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Achieving sustainable agricultural practices: From incentives to adoption and outcomes

Valeria Piñeiro, Joaquín Arias, Pablo Elverdin, Ana María Ibáñez, Cristian Morales Opazo, Steve Prager, and Máximo Torero

The pressure on agricultural production systems to achieve global food security — particularly in today's context of growing populations, changing food demand, and threats of natural resource degradation and climate change — demands that we rethink current production systems and shift rapidly toward more sustainable models. When employed by land users, a combination of sustainable agricultural practices can facilitate ecosystem protection, increase farm productivity, reduce poverty, and advance food security. Sustainable agriculture has the potential to contribute directly to meeting several of the UN Sustainable Development Goals (SDGs), including those on poverty, hunger, inequality, responsible consumption and production, climate, and ecosystems, in addition to local and national development and environmental goals.

Sustainable agricultural practices are those that enable more efficient use of natural resources, mitigate the impact of agriculture on the environment, and strengthen capacity for adaptation to climate change and climate variability. They include crop rotation, increased crop diversity, use of cover crops, no-till and reduced-till systems, integrated pest management (IPM), integration of livestock and crops, sustainable agroforestry practices, and precision farming, among others. Achieving environmental sustainability in agriculture requires good management of the natural systems and resources that farms rely on, which can provide important public goods, particularly in the form of ecosystem services.

Sustainable agricultural practices usually require substantial effort or resource allocation from farmers, and are adopted in response to concrete incentives provided by policies and market conditions as well as by the support of local and national governments and public-private partnerships. Adoption of sustainable practices also depends on farmers' environmental preferences, market factors, and cultural and socioeconomic characteristics. Despite growing interest in sustainable agriculture and an expanding number of projects and policies to promote these practices in many countries, there has been little evaluation of the incentives–adoption–outcome chain: that is, how well different incentives promote adoption, whether adoption leads to meaningful and measurable changes in outcomes, and what factors shape these links. The incentives–adoption–outcomes chain offers a consistent logic by which to parse and evaluate best practices around sustainability themes; however, the existing literature on these links is inconclusive and unclear at best, especially across different incentive types.

With this challenge in mind, and within the framework of the Ceres2030 initiative for Sustainable Solutions to End Hunger, we conducted a scoping review to provide much-needed evidence on the effects of different incentives both on farmers' adoption of sustainable agricultural practices and on the agricultural, economic, and environmental outcomes expected from these interventions (Box 1). This analysis aims to support a more evidence-based focus on the policy options open to national governments and other relevant stakeholders.

Our scoping review of the linkages between incentives, adoption, and outcomes looked at studies across a range of developed and developing countries to examine: (1) the

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BOX 1: THE SCOPING REVIEW

Our full study,[4] published in *Nature Sustainability*, began with a double-blind screening of nearly 18,000 papers on the incentives that are offered to farmers by governments, NGOs, development organizations, and market actors (e.g., consumers, enterprises) and their links to adoption of sustainable agricultural practices and to environmental, productivity, and economic outcomes. Both developed and developing country studies were included. Of those papers, all published since 1994, closer screening narrowed the field to 577, from which a stratified random sample of 93 papers was selected for a full-text review and data extraction.

A scoping review aims to capture all literature on the selected topic and allows for synthesis across the existing research. The *Nature Sustainability* article includes a descriptive analysis of various incentive structures, farmers' adoption responses, and productivity and environmental outcomes, as well as the factors that drive the observed linkages between incentives, adoption, and outcomes. The range of demographic, social, environmental, and economic conditions represented by the sample allows for an in-depth exploration of the contexts and nuances that affect these linkages.

means for motivating participation (incentives); (2) how these drive the level of uptake (adoption); and (3) how adoption facilitates meeting program objectives (outcomes) at scale.

We examined three kinds of incentives: market and nonmarket, regulations, and cross-compliance (Box 2). We also considered whether the compulsory or voluntary nature of the incentives affects farmers' willingness to adopt sustainable practices.

For each type of incentive, we examined its expected effect on (1) productivity (e.g., yields, labor per hectare); (2) profitability (e.g., farm incomes); and (3) environmental sustainability (e.g., water-use efficiency, sustainable forestry). We also analyzed the factors that influence the adoption, or not, of sustainable practices. Finally, we examined the effectiveness of incentives in achieving the expected outcomes.

Broadly speaking, the evidence shows that incentives that promote economic benefits are more likely to lead to the adoption of better practices in the short term, especially if they are voluntary. In the long-term, however, positive outcomes for the farm or the environment are prime motivators. Adoption of new practices under compulsory programs depends on enforcement and monitoring.

While the scoping review revealed important knowledge gaps that should be addressed in the near future, we are able to make some simple but important recommendations for policymakers based on our findings.

HOW TO CREATE INCENTIVES FOR FARMERS

Adoption of sustainable agricultural practices comes at a cost for farmers (at least in the short term) and may entail trade-offs with other environmental or socioeconomic goals at the farm or country level. In selecting policy objectives and designing a policy instrument, policymakers must understand that a policy will only be successful if these costs and trade-offs are addressed. Three primary considerations regarding incentives apply.

First, in designing a policy, the number of incentives used should usually be directly linked to the number of desired outcomes. For example, it is a mistake to provide an economic incentive for a specific outcome, such as soil health, and expect to achieve an additional outcome, such as increases in productivity.

Second, certain preconditions for implementation, including understanding of the policy's impact and selection of appropriate institutions and mechanisms, must be considered. These include instruments to minimize potential trade-offs for farmers associated with adoption, such as high upfront costs; institutions to implement the practice; monitoring mechanisms to ensure implementation; and a clear understanding of the sustainability of the incentive.

Third, assessment of the effectiveness of incentives should account for trade-offs between economic and environmental outcomes and, if possible, social outcomes. The measurement of outcomes should also account for

BOX 2: TYPES OF INCENTIVES FOR SUSTAINABLE AGRICULTURAL PRACTICES

Market-based incentives encourage behavioral change through market signals by providing economic incentives. These can include changes in prices of inputs and outputs, income transfers, or other in-cash or in-kind incentives provided to agricultural producers. **Nonmarket incentives** are the broad group of mechanisms such as technical support and technology transfers to improve environmental sustainability that are not market-based.

Regulatory measures are general rules or specific actions imposed by government agencies or private businesses and entities to enhance environmental and economic outcomes through improved practices. Examples in the agriculture sector include certifications and environmental laws and standards.

Cross-compliance incentives link direct payments to farmers' compliance with basic environmental standards or maintaining land in good agricultural and environmental condition. Examples include government subsidies for adherence to certain resource-use or conservation practices, including payments for environmental services (PES), which are largely voluntary.

the trade-offs among different types of incentives — and consider how market, nonmarket, regulatory, and cross-compliance incentives could complement one another to achieve the desired outcomes. For example, if assessment of a water-trading option shows that this instrument may reallocate water away from agriculture to "high-value" sectors with negative environmental effects, like mining, then an additional measure, such as a regulatory mechanism, would be needed to minimize the potential trade-off. Similarly, if the policy uses a cross-compliance mechanism requiring a conditionality, such as payment for environmental services, then institutions must be in place to enforce it.

Limitations of the literature notwithstanding, there is a set of tested principles to follow in designing and implementing incentives for sustainable agriculture.

1. **Balance the incentives and outcomes.** Incentives must be large enough to motivate a change in production practices. Because gains in productivity and profitability may not be sufficient to compensate farmers for the total initial investments required and/or any unexpected costs of adoption, incentives must make up the difference. To determine the intensity and scale of the incentives needed to achieve the desired outcomes, it is important to simulate the expected short-, medium-, and long-term results and to consider risks and uncertainties in the planning phase. Follow-up indicators for outcomes and impacts are key to capturing the trade-offs between economic and environmental outcomes and measuring the incentive's effectiveness in achieving outcomes.

2. **Know your farmers.** Farmers may be non-adopters, low-level adopters (cautious), or high-level adopters (open to change), depending on their experience, education, access to information, and level of risk-aversion. Low-level adopters will require larger incentives than other farmers and proof of the practice's efficacy. High-level adopters, more progressive and open to new approaches, can be agents of change. Policymakers who are familiar with the farmers can better tailor the design of incentive programs by considering the range of personal, political, institutional, and biophysical factors affecting adoption of new practices.

3. **Keep it simple.** Farmers prefer simple, easy-to-understand instruments, and are less motivated by complex, inflexible instruments such as legal regulations. Complexity also makes instruments hard to explain to farmers and more expensive to adopt or enforce.

4. **Provide complementary support.** The success of incentives often depends on complementary policies, and single interventions are less likely to succeed than a combination of policy instruments. For example, provision of technical assistance and extension services contributes to farmers' understanding and facilitates their adoption of new practices. Regulatory approaches require institutions to be in place for enforcement and proper monitoring and evaluation of compliance and impacts. And financial instruments are necessary to ensure the sustainability of incentives.

5. **Be aware that behavioral preferences matter.** People tend to copy the behavior of others — the bandwagon effect. Farmers' preferences matter and will vary depending on the population. Accordingly, the practices, policy, and design of incentives need to be responsive to the characteristics of the targeted population, including farmers' level of education, customary practices, socio-economic conditions, level of resilience, and biophysical aspects of the land, among other factors.

6. **Prepare for a long time-horizon.** The time lag between adoption and outcomes varies by agricultural practice, production system, and biological cycle. In some cases, it can be a considerable time before any economic and environmental results become visible. Farmers may perceive positive outcomes for their farm and for the environment in the long run, but may not be financially capable of sustaining themselves in the short run. This means that the opportunity cost of time must be taken into account, and financial (or economic) tools must be put in place so that short-term cash flow problems do not jeopardize the intervention.

7. **Create an enabling environment.** Incentives to make adoption of sustainable practices attractive depend heavily on an enabling economic and financial environment. Beyond providing targeted incentives, the general conditions that influence agricultural systems must be conducive to adoption. Agricultural institutions, policies and regulations, social protection, infrastructure and markets, prices, off-farm employment opportunities, and structural poverty — all influence the capacity and willingness of farmers to invest in land, water, and forest conservation and to pursue sustainable practices.

In sum, given the available evidence base, it is possible to provide broad guidance to policymakers and market actors on how to promote the widespread adoption of sustainable farming practices. The scoping review also revealed the urgent need for further research and much more extensive data collection on the incentive–adoption–outcomes chain, and particularly on the costs of adoption and measurement of outcomes, to improve achievement of outcomes.

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Valeria Piñeiro is a senior research coordinator in the Markets, Trade and Institutions Division of the International Food Policy Research Institute, Washington, DC. **Joaquín Arias** is an international technical specialist in the Center for Strategic Analysis for Agriculture (CAESPA) of the Inter-American Institute for Cooperation on Agriculture, San Jose, Costa Rica. **Pablo Elverdin** is a strategy and content coordinator at the Grupo de Países Productores del Sur, Buenos Aires. **Ana María Ibáñez** is a principal economics advisor in the Vice Presidency for Sectors and Knowledge of the Inter-American Development Bank, Washington, DC. **Cristian Morales Opazo** is a senior economist in the Agrifood Economics Division of the Food and Agriculture Organization of the United Nations (FAO), Rome. **Steve Prager** is a principal scientist with the Alliance of Bioversity International and the International Center for Tropical Agriculture, Cali, Colombia. **Máximo Torero** is chief economist in the Economic and Social Development Stream of the FAO, Rome.

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Endnotes

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1201 Eye St, NW, Washington, DC 20005 USA | T. +1-202-862-5600 | F. +1-202-862-5606 | Email: ifpri@cgiar.org | www.ifpri.org | www.ifpri.info

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