Appendix B
Risk-Based Framework and Assessments of Agroforestry as a Climate Change Adaptation and Mitigation Strategy

Risk-Based Framework for Evaluating Adaptation and Mitigation Strategies

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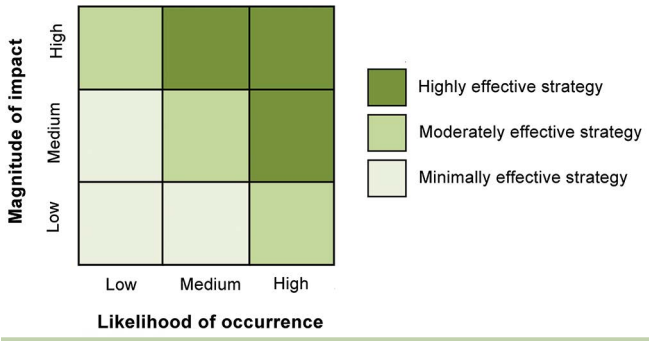
The effectiveness of an agroforestry strategy for adapting agriculture to climate change or for mitigating it can be evaluated within a risk-based framework. Such a framework has been used to evaluate hazards from climate change (Iverson et al. 2012, Yohe 2010). The same approach can be used to evaluate adaptation and mitigation strategies. The framework describes both the likelihood that a strategy will have a positive impact and the magnitude of that impact (fig. B.1). A highly effective strategy has a high probability or likelihood of occurring or being implemented and also has a high magnitude of positive impact. A strategy that has a high magnitude of impact is less effective if it has a low probability of occurring. Strategies that are minimally effective have a low magnitude of impact and a low probability of occurring. This framework can be applied to evaluate and compare potential adaptation strategies by organizing thoughts along two dimensions—likelihood and consequence. The results will help managers and decisionmakers prioritize management options.

Figure B.1. A matrix illustrating the framework for identifying better strategies for adapting to or mitigating climate changes. (Adapted from Iverson et al. 2012, Yohe and Leichenko 2010). A highly effective strategy (dark green) has a high likelihood of occurring (or being implemented) and a high level of positive impact. Strategies that would have minimal effectiveness (light brown) have a low probability of occurring and a low magnitude of impact.



In a qualitative definition of impact—

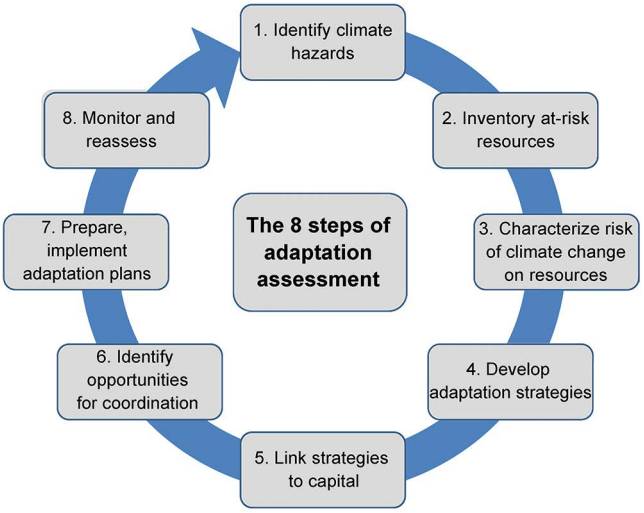
- Low = the strategy will have an insignificant impact.
- Medium = the strategy will have a measurable and potentially significantly positive impact.
- High = the strategy will produce a large positive impact of critical importance.

In a qualitative definition of likelihood—

- Low = an impact of the strategy is deemed to be unlikely to occur.
- Medium = an impact of the strategy is deemed to be likely to occur.
- High = an impact of the strategy is deemed to be very likely to occur.

The process of developing strategies begins with an assessment of risk, starting with identification of current and future climate hazards (step 1 in fig. B.2) and followed by an inventory of at-risk assets (step 2 in fig. B.2). A future hazard can be a particular or aggregate threat of climate change on a particular resource or service. The risk framework can be used to evaluate the level of climate change risk to various resources and services (step 3 in fig. B.2). The risks that climate change poses for U.S. agriculture have been recently evaluated by the USDA (Walthall et al. 2012); their pervasive scope is one of the fundamental insights of the National Climate Assessment (Melillo et al. 2014). That assessment covers both effects on agricultural production (e.g., reduced crop yield) and on environmental resources (e.g., soil erosion).

Figure B.2. Flowchart of an adaptation/mitigation planning process. Risk management begins with the development of strategies for adaptation and mitigation (step 4) that reduce risks to agricultural resources and services identified in step 3. (Adapted from Carnesale et al. 2010, Yohe 2010).



Adaptation strategies, such as agroforestry practices, can also be evaluated by using the risk framework (step 4 in fig. B.2). The effectiveness of an agroforestry strategy is determined by comparing the level of risk (calibrated in terms of likelihood and impact) without adaptation with the risk level if a given agroforestry strategy were implemented. Because risks can also be influenced by changes in various agronomic practices (e.g., crop types, cultivation practices) not related to agroforestry, a key challenge for managers is to determine an appropriate balance of agronomic and agroforestry practices for providing desirable outcomes. Assessing agroforestry options by themselves (that is, by assuming that other agronomic practices remain unchanged) will provide a clear baseline condition from which to make these determinations.

The risk-based framework and underlying concepts are used in the following case studies. These case studies are intended as examples of different ways to convey risk and to evaluate benefits and tradeoffs. Scientists and managers can use the framework and concepts for assessing adaptation strategies for a wide range of impacts on threatened agricultural resources. As readers consider these case studies, they may wish to keep in mind that different decisionmakers may have different perceptions about the likelihood of occurrence and magnitude of impact.

Literature Cited

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