Can Ecosystem-based Adaptation help reduce the vulnerability of smallholder farmers to climate change in Central America?

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Introduction

In Central America, most farmers are smallholders who cultivate either maize and beans for subsistence, or small plots of coffee. These smallholder farmers are particularly vulnerable to the impacts of climate change due to their dependence on natural resources in their agricultural systems, and their limited resources to cope with shocks. There is an urgent need to help identify options which can help smallholder farmers adapt to climate change.

Ecosystem-based adaptation (EbA) offers a potential means of reducing farmer vulnerability by helping them to cope with the adverse impacts of climate change, however little is known about what EbA practices are appropriate for smallholder farmers. We reviewed literature to identify which EbA practices have been documented for smallholder coffee and subsistence farmers in Central America, and explored which of these practices reduce in a sustainable manner vulnerability to climate change.

Methods

We conducted an extensive literature survey on management practices with potential for adaptation to climate change for smallholder coffee and maize/bean farmers. We reviewed a total of 217 documents (of 461 found). The reviewed documents corresponded to the 43% (69) and 56% (148) of the total publications available for coffee and basic grains, respectively. We also conducted a consultation with 21 experts to collect additional information on adaptation measures for these crops and to compare expert knowledge to the literature. Our analysis consisted of identifying EbA practices described by the literature or suggested by the experts, their main tested benefits and trade-offs.

Results

Although there is significant interest in helping smallholder farmers adapt to climate change, there is limited regional information available on adaptation options for either coffee or maize/bean farmers. None of the 217 papers reviewed mentioned EbA for either coffee or maize/bean systems. However, we identified a set of sustainable agriculture practices that are based on maintaining the provision of ecosystem services, thus, such practices could be considered as EbA options (Table 1). These practices are well documented in the literature and are known by the regional experts.

Ecosystem-based adaptation (EbA) uses biodiversity and ecosystem services in an overall adaptation practices. It includes the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to climate change.

Table 1. Examples of management practices that could be considered as 'Ecosystem-based Adaptation' options for coffee and maize/bean

Crop	Practice name	Description	Potential for adaptation	Additional benefits	Trade-off	# References Experts/	# References Publications
Coffee	Agroforestry	Use of trees with multiple purposes and pruning management	Adds resilience to the system in face of extreme temperature, winds or rainfall changes Increases water infiltration, improving water availability	Increases carbon stocks Helps conserve biodiversity	Trees competing for light, water and nutrients with coffee Could decrease yield if tree pruning is not adequately managed	3	14
	Integrated pest and disease management	A combination of practices: adding trees, different coffee tree density, pruning and use of natural enemies	Reduces coffee vulnerability due to temperature increases that favor certain pests and diseases Reduces yield losses to pests and diseases	Reduces the use of agrochemicals Beneficial for insect abundance	Trees competing for light, water and nutrients with coffee Could decrease yield if tree pruning is not adequately managed	3	7
	Organic production	Replaces agrochemical inputs with addition of organic amendments and coffee agro-ecosystem diversification	Reduces vulnerability by diversifying the products obtained from the farm Buffers the impact of extreme rainfalls by improving soil structure Reduces soil erosion and improves fertility	Increases soil carbon stocks Contributes to biodiversity conservation	Could reduce yield because plant competition Increase cost of labor	3	7
Maize/ bean	Mixed cropping	Intercropping of at least two crops in the same plot	Enhances food security by differential affectation of crops by extreme weather events Reduces runoff and gully erosion Decreases pest outbreaks	Provides diversified income to farmers Can provide fodder for livestock	Increase inputs, costs and investment risk of competition for resources.	3	9
	Improved soil management	Incorporation of organic amendments and crop residues	Buffers the impact of extreme rainfall by improving soil conditions and soil moisture retention	Higher yield/Increase income/ Reduces damage of pests	Higher costs/ More labor required/ Longer rate of return	1	7
	Cover crop	Association of crops with herbaceous cover crops	Improves soil moisture retention Buffers the impacts of extreme rainfalls by enhancing water infiltration	Facilitates weed control Conserves soil moisture/ Increases crop yield Improves soil fertility	May need herbicides/ Requires more labour	4	5

Most of these management practices are well known and have been tested in terms of their ability ensure the provision of ecosystem services (e.g., water provision, pollination, pest control, maintenance of soil fertility), as well as their impacts on crop yields. However, there is limited evidence, to date, of the ability of these practices to help reduce farm vulnerability to climate change.

In addition, some of these management practices entail important trade-offs in terms of labor requirements, management costs, investment risk, among other aspects, which may limit their use.

Shaded coffee plantation

Mixed cropping maize/bean/coffee

Conclusion and recommendations

•Although there is significant interest in implementing EbA practices to help smallholder farmers adapt to climate change, the regional literature does not yet contain specific information on what EbA practices are appropriate for coffee and maize production.

•However, several management practices have the potential to confer adaptation benefits and could be considered as EbA options.

•Additional research is needed to better identify which of EbA management practices have the potential to ensure the productivity and resiliency of smallholder agricultural systems in the face of climate change.

•The project "Ecosystem-based Adaptation for Smallholder Subsistence and Coffee Farming Communities in Central America" will aim to fill this knowledge gap by assessing the effectiveness of EbA management practices in reducing farmer vulnerability to climate change.

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