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Building Capacity to Investigate the Potential Role of Sustainable Agricultural Intensification in Agro-Ecological System

Given an ever-growing population, the global agro-ecosystem is required to deliver increasing levels of food production from a non-expanding stock of land, water and other natural resources. While this clearly implies increasing the productivity of finite resources, there are widely differing views as to how this may be achieved without degrading or destroying the bio-ecological foundations on which agricultural productivity depends. In the absence of exogenous growth in productivity arising from technical change, this implies a need to develop strategies for sustainable intensification.

This project investigated the potential contribution of sustainable intensification in agricultural ecosystems from an interdisciplinary perspective. An important focus was to build capacity in cross-disciplinary research into the economic and ecological processes in agro-ecosystems. The specific objectives were to: (1) Investigate the ecological implications of sustainable intensification and the ecological mechanisms that would be required to support it; (2) Explore the potential usefulness of alternative economic incentive structures that could support sustainable intensification, including 'club' type institutions and other aggregate and multi-level structures; and (3) Examine how the impact of potential or actual reforms to the policy system on incentives, land use change and ecological process might be jointly modelled in a way that appropriately represented the dynamic and spatial structure of the economic and ecological processes involved.

A key finding is that the sustainable intensification approach could have a sound ecological basis especially in food and fibre producing systems that are already intensified. The main results can be summarised as follows:

- Distinguishing between vertical intensification (agricultural production processes are intensified on a given land area) and horizontal intensification (land used by these processes is expanded), provides a useful synthesis of the work of economists and ecologists in this area and an important element in any framework for joint economic-ecological investigation of agro-ecosystems.
- The Sustainable Intensification approach takes a broad view of sustainable agricultural production processes and sets them within a global evolutionary context that recognises both the physical limits of available productive land and ecological services, and the expanding demand for food.
- Trophic Cascade theory can be seen as an ecological based approach that can facilitate joint economic-ecological investigations of ecosystems.
- It is important to consider ecological thresholds when investigating intensification processes in agro-ecosystems.
- While recent CAP reforms may have moderated incentives for over-intensification and significantly broadened incentives for ecological conservation, the current policy system does not provide effective incentives for efficient ecological management over time and space.
- An ideal framework for joint economic-ecological modeling should incorporate suitable measures of intensification, productivity, sustainability

and the relationships between them, while allowing sufficient spatial articulation to represent positive as well as negative ecological responses to intensification, and would include a behavioural component representing the influence of market- and policy-based incentives on land use and ecological structures.

- Data to support this type of model is more likely to be available from larger data sets collated at national level that could provide a long time series of observations on both economic and ecological aspects of identifiable farms and habitats.

The research has involved close collaboration between ecologists and economists and has enhanced capacity for interdisciplinary research by promoting mutual understanding and a sharing of expertise between disciplines. In particular the team could take advantage of the contrast between the empirical focus of members with ecological training and the more abstract approaches favoured by those with economics training.