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Editorial

Heterogeneity and diversity in less-favoured areas

Roughly 40% of the developing world's rural population lives in less-favoured areas (LFAs), areas that have low agricultural potential because of limited and uncertain rainfall, poor soils, steep slopes, or other biophysical constraints, as well as areas that may have higher agricultural potential, but have limited access to infrastructure and markets, low population density, or other socio-economic constraints. In other words, less-favoured lands may be less favoured either by nature or by man. These areas typically are characterized by conditions of extreme rural poverty, critical food insecurity and natural resource degradation. In general, LFAs have gained little from past agricultural successes as they have largely been bypassed by the modern farming revolution. Most of the population of these areas is located in mountain and hillside regions (uplands or highlands), and arid and semi-arid zones (drylands). Recent developments in technological progress for arable cropping and livestock systems tend to disregard the specific agro-ecological and socio-economic conditions that prevail in less-favoured areas, e.g.,

- low agricultural yields that impose constraints on labour productivity, making engagement in off/non-farm employment an important aspect of activity choice;
- high risks in rainfed production that discourage farmers to specialise, leading to risk-aversion in input use and investment behaviour;
- high incidence of serious degradation of the natural resource base due to deterioration of soil physical properties, soil erosion and nutrient depletion.

Fragile soils, growing population density, inadequate property rights, poor infrastructure and limited market access, and often neglect by policy makers and agricultural research and extension systems have all contributed to agricultural and economic stagnation and aggravated poverty. As more and more people seek to make a living in these areas, they expand their cropland into marginal lands, forests and steep hillsides, farm their land in erosive ways and fail to replenish the soil nutrients that they remove. This degradation is worsening poverty in LFAs, which, in turn, contributes to the spread of diseases such as HIV/AIDS, social conflict and loss of indigenous cultures at scales of global concern. Due in part to their lower agricultural potential and/or remoteness, such areas are often politically marginalised,

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contributing to their neglect by policy makers. Poverty, low agricultural productivity, and natural resource degradation are strongly interrelated problems in less-favoured areas of the tropics.

LFAs, however, contain a variety of natural resources that are at risk. They are the custodians of critical watersheds for nearly all rivers of the developing world; they contain vast areas of forest resources and unique bio-diversity, and are sites of origin for many important food and tree crops. The degradation of these resources has consequences that stretch far beyond the LFAs.

The agrarian structure of less-favoured areas is usually characterised by a strong *heterogeneity* in resource use by farm households and high levels of yield and income *variability*, both spatially and temporally. Consequently, demand-led rural development policies should take into account these differences in farmer behaviour. Different *development pathways* can be distinguished that enable rural households to satisfy their food security conditions. Moreover, agricultural intensification for improved resource management in these areas should be based on a careful balance of internal and external inputs that ensures attractive and stable factor returns. Effective interventions that respond to local needs of the population should be based, therefore, on a thorough understanding of micro–macro interactions and their implications in time and space.

1. Heterogeneity and diversity in less-favoured areas

Heterogeneity and diversity in natural resource quality play critical roles in farming systems. This holds for any agro-ecosystem, but is of particular importance in less-favoured (marginal) areas, because small differences can be crucial (Scoones, 2001). In crop and soil management in marginal areas, heterogeneity is often intentionally created. At plot level it is created to profit from the concavity of the relation between input intensity and output level. Such concavity implies that the average output of two distinct input intensities exceeds the output at the average input intensity. At community (village) level heterogeneity is created to profit in arable farming from soil mining of common (grazing) lands.

Heterogeneity in water availability is created through the process of water harvesting (Reij et al., 1988); on part of an area, surface run-off is stimulated, and this water is infiltrated on another part, so that precipitation is concentrated on a limited area, on which crop production takes place. This practice limits non-productive water losses through soil surface evaporation, thus saving a greater proportion of the water for crop production, while the greater availability per unit surface area allows the crop to complete its life cycle and produce economic yield.

Heterogeneity in nutrient availability is created through placement of the organic (manure) or inorganic fertilizer at a limited part of the area. The consequence is that locally the concentration of the nutrient element is higher, thus enhancing uptake of that element by the crop (de Wit, 1953). In tropical cropping systems, animal manure

is often concentrated on part of the field, and manuring 'rotates' over the field in a period of several years (Kanté, 2001).

At farm level, heterogeneity is created through preferential application of nutrients near the homestead, resulting in strong gradients in soil fertility with distance from the homestead. At the level of (village) communities, livestock are the central means of concentration of nutrients within farming systems, resulting in inequitable redistribution of nutrients from common lands and lands of poorer households to farms of richer households. Productivity gains achieved by concentration from common lands, or concentration to infields/home gardens, are at the long-term expense of declining productivity in remote fields, contributing to heterogeneity at territory level (Hilhorst and Muchena, 2000).

This wide diversity and heterogeneity of farmers and fields as a prime characteristic of livelihoods and farming systems in LFAs has been an important reason for the failure of Integrated Rural Development Programmes. Biophysical conditions are highly *variable* among and within farms. Rural households are *diverse* in terms of resources, activities and access to markets and institutions. Rural communities are *heterogeneous* as far as assets, wealth and power are concerned. As a result, various development pathways, defined as a common pattern of change in livelihood strategies, will exist at different scales (Pender et al., 1999). By carefully utilising local comparative advantages, rural households linked to farms and firms, communities or regions will be able to improve their level of living and natural resource management practices.

The purpose of this special issue is to illustrate different aspects of heterogeneity and diversity as a basis for analysis of development perspectives of LFAs, focusing attention on interaction of agro-ecological and socio-economic factors at household, regional, national and international levels. Enhancing simultaneously welfare (including food security) objectives and sustainable natural resource conditions requires an understanding of: (1) the nature of interactions between socio-economic and agro-biological processes at different scale levels; (2) the heterogeneity of resource conditions, the diversity of livelihood strategies under vulnerability and risk; and (3) the role of generic enabling factors and market integration. Only then can fruitful efforts be made to identify the required type, mix and sequence of possible policy interventions.

2. Overview of the contributions

The articles in this issue comprise a selection of papers presented at a Wageningen University-IFPRI (International Food Policy Research Institute, one of the partners in the Consultative Group on International Agricultural Research) conference on development strategies for LFAs held in the framework of the INREF (Interdisciplinary Research and Education Fund; www.north-south.nl/index.php/item/1) programme Regional Food Security Policies for Natural Resource Management and Sustainable Economies (RESPONSE; www.north-south.nl/index.php/item/156) in July 2002. A sequel to this issue deals with the development strategies for LFAs,

comprising a selection of companion papers from the same conference (special issue Food Policy, 29 (4), pp. 295–465, 2004).

2.1. The nature of interactions between socio-economic and agro-biological processes at different scale levels

The contribution by Giller et al. discusses the *temporal and spatial dynamics* of nutrient resources, light and water within cropping and livestock systems, and their interactions and those with other resources such as labour. Research has focused predominantly on individual *components* of successful farming enterprises rather than on the design of successful farms. Principles for enhancing allocation efficiency of scarce resources must however, be derived taking into account the complex dynamics of interacting temporal and spatial scales. Combinations of socio-economic and agro-ecological conditions can provide windows of opportunity in both time and space that favour investment in particular forms of management. A research framework is proposed that represents a farm livelihood system as a set of interacting components. This can be used to explore the short and long-term trade-offs of introducing new technologies and to evaluate effects of policy on farms varying in resource endowment.

In the largely methodological contribution of Berger et al., a Multi-Agent Systems (MAS) modelling approach is proposed as a suitable method to represent the heterogeneity of farm households in an environment characterized by many biophysical and socio-economic constraints and their dynamic interactions. MAS is also presented as a promising tool for simulating the impacts of various policy interventions on household livelihoods, the quality of the natural resource base, and food production.

Kaizzi et al. describe evaluation of Velvet bean (Mucuna pruriens var. utilis) and inorganic N fertilizer for improving maize production in a range of agro-ecological zones in eastern Uganda on a transect from Mt. Elgon (high altitude) to the low-altitude zones. The high and medium altitude zones are high-potential agricultural areas, with more reliable rainfall, in contrast to the low-altitude zone.

2.2. The heterogeneity of resource conditions, the diversity of livelihood strategies under vulnerability and risk

Beyene et al. explore local people's perceptions and understanding of their land resources, and the way their views influence natural resource management in Tigray, Ethiopia, a typical example of a less-favoured area. They show that land use is not only a function of the physical properties of fields, but is also shaped by historical processes and local cultural values, and that management strategies adopted by farmers are influenced by a broad range of factors. Thus, the diversity in socio- cultural values adds complexity to the bio-physical heterogeneity in judging land resources in less-favoured areas. Hence, in research on soil erosion and land degradation, the social, cultural and political context needs to be considered.

Kruseman et al. contribute to the discussion on heterogeneity by looking, on the basis of the concept of development domains, at the best way of targeting development interventions, either geographic targeting or targeting of specific household types. They examine the degree to which there is heterogeneity within the diversity of livelihood strategies in comparable geographic areas. Patterns of crop diversification and the adoption of alternative technologies, both instrumental in the alleviation of poverty and in ensuring sustainable livelihoods, appear to be linked to development domains.

The paper of Jansen et al. deals with the diversity in income earning strategies and adoption of conservation technologies in rural hillside areas in Honduras. Eight different income-earning strategies were identified, that reflect differences in comparative advantage in biophysical (elevation, rainfall); economic (rural population density, market access); social (land tenure, education); and institutional (community-based and external organizations) factors among different communities.

2.3. The role of generic enabling factors and market integration

The qualitative analysis of the relationship between income earning strategies and income levels in he paper of Jansen et al. suggests several critical policy issues to overcome the poverty faced by the majority of the inhabitants in the rural hillside areas in Honduras. Given the limited coverage of basic public services such as public health, education, electricity, communication facilities and extension services in most hillside regions, it is imperative to substantially increase the currently low levels of public expenditures in these areas. Moreover, education and extension aimed at maintaining soil fertility have particular potential to raise incomes.

The analysis of Kaizzi et al. comparing organic and inorganic N sources shows that both strategies are economically beneficial on highly productive fields in high-potential agro-ecological zones. However, farmers on low-productive fields across all agro-ecological zones are currently operating in an economically downward spiral. Only the alternate use of a Mucuna-maize relay provides them a way out of this predicament. Given the current prices for maize and urea, adoption of fertilizer-N is profitable only in the most favourable environment, illustrating the necessity of site-specific nutrient management recommendations.

3. Further perspectives

Fundamental research questions for analysis of resource dynamics and potential for modification of complex farming systems relate to the degree of simplification of processes that is allowed and the site-specific knowledge that is necessary to integrate and move from one scale to the next. Understanding which factors are the most important in determining site-specific response to changes in management is a central issue (Voortman and Brouwer, 2001). Comparative studies of farming systems will allow exploration of the linkages to policies that will favour investment in smallholder agriculture under alternative policies.

Interactions between livelihoods, poverty and environmental impacts are extremely complex, and strongly depend on the context in which they take place. To understand such dynamics, it is necessary to understand existing practices and the specific agro-ecological opportunities for investment. In understanding outcomes, it is also necessary to consider the relationships between the broader context, and the differential circumstances of different households (de Ridder et al., 2004). In short, natural resource dynamics, including change in soil properties, must be seen in a wider livelihood context where influences range from macro-policy factors to micro-household based factors and the institutions that mediate these (see Blaikie, 1985; Warren, 2002). In any particular case, a technical understanding of agro-technical relations must be allied to a broader understanding of livelihood diversity and change, if the underlying factors influencing the prospects for a more sustainable use of natural resources are to be grasped. Without considering investment practices in natural resources in less-favoured areas, and their political economic conditioning in this way, decontextualised arguments will continue to rage between those who would suggest the generalised inadequacy of low-external-input and participatory approaches to meet the 'crisis', and those who suggest their universal applicability (Röling, 2005); between 'believers' in soil degradation and soil mining as the fundamental causes underlying poverty in less-favoured areas and those that see these phenomena as consequences of globalisation and inadequate agricultural policies (Hartemink and van Keulen, 2005); between advocates of increasing internal democratization as the vehicle for enhanced development and those that argue that only more favourable economic terms can help the less-favoured areas on their way. Such two-dimensional reasoning may serve the rhetoric of different elements of the scientific and development community, but it does not serve farmers in less-favoured areas.

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