology are however covered in the meta-analyses and reviews included, and this bias in the choice of the case studies does thus not result in a bias in the knowledge base covered. Second, the meta-analyses and reviews may cover some of the single agroecological case-studies as well. However, given the low number of the latter compared to the huge number of studies covered in these meta-analyses and reviews, this potential double-count will neither result in any relevant bias.

### Reviews on extension services and knowledge transfer

We use reviews on the role of extension, rural advisory services (RAS) and knowledge dissemination on the performance of agricultural production systems as a third body of literature for the assessment of the potential of agroecology for climate change adaptation. This is based on the assumption that to promote the transformation of farming systems through agroecology, effective innovation delivery is essential and that co-creation and sharing of knowledge is considered an integral part of agroecology (FAO 2018). Furthermore, the mandate of RAS has widened from a productivity focus to a more holistic perspective, including, among other things, nutrition, livelihoods, gender and environmental sustainability issues, thus relating it closely to central aspects of agroecology (David and Cofini 2017).We used a large meta-study on agricultural innovation by the International Initiative on Impact Evaluation (3ie) as a starting point (Lopez-Avila, Husain et al. 2017) and from there identified 3 articles of relevance, i.e. quantitative reviews on the effects of knowledge dissemination and co-creation on the performance of agricultural production systems. These do not directly relate to agroecology, but given the central role knowledge transfer and exchange plays in agroecology, they serve to potentially identify important patterns relating to this aspect of agroecology, just as we identified patterns relating to diversity from the meta-analyses above as one characteristics of agroecology, without specifically referring to papers explicitly addressing agroecology.

### Data analysis

Due to the small number of studies identified and the heterogeneity of contexts and indicators reported, it has not been possible to perform a formal meta-analysis. We analysed the data as follows:

* Descriptive analysis of the Gliessman level to which the practices implemented in the single system comparison studies refer to
* Descriptive analysis of the 10 elements of agroecology to which the practices implemented in the single system comparison studies refer to
* Descriptive analysis of the agroecological practices the single system comparison studies refer to
* Descriptive synthesis of the performance of agroecology in the single system comparison studies regarding the FAO performance indicators, with a focus on the indicators most directly relating to climate change adaptation (9 agricultural biodiversity; 10 soil health), but also considering those more broadly relating to resilience (2 productivity; 3 income).
* Descriptive synthesis of the patterns identified in the complementary meta-analyses
* Descriptive synthesis of the reviews on rural advisory services and knowledge transfer

### Data base

All data is contained in the excel-file “LiteratureReview\_Data\_1\_11\_2019.xlsx”, the first Sheet “Notes” contains some information on its structure and contents.

All papers covered in the analysis of the single system comparison studies and the meta-analyses/reviews are referenced in the Word-File “Review\_AgroecAndCCAdapt\_Literature Analysed.docx”.

## SHARP module mean scores Kenya

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Mean Scores** | | | | |
| **Module** | | **Agroecological Farmers** | **Conventional Farmers** | **Difference in Mean Scores** |
| 2 | Household | 11.3 | 11.0 | 0.4 |
| 3 | Production Activities | 12.6 | 12.4 | 0.2 |
| 4 | Non-farm Generating Income | 5.8 | 6.8 | -1.0 |
| 5 | Land Access | 8.1 | 7.5 | 0.6 |
| 6 | Crop Production | 7.4 | 6.6 | 0.8 |
| 7 | Intercropping | 12.0 | 10.9 | 1.2 |
| 8 | **\*Weed Species and Management** | **13.6** | **12.0** | **1.6** |
| 9 | Pest Management Practices | 10.4 | 9.8 | 0.5 |
| 10 | **\*Land Management Practices** | **13.4** | **10.3** | **3.1** |
| 11 | Leguminous Crops and Trees | 14.7 | 14.1 | 0.5 |
| 12 | Fertilizers Practices | 12.7 | 12.0 | 0.7 |
| 13 | **\*\*Animal Production Practices** | **8.8** | **6.5** | **2.3** |
| 14 | Animal Breeding Practices | 5.6 | 4.8 | 0.8 |
| 15 | Animal Nutrition and Health | 14.9 | 13.4 | 1.5 |
| 16 | Utilization of New and Locally adapted varieties | 14.1 | 13.8 | 0.4 |
| 17 | Farm Input | 10.0 | 10.1 | -0.1 |
| 18 | Water Access | 7.6 | 7.2 | 0.4 |
| 19 | Water Conservation Practices and Techniques | 8.3 | 6.3 | 2.0 |
| 20 | Water Quality | 12.4 | 11.8 | 0.6 |
| 21 | Soil Quality and Land Degradation | 12.0 | 12.9 | -0.9 |
| 22 | **\*\*Trees** | **12.9** | **10.3** | **2.6** |
| 23 | Landscape Characteristics | 11.0 | 10.4 | 0.6 |
| 24 | Energy Sources | 12.5 | 11.4 | 1.1 |
| 25 | Disturbances | 8.3 | 8.7 | -0.4 |
| 26 | **\*\*Access to Information on Weather and Climate Change Adaptation Practices** | **9.4** | **6.3** | **3.0** |
| **Module** | | **Agroecological Farmers** | **Conventional Farmers** | **Difference in Mean Scores** |
| 27 | Information and Communication Technologies (ICTs) | 15.3 | 14.6 | 0.7 |
| 28 | **\*Access to Markets** | **10.4** | **9.4** | **1.0** |
| 29 | Income Sources, Expenditure and Savings | 11.4 | 10.3 | 1.1 |
| 30 | Major Productive Assets | 15.2 | 14.7 | 0.6 |
| 31 | Access to Financial Services | 11.1 | 11.7 | -0.6 |
| 32 | Insurance | 2.4 | 0.8 | 1.6 |
| 33 | Community Cooperation | 11.4 | 10.9 | 0.5 |
| 34 | Group Membership | 9.3 | 7.9 | 1.4 |
| 35 | Meal/Food stocks | 8.9 | 9.2 | -0.3 |
| 36 | Decision Making (Household level) | 11.3 | 11.7 | -0.4 |
| 37 | Decision making (Farm Management) | 12.5 | 12.9 | -0.4 |

Agroecological and conventional mean scores for 36 modules describing various components of the farm agro system. Significant differences determined by t-test are indicated as \*P < 0.05, \*\*P <0.01, \*\*\*P<0.001.

## Seed sources for farmers

## Priority ranking assessment Kenya

Priority ranking assessment for agroecological and conventional farm systems based on technical, adequacy and importance scores of each SHARP module

|  |  |  |
| --- | --- | --- |
| SHARP farm system module | Agroecological farm system | Conventional farm system |
| Insurance | 1 | 1a |
| Animal Breeding Practices | 2 | 2a |
| **Non-Farm Income Generating Activities** | **3** | **7a** |
| Water Access | 4 | 4a |
| Land Access | 5 | 8a |
| Meal/Food Stocks | 6 | 9a |
| Disturbances | 7 | 10a |
| **Water Conservation Practises and Techniques** | **8** | **5a** |
| Animal Production Practices | 9 | 6a |
| **Access to Information on Weather and Climate Change Adaptation Practices** | **10** | **3a** |
| Farm Input | 11 | 11a |
| Pest Management Practices | 12 | 13a |
| Access to Markets | 13 | 14a |
| Soil Quality and Land Degradation | 14 | 21 |
| Income Sources, Expenditures and Savings | 15 | 16a |
| **Community Cooperation** | **16** | **28** |
| Crop Production | 17 | 15a |
| Household | 18 | 22 |
| Landscape Characteristics | 19 | 24 |
| Water Quality | 20 | 23 |
| Group Membership | 21 | 17a |
| Intercropping | 22 | 19a |
| Fertilizer Practices | 23 | 25 |
| Production Activities | 24 | 27 |
| Energy Sources | 25 | 20a |
| Trees | 26 | 18a |
| Weed Species and Management | 27 | 26 |
| **Land Management Practices** | **28** | **12a** |
| Utilization of New and Adapted Varieties and Breeds | 29 | 29 |
| Leguminous Plants and Trees | 30 | 32 |
| Animal Nutrition and Health | 31 | 30 |
| Decision Making (Household Level) | 32 | 33 |
| Access to financial Services | 33 | 36 |
| Major Productive Assets | 34 | 31 |
| Information and Communication Technologies (ICTs) | 35 | 34 |
| Decision Making (Farm Management) | 36 | 35 |

## Social module Kenya

Focus Group Discussion, climate change related questions:

* In what year did they perceive that the climate has changed significantly? List extreme weather events that have occurred between the date identified and the present. Where there any changes in the start date of the rains or the length of the rainy season?:

Climate change has changed drastically from 2015 starting with El Nino rains of 2015/16 and the prolonged drought that has persisted from 2018 to date. Rainfall levels are below normal and cannot sustain rainfed agriculture. The just concluded ‘long’ rains started late April and ended late may leading to crop failure especially for green grams, the most popular crop in Tharaka. No harvest for 2 years in some parts.

* Can you locate and mention the effects of this event on the map? How did this effect occur? For example: how were the crops lost? What crops have been lost? Due to increased heat? Due to a pest? What pest? Is it new? Was there a lack of water in the flowering months?:

The available maps do not capture 2016-2018. However crop failure is mainly due to below normal rainfall around flowering time. Green grams, cow peas and pigeon peas crop lost to the drought. Few cases of fall army worm affecting maize (very recent).

* Please describe how this event affected soil, water, vegetation and/or crops and animals and/or livestock:

Drought generally led to land/soil degradation, drying of crops and some streams and reduction in pasture plus other herbaceous plants leading to death of some livestock

* If an area has been heavily affected, has this affected other areas to which it is connected? If so, how?:

When the higher grounds are degraded, the agropastoralists take their animals for grazing along riverines which results in riverine degradation due to overgrazing. In addition erosion on uplands leads to pollution of rivers.

* Are areas that benefit more from nature more adapted to major climatic events? Have they been more or less affected by the changes? Has this affected the provision of services?

Every part has been affected by climatic shocks but the protected areas like riverines and forests have retained some level of resilience amidst severe climatic changes

* Why do they think that is? How do the species present in this area contribute to this observation?:

Forests and riverine are retaining a good level of moisture, and so plants growing there are more resilient. Soils in these areas are also not very vulnerable to erosion due to good protective vegetation cover

**Water:**

* What changes have been observed in the water (decrease in sources, quality, etc.)? Where and since when? Why is this happening? - How do they recognise them?:

Reduction in water volume due to aridification and overabstraction; and sedimentation due to erosion (quality). 15 years little irrigation but now-> excess water with pesticides. People getting sick not very prominent. Some cholera.

* Do they know any method that is used to conserve the water system? (practices, plant/animal species). How do they do it?

Yes. Tree planting and avoiding grazing in forests and riverines

* What structure or species help to conserve water?

Fig trees and herbaceous plants

**Seasonal calendar:**

* What are traditional climate predictors, i.e. signals that allow them to predict the start of the given season? For example, the flowering of a specific tree that signals the beginning of the rainy season.:

Some changes in cosmos eg stars(constellation studying by the elders); environmental changes like flowering of certain trees, shedding of leaves; birds movement(moving away from droughts and pest); insects like butterflies (move in a certain direction a lot of pest). Movements of the clouds southeast direction.

* What are major diseases that affect the community and economic spending - over the seasons?:

Mostly pests like fall army worm which destroy maize crop. New castle poultry desease during dry season. Flue with dry and cold and windy. cholera with rainy season and floods.

Most spendings in dry season because of malaria and flues. Warm temperature are good for breeding insect carring diseases.

1. http://www.fao.org/3/I9049EN/i9049en.pdf [↑](#footnote-ref-2)
2. Mitigation co-benefits and trade-offs are also considered, wherever possible. [↑](#footnote-ref-3)
3. The 10 Elements of Agroecology were developed through a synthesis process. They are based on the seminal scientific literature on agroecology – in particular, Altieri’s (1995) five principles of agroecology and Gliessman’s (2015) five levels of agroecological transitions. This scientific foundation was complemented by discussions held in workshop settings during FAO’s multi-actor regional meetings on agroecology from 2015 to 2017, which incorporated civil society values on agroecology, and subsequently, several rounds of revision by international and FAO experts. [↑](#footnote-ref-4)
4. see: <http://www.fao.org/3/I9037EN/i9037en.pdf> [↑](#footnote-ref-5)
5. Established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1998, endorsed by the UN General Assembly the same year. [↑](#footnote-ref-6)
6. As stipulated in UNFCCC, art. 2: <https://unfccc.int/resource/docs/convkp/conveng.pdf> [↑](#footnote-ref-7)
7. stakeholder interviews for this report (see Annex 7.1) [↑](#footnote-ref-8)
8. adopted at the [UN Sustainable Development Summit](https://sustainabledevelopment.un.org/post2015/summit) in New York in September 2015. [↑](#footnote-ref-9)
9. adopted at COP 21 in December 2015 [↑](#footnote-ref-10)
10. such as the [Global Research Alliance on Agricultural Greenhouse Gases](https://globalresearchalliance.org/about/) (launched in December 2009), debate on Climate Smart Agriculture, “4 per 1000” soils for security and climate initiative, a carbon sequestration initiative (launched by France in December 2015 at the COP 21) [↑](#footnote-ref-11)
11. adoption of decision 4/CP.23 on the Koronivia Joint Work on Agriculture [↑](#footnote-ref-12)
12. Burundi, Comoros, Ethiopia, Rwanda, Seychelles, Tunisia, Gambia, Togo, Côte d’Ivoire, Nigeria, Central African Republic, Chad, Democratic Republic of Congo, Honduras, Venezuela, Afghanistan. [↑](#footnote-ref-13)
13. SRI breaks with several rules of traditional rice growing by relying on intermittent flooding, mechanical weeding, and planting very young seedlings single at larger spaces than [↑](#footnote-ref-14)
14. Polity: political system, institutions and norms; Policies: visions, strategies, implementation plans and regulations; Politics: policy making processes, interactions of stakeholders and power relations among them. [↑](#footnote-ref-15)
15. Kenya small scale farmers’ federation (KEFF); Kenya national farmer federation; Kenya Agricultural Industrial networks; Kenya Dairy Board [↑](#footnote-ref-16)