Ethical Questions Associated with Research on Soil-Based Ecosystem Services

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Soils are one of the many resources provided by nature, and we must utilize them carefully. The concept of "ecosystem services," which emerged at the end of the 1970s, became more widely known after the 2005 Millennium Ecosystems Assessment (MEA) conducted at the behest of the United Nations. The term refers to the benefits that humans derive from ecosystems and natural resources like soils; the concept has given rise to discussions within various scientific communities about environmental issues and drawn the attention of both the public and decision-makers to the importance of nature conservation.[1,2] However this idea reinforces and disseminates an anthropocentric view that reduces nature to a purveyor of services for the benefit of human well-being.[3] The attempts to put a monetary value on ecosystem services that developed in the 1990s have been hotly debated: one side views them as new tools for environmental conservation, while the other sees them as part of a greater trend towards the commodification of nature.[1] A third position, falling between the other two, recommends incorporating several kinds of values along with scientific knowledge and local know-how to assess ecosystem services.[4]

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Soils supply us with food, raw materials, and energy. They play an important role in regulating the flow of water and solid materials, in processes like runoff and erosion, and in water and air quality. They also provide cultural services, in the form of recreational activities, natural heritage, and beautiful landscapes, and support many key ecosystem functions such as water, nutriments, and carbon cycles; and plant photosynthesis.

Soils are also vulnerable to threats, which society should work to prevent. Most such threats are primarily associated with human activities—farming, industry, and others—that may interfere with the ability of soils to provide ecosystem services. These threats include the loss of organic matter, impermeability, erosion, pollution and microbial contamination, compaction, loss of biodiversity, salinization, acidification, aridification—the list goes on and on. Soil is both a precious asset for society and a resource whose sustainability must be ensured through measures that limit the loss of organic matter, promote deep rooting and water storage, prevent the loss of biodiversity, minimize pollution, and others. Achieving these goals is often a balancing act between short-term societal use and long-term soil preservation.

The Twelfth Conference of the Parties (COP12) of the United Nations Convention to Combat Desertification (UNCCD) adopted the principle of a land-degradation neutral world. It expressed the common desire to limit soil degradation and promote the long-term conservation of soil capacity to provide services. The target is to stabilize productive, healthy soil surfaces by 2030. A two-billion-dollar fund will be devoted to designing indicators for implementing and monitoring measures to reduce soil degradation and enrich soils that are already depleted.

Research plays an important role in evaluating and assessing the value of measures taken to conserve soils and ecosystem services provided by nature as a whole. Here we will identify some ethical issues in research on soil-based ecosystem services from an analysis of the land use changes in the countries of the Mekong Delta.

The case of Mekong Delta countries: lessons learned from research on land use changes

The Mekong Delta region is experiencing strong economic growth that, although beneficial for agriculture (market demand, job creation) also accelerates agrarian transitions. The rural space is rapidly becoming saturated due to demographic growth and the expansion of urban and industrial spaces and transportation networks (roads, railways, airports). Agricultural production is increasingly market-driven, with increased demand for agricultural, human, and animal products (which is also related to general trends in standards of living and consumption) and for raw materials

(wood, latex, medicinal products, plant-based fuels, etc.). All of these factors lead to land use changes, whose effects on natural resources must be understood if we want to continue to control these resources.

Output from agricultural systems must increase to accommodate current demographic transitions and lifestyle changes. This is particularly true for agriculture on sloping land in mountainous regions, where increased output could result in serious consequences for the environment. Agriculture in the Mekong Delta is predominantly the domain of small family farmers with little capital. Highly intensive farming has developed in the most fertile areas (lower slopes, rice paddies) that maximizes yields by using significant labor and inputs. The possibility to increase production has mainly shifted to slope areas with specific social, economic, and environmental characteristics: these are areas where ethnic minorities live and implement a wide diversity of farming systems, with biodiversity reserves and significant capacity to provide fresh water for rice paddies, industries, and urban populations. These sloping lands are at high risk of soil erosion, which affects planted areas, waterways, and infrastructure located downslope and in rice paddies, and leads to conflict between the people who live in the plains and those who live on the mountainside.

Slope farming has traditionally used the practices of clearing, slash-and-burn, and long-term fallowing to maintain soil fertility over time. With arable land now filled to capacity, farmers have modified their soil practices and usage with detrimental effects, such as inefficient water use, soil loss by erosion or landslides, pollution (affecting the soil itself as well as water and food products), decrease of animal and plant biodiversity due to alterations of local habitats and the loss of forests, increase in flooding due to poor permeability and the increase in runoff area. The intensive use of chemical fertilizers and phytosanitary products, combined with poor management of both organic (animal) and inorganic (chemical residue, plastic packaging) waste products, have created new environmental risks for the short, medium, and long term. This situation urgently calls for developing more sustainable agriculture systems that are more sustainable than the ones currently being used to remedy the problem of soil degradation. Climate change only exacerbates the problem, as events like uneven and torrential rainfall complicate farming on sloping land and increase the risk of erosion and unbalanced water supply to crops.

An environmentally friendly way of intensifying agricultural production on slopes requires innovations in farming and animal rearing. For over 20 years now, researchers from the Institut de Recherche pour le Développement (IRD), the Centre de coopération internationale en recherche agronomique pour le développement (CIRAD), and their partners in Vietnam have been working in collaboration with and for farmers in the Mekong Delta to design ecologically conscious agronomy. But have these practices been adopted by the local population? It is not enough to simply develop new

production systems: people must adopt them and adapt them to their own uses. Rural actors must become part of new forms of collective organization in order to manage natural resources. Methods that make it easy to adopt new practices must be found. The harmful consequences of farming on sloping land are associated with producers' lack of attention to ecosystem regulation measures like erosion control, water flow regulation, biodiversity conservation, and soil regeneration. Research studies have proposed innovative incentive mechanisms (e.g., payment for environmental services) to encourage new practices that strengthen ecosystem services related to ecological functions. The goal of these mechanisms, which are based on the logic of market forces (supply and demand), is to compensate for the increased costs of new practices to make them economically attractive to small family producers. The mechanisms may include land access practices to eliminate problematic usage, for example, or environmentally based tax and grant systems.[5]

Ethical issues in research on soil-based ecosystem services

One of the threats to sustainable land use is the way people and society use soil for their immediate needs. Making good choices that reconcile profitable use with the sustainable management of this resource requires a sense of ethical responsibility. Often choices have to be made that pit individual use against collective use[6] or short-term yields against long-term conservation. We must fully understand the resource itself as well as the interests of stakeholders in order to make decisions that will preserve the soil. Researchers must be cautious when advising decision-makers, given the considerable uncertainties about the exact cause-and-effect relationship between the current status of the resource, the impact of conservation interventions, and the benefits and services it provides to humans and society.[7] The various actors (users, direct and indirect beneficiaries) may have widely differing viewpoints and interests. Researchers must adopt a global approach in their work that makes room for all such perceptions and expectations.

Innovation may seem like a matter for technocrats, which makes it all the more important to incorporate local practices and realities along with

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past experiences, both good and bad. Alternative techniques cannot be developed and assessed without involving local actors. The top-down approach to innovation, in which new techniques are created under experimental conditions, does not lead to true "popularization" in rural areas and such innovations may turn out to be poorly adapted to real-world applications.

We must therefore seek compromise and arbitration when defining short- and long-term sustainability goals and performance, such as between short-term economic profit and medium- or long-term environmental and health impacts. Negotiations must keep in mind that capacities for adaptation vary and often differ between actors, since active non-farm workers, industrial agriculture companies, and small family farms operate with different amounts of flexibility and margins of error.

Another ethical issue specific to countries in the Mekong Delta is the cost-sharing arrangement for both the benefits and negative effects of increasing production in slope areas. Several populations are concerned by such increases: the various farmers who plant in this zone, residents and farmers in the plains areas, and consumers of products that come from the soil. Who should pay the cost of measures to prevent soil degradation? The benefits of these measures must be assessed in terms of improvements to health, water quality, and the environment. Who will pay to develop and implement technical innovations? Traditionally local actors, especially downstream users, i.e., the direct beneficiaries of practices that limit erosion and flooding, are asked to pay to solve problems that should be viewed as broader in scope. The demand for meat and raw materials continues to grow throughout Asia; this drives up the value of farming in fragile spaces like slopes, which in turn leads to the environmental predicaments discussed earlier such as flooding, erosion, soil degradation, and decreased biodiversity.

Conclusion

Soil conservation in the countries of the Mekong Delta, as elsewhere, is an issue that faces a multitude of ethical issues: balancing the many actors involved and their often divergent interests; funding mechanisms and private sector intervention; the validity of the components of scientific proof; and how to compensate the people who provide soil-based services.

Researchers therefore cannot limit themselves to offering technical innovations for improving soil production, limiting degradation, and preventing accidents. They must collaborate and engage in mutual dialogue with representatives of the various interests and contribute to global reflection on soil issues, from the perspective of research ethics and with the goal of equity between actors depending on the natural resources.

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