BENEFITS OF AGROECOLOGY ON CLIMATE CHANGE: WHAT THE SCIENCE SAYS

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Agroecology: Building resilience to climate change

Ghana is already experiencing climate change. It is already negatively impacting many famers. Extreme climate variability – droughts and periods of intense rainfall -- are likely to increase. It is in this context that two critical questions arise: (1) how to strengthen the resilience of agriculture in the face of climate change and (2) how to reduce the contribution of agriculture to the emission of GHGs.

Agroecology is increasingly seen as providing potential pathway to addressing both of these questions. What, then, is agroecology? Agroecology has developed to have three distinct yet interrelated meanings. Initially, its meaning referred to agricultural practices that were attentive to ecological relationships. A second meaning refers to the scientific study of agronomy and ecology. More recently, agroecology is also a movement with a political vision that promotes equity and the democratization of food systems and is inextricably linked to food sovereignty (La Via Campensina).

Why do more and more people and institutions believe that agroecology is extremely important for strengthening the resilience of agriculture in the face of climate change?

Let's turn to the scientific evidence. It is important to note here that this is not original research. Rather, it is an attempt to make scientific research more accessible for non- academic readers. This has been done by identifying some of the most recent published research and reiterating some of the most salient points, especially those that may be deemed most interesting to practitioners (e.g. farmers), policy makers and other stakeholders.

"**Agroecology and climate change rapid evidence review: Performance of agroecological approaches in low- and middle- income countries**" was published in April 2021.

This study identified 18 review papers that explored agroecology and their relevance for climate change adaptation and mitigation. This was comprised of meta-analysis, systematic reviews and meta analysis of other meta analysis. These papers covered a total of 9, 880 studies on adaptation and 200 studies on climate mitigation. Four of these studies were focused on low middle income countries.

The authors explain their purpose "our review focus is on the scientific evidence for agroecological practices (agroecological transition level 2) and systems (agroecological

transition level 3) (2021;10). The reference of transition is from Gliessman (2016). The authors of this rapid review are informed by the Food and Agriculture Organization's (FAO) ten elements of agroecology and Gliessman's agroecological transition concept. They use both to provide an analytical framework.

The authors are interested, not in individual agroecological practices, but, as they explain, "considered approaches as more agroecological to the extent they made use of ecological processes, supported increasing autonomy from external inputs, and enabled whole system change" (2021: 9).

Consequently, they focused on recycling, synergy and diversity because these are ecological processes, which provide ecosystem services that benefit agriculture (Barrios et al. 2020). More specifically the authors "propose that agroecology supports climate change adaptation and mitigation outcomes most directly by promoting resilience, diversification, efficiency, synergies, circular economy, recycling and co-learning" (2021:10)

They formulated three questions to guide their rapid review. These are:

(1) Does agroecology support better climate change adaptation and mitigation as consequence of whole-systems approach, co-benefits in addition to productivity, or capacity to respond to extreme events?

(2) Does agroecology provide more climate change adaptation and mitigation than conventional agriculture by emphasising locally relevant solutions, participatory processes and co-creation of knowledge?

(3) Do the programme interventions, enabling environment or barriers needed for agroecological transitions at scale differ compared to conventional systems?

The authors explain that they established indicators for climate change adaptation and mitigation by drawing on and modifying the 2016 IPES-Food report. These are the indicators for climate change adaptation and climate change mitigation below.

Climate change adaptation: productivity, agricultural diversity, water and nutrient regulation, soil health, pollination and pest regulation, landscape conservation, response to extreme weather and local adaptation processes.

It is important to note here that "productivity" within agroecology is not limited to increasing yield; in agroecological systems there is also great emphasis on the stability of yield, diversity of foods cultivated, nutritional quality and non-dependence on external agricultural inputs. All of these are aspects that increase resilience of agroecosystems.

Climate change mitigation: included reduced GHG emissions and carbon sequestration in soil and biomass. (2021: 13).

Thus the authors then use these two primary indicators and another eleven sub indicators (7 for climate change adaptation and 4 for climate mitigation) to assess the articles they reviewed. In the published article the authors provide a very useful table that list all of these indicators and their relationship to agroecology (see 2021: 14). This is one example from their list:

Table 1. Indicators between agroecology and climate change adaptation and mitigation

Indicator	**Relationship to agroecology**
	Climate Change Adaptations Indicators
Soil Health	Many of the practices promoted under AE (legumes intercropping, cover crops, rotation, agroforestry, crop-livestock integration, etc.) can have a positive impact on soil health: nitrogen fixation, soil organic matter, soil biological diversity, soil carbon stocks. An improvement of soil health has in return a range of benefits for Climate Change adaptation and mitigation: reducing Nitrogen and Carbon in the atmosphere, increasing fertility therefore production; increasing soil structure and water holding capacity which can lead to reduced soil losses due to wind or water erosion or floods.
	Climate Change Mitigation Indicators
GHG emissions	AE promotes reduced use of inorganic fertilizers and pesticides, this reduces GHG emissions related to the production of those external inputs. In addition, AE supports short value chains and local consumptions which reduces energy use for transport, processing, storage agricultural products.

It is important to note that the authors did not include approaches to agriculture that are concerned with sustainable intensification, such as precision agriculture. For a practice be deemed agroecological it is not sufficient for it to promote agronomic efficiency. From an agroecological perspective, we could say that there is a principle of "do no harm to the environment." To the extent that sustainable intensification practices may promote crop and context specific inorganic fertilizer formulation to improve precision but elide the negative externalities (ground water pollution) it is not agroecological.

The Results

The authors identified 18 review papers, which they assert provided quality evidence. The table below, based on their report, provide details of the results of the studies which their paper analyzed.

18 review papers	9,880 studies on adaptations	200 studies on climate change mitigation	225 studies on scaling conditions
	four of them covered exclusively LMICs	five studies had 50-80% coverage of LMICs	seven covered less than 50% of LMICs

For a detailed breakdown of the papers reviewed see the original article -- table 2 (2021: 17).

For those who may wonder if this research was relevant for Ghana and other African countries, it is important to note that 74% of the papers were concentrated in Africa and on small holder farmer (i.e. those farming less than 2 hectares).

Now that we have some perspective on what the study found as it reviewed the literature, we can now turn to its findings in relation to our key concern: if and to what extent does agroecology help build resilience in the face of climate change.

Diversity was understood as an important way in which agroecology promotes resilience to climate change. The authors elaborated it this way: Agroecological approaches associated with diversification supported climate change adaptation (strong evidence and high agreement), and to a lesser extent, climate change mitigation (medium evidence, medium agreement) (2021: 28).

The benefits of diversification – agroforestry was one of the most effective approaches - - was noted positively on important areas such as soil fertility and water conservation and the recycling of nutrients. This was also a mechanism for mitigation as diversification enabled increased carbon storage in soils.

Potentially, one of the most compelling selling points of agroecology to small holder farmers, if not the Ministry of Food and Agriculture, would be the possibility of agroecology increasing farm resilience in the face of extreme weather events. Unfortunately, the rapid review did not identify many articles that studied resilience to climate change. One exception they identified is the work by Holt-Gimenez (2002) which focuses on farmer's resilience in the aftermath of Hurricane Mitch in Nicaragua.

In that article, Holt-Gimenez posits that agroecological farms suffered less destruction of their farms when Hurricane Mitch inundated their region with rain and powerful wind. Another study

which took place in Malawi, found that small holder farmers across the entire country tended to experience yield stability over multiple years, which was linked to the biodiversity enabled by agroecology (see Snapp et al. 2010; Schipanski et al.
2016).

Opponents of agroecology often claim that a transition to agroecology would be disastrous because it cannot be as productive as industrial agriculture. However, a number of studies suggest this is a flawed argument. These found that there was no yield or only a "modest" yield trade-off; critically, there was an additional benefit – "substantial gains in carbon sequestration" (2021:28). In other words, agroecological agriculture did not produce yields that were substantially less than yields in industrial agriculture. In some cases, there was no reduction in yield at all. In addition to this, there was the additional benefit of increased carbon sequestration (see Leippert et al.
2020, Smith et al. 2019, Tamburini et al. 2020).

Another finding is that agroecology prioritises and supports the development of adaptive capacity. The authors of the rapid review indicate that one synthesis report on adaptation highlighted agroecology (Owen 2020). Adaptive capacity refers to the ability
of actors to realize the need for a course change and to implement it. Agroecology takes indigenous and local knowledge as foundational to processes of knowledge co-creation, so it enables learning and adaptation at the local level; critically, it is therefore less dependent on external "expert" knowledge. The review authors found that the literature avers the importance of agroecology's prioritization of knowledge co-creation.

Conclusion

There is a relationship between agroecology and climate change. According to the rapid review report utilized here, the evidence is clear. Agroecology is strongly linked to increased diversity. This, in turn, is linked to greater adaptation and mitigation in face of climate change. Put more precisely, agroecological practices used in a systemic manner strengthens/promotes diversity and strengthen resilience; additionally, especially in the case of agroforestry, it enables carbon sequestration. Given the ongoing and coming challenges of climate change it is critical that agroecology be scaled up and out.

Recommendations

1. Promote an understanding of and appreciation for agroecology by farmers, the general public and the Ministry of Food and Agriculture.
2. Promote a transition to agroecology by farmers and the Ministry of Food and Agriculture.

3. Facilitate the development of collaborative research projects between farmers and researcher to document the efficacy of different strategies to improve water regulation, soil health and diversity in the context of climate change.
4. Facilitate the expansion of farmer led knowledge sharing networks (e.g. farmer field schools) by building on the Endogenous Development approach.
5. Establish relationships with research institutions, scholars and farmer- researchers to co-create and disseminate scholarship on agroecology on a regular basis across multiple platforms and to a variety of audiences.

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