Agrodiversity: Definition, Description and Design

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2 authors:

Harold Brookfield
Australian National University

Michael Stocking
University of East Anglia

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Viewpoint

Agrodiversity: definition, description and design

Harold Brookfield[a,*], Michael Stocking[b]

[a]*Department of Anthropology, Division of Society and Environment, Research School of Pacific and Asian Studies, The Australian National University, Canberra ACT 0200, Australia*

[b]*School of Development Studies, University of East Anglia, Norwich NR4 7TJ, UK*

Abstract

'Agrodiversity', a term of the 1990s, refers to interactions between agricultural management practices, farmers' resource endowments, bio-physical resources, and species. If it is to have practical use, it must be codified as a basis for analysis. A division into overlapping and interrelated components is proposed, which distinguish spatial and temporal variations as well as related developmental issues such as livelihoods and food security.

Keywords: Agrodiversity; Agrobiodiversity; Livelihoods; Food security; Farming systems

1. Introduction and definition

Although sometimes used interchangeably, the words 'agrodiversity' and 'agrobiodiversity' have distinct meanings. Agrobiodiversity, much the older term, has generally been a shorthand for biological diversity on lands used for agricultural purposes. 'Agrodiversity' is much less common, with only 23 versus 232 references produced by a recent Internet search. Brookfield and Padoch (1994, p. 9) defined agrodiversity as "the many ways in which farmers use the natural diversity of the environment for production, including not only their choice of crops but also their management of land, water, and biota as a whole". Independently, Almekinders et al. (1995) wrote of agrodiversity in arable systems as resulting from the interaction between plant genetic resources, the abiotic and biotic environments, and management practices. They define it as "the variation resulting from the interaction between the factors that determine the agro-ecosystems" (p. 128). Anthropologists Netting and Stone (1996) use it for the Kofyar cultivation systems in central Nigeria to encompass the diversity of species cultivated, the complexity of crop-management skills, and marketing arrangements. Ecologists Pimentel et al. (1992) include insect and soil biodiversity in agrodiversity as well as managed species in agricultural land use.

We are scientific coordinators of the first Global Environment Facility (GEF) funded project – PLEC[1] – to be targeted specifically at understanding how biological diversity is supported by smallholder farmers in the tropics and how, in turn, their livelihoods are underwritten by biological diversity. Our many developing country collaborators are charged with developing "participatory and sustainable models of biodiversity management based on farmers' technologies and knowledge within agricultural systems" and recommending "approaches and policies for sustainable agrodiversity management" (UNU/UNEP, 1998, p. 6). To do this requires a framework for classifying and describing what is involved. This short paper, the origin of which is a guidance document prepared for our colleagues, seeks to outline such a framework.

*Corresponding author. Tel.: + 61 2 6249 4348; fax: + 61 2 6249 4688; e-mail: hbrook@coombs.anu.edu.au

[1]This paper is a contribution from the project *People, Land Management and Environmental Change* (*PLEC*) which is executed by the United Nations University, Tokyo, and implemented by the United Nations Environment Programme, Nairobi. PLEC involves nearly 200 mainly developing country scientists in 12 countries, and a larger number of collaborating farmers and officials. A special edition of this journal (Vol. 5, No. 4, 1995) was devoted to PLEC. The project document (UNU/UNEP, 1998) is available from the first author by e-mail.

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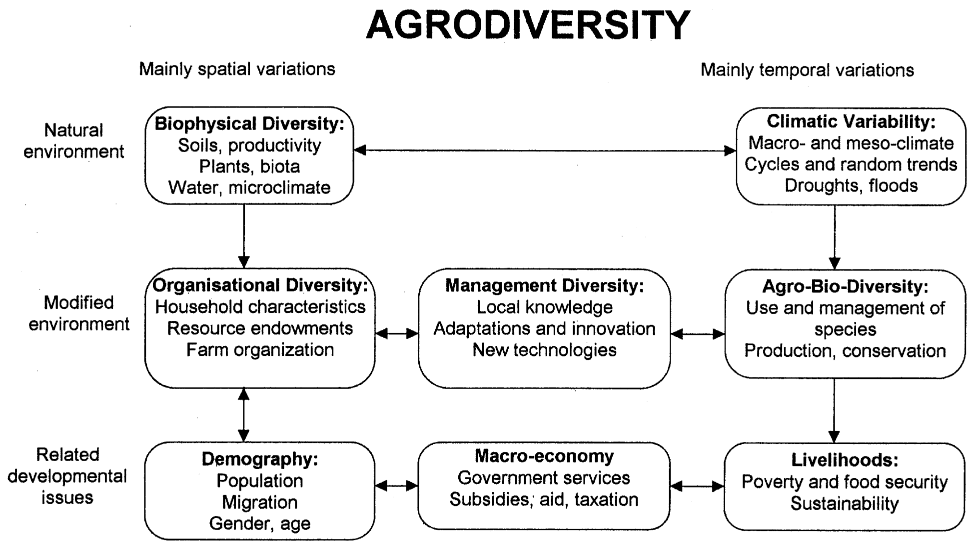

Fig. 1. Elements of agrodiversity – main components and principal development issues.

2. The need to codify agrodiversity

Following the definitions above, it is essential to any understanding of agrodiversity to know (1) how farmers' practices and circumstances affect different aspects of biological diversity ranging from genetic to the whole landscape; and (2) how biological diversity affects rural elements of society from individual livelihoods to households, communities and the wider economy. Overlying this two-way interaction are different scales of operation, both spatially and temporally, and different degrees of modification of natural biological diversity. Affecting the associations are some of the most important developmental issues today: poverty, livelihoods, food security, population growth, migration and programme interventions. It is a complicated picture for our collaborators, most of whom come from the natural sciences.

Two examples from PLEC scientists demonstrate the difficulty of getting to grips with diversity and with imposition of a classificatory structure on patterns that are often different from field to field. Padoch and de Jong (1992) identified 12 distinct farming systems in one small community in the Peruvian Amazon, and 39 ways of combining the 12 production types amongst the 46 households surveyed. Many changed their production combinations the following year in response to a dynamic environment of a shifting flood plain and differential opportunities in the dryland above. In a different environment, work at our PLEC site in semi-arid Kenya has identified 25 different cropping systems, without taking account of tree crops, in four communities over four growing seasons (Tengberg et al., 1998). Classifying farmers into high, medium and low resources, and differentiating between three clusters of soil conditions, enabled a partial understanding of how specific crop combinations were supportive of livelihoods. These two cases exemplify that agrodiversity involves spatial, temporal management, organisational and livelihood dimensions.

A way of codifying the complexity needs to be sought which preserves the richness of the smallholder farming situation but enables the analyst to describe and understand the forces, pressures and opportunities which shape production decisions. Fig. 1 is our initial conceptualization of the elements of agrodiversity and their relationship with each other.[2] Each element contains components which contribute to the main characteristics that would typify that particular element and which would be the start of the construction of an agrodiversity database. The next section examines what might be contained within these elements of agrodiversity, thereby providing a precursor of a full database and analytical methodology.[3]

3. Description: the components of agrodiversity

Agrodiversity can, we suggest, be divided into four principal elements, all of which overlap but each of which constitute distinctive elements that have their own rationale and means of assessment:

1. *Biophysical diversity.* This is the diversity of the natural environment, which controls (especially in low-input farming) the intrinsic quality of the natural

[2] We are grateful to Dr. Anna Tengberg who drafted two versions of this diagram and who has assisted the PLEC project in the development of analytical methodology.

[3] Turning the concept of agrodiversity into a workable database and useful analytical tool is, we believe, a high priority – see Thrupp (1998).

resource base which is utilised for production. It contains the natural resilience of the biophysical environment, to be exploited by agricultural systems. It includes soil characteristics and their productivity, the biodiversity of natural (or spontaneous) plant life, and of the soil biota. It takes account of physical and chemical aspects of the soil, surface and near-surface physical and biological processes, hydrology, micro-climate, and also variability and variation in all these elements. Farmers select within this diversity and they often manipulate it quite substantially. Sometimes this management goes to the extent of 'manufacturing' soils, and remodelling the landscape in, for example, terracing.

2. *Management diversity*. In addition to land transformation as above, this includes all methods of managing the land, water and biota for crop production and the maintenance of soil fertility and structure. Included are biological, chemical and physical methods of management. Management may not only be specific to certain soils and terrains, but also to different seasons. Smallholder farmers are often adept at altering practices according to rainfall patterns. Some biological management, such as the reservation of forest for watershed protection, or the planting of live hedges, has direct physical consequences. Local knowledge, constantly modified by new information, is the foundation of this management diversity.
3. *Agro-biodiversity*. This has been re-defined within PLEC as "management and direct use of biological species, including all crops, semi-domesticates and wild species" (Guo et al., 1996, p. 15). It embraces all plants used by or useful to people and, by also involving biota having only indirect value to people, it is similar to total plant biodiversity. Particularly important is the diversity of crop combinations, and the manner in which these are used to sustain or increase production, reduce risk, and enhance conservation.
4. *Organizational diversity*. Often called the 'socio-economic aspects', this includes diversity in the manner in which farms are owned and operated, and in the use of resource endowments. It underpins and helps explain 'management diversity' and its variation between particular farms. Explanatory elements include labour, household size, the differing resource endowments of households, and reliance on off-farm employment. Also included are age-group and gender relations in farm work, dependence on the farm as against external sources of support, the spatial distribution of the farm, and differential access to land.

These categories are, we argue, fundamental to understanding the interface between natural biological diversity and human land use. They operate through a variety of spatial scales, which are important to distinguish. Typically, biological diversity is an attribute of an organism or a site; by contrast, agrodiversity is also a feature of whole fields, farms, communities and landscapes.

In addition to spatial scale, all categories of agrodiversity have different time dimensions and dynamic attributes. Broadly, we distinguish two main time scales:

(A) *Short-term* (*inter- and intra-seasonal*) *sequential diversity* in farmers' decision-making on use of land, labour, capital and other farming resources, and in the security or risk of the harvest. The time scale is from months to a short sequence of years.

(B) *Longer-term change in cropping and management practices*, in response to environmental, demographic, social, economic or political change. This includes shifts through time in cropping patterns, land-use allocation, reliance on different income sources. It also includes the long-term creation of fixed capital ('landesque capital') in the land. These changes occur as soils and biota are modified by use and natural processes, as self-provisioning gives way to commercial production, new crops are adopted and others discarded, new practices are taken into the system and others neglected. The time scale is from a few years to many decades.

The shorter-term changes can be observed and directly monitored within a project cycle as in the four years of PLEC. Short-term sequential diversity may well offer useful insights into adaptations and coping strategies to risky and variable environments. Longer-term change is perhaps more fundamental in development responses and programme interventions. To understand these shifts in practices and exploitation of the natural environment is a key to development that is both economically and ecologically sustainable. Very often, farmers make changes in their systems 'incrementally', cultivating the land while introducing new practices over a period of years (Doolittle, 1984). A project over four years will not necessarily capture such changes, planned and implemented over long periods. Yet this may be the manner in which a large part of agricultural transformation has been achieved, by farmers themselves.

4.1. Interrelation of the elements

Such a means of organizing description cannot be treated as any rigid framework because no part is separate from the others. This interrelationship of the different elements is centrally important for understanding, and for derivation of principles of diversity management. Biophysical diversity can be viewed at almost any meaningful scale. At a 'landscape' scale, it is a major element in the widely repeated manner in which farms are structured to allocate land of different intrinsic qualities so that all or most households have access to each. This is one way in which organizational diversity is directly related to biophysical diversity. At closer resolution, biophysical diversity can arise within a single field, where a crop will yield differently in separate parts of the field, either every year, or in years with drier or wetter climatic conditions better

Table 1
Potential developmental benefits of agrodiversity

Outputs
Improving *food security* through a greater range of plant and animal varieties which reduce the risk of loss due to pests, and increase tolerance to climatic stress
Assisting *nutrition and health* by providing a wider source of nutrients, medicines and vitamins
Increasing *total production* through greater biomass output
Agricultural Practices
Enabling support of *greater population densities* through provision of wider range of outputs and employment opportunities
Providing *crop protection* against epidemic pathogens
Employing *indigenous technologies* of plant production, tillage, soil management, and crop protection that are acceptable to local people and proved technically in specific environments
Society and environment
Reducing *environmental risk* through supporting ecosystem processes which are accessible to poor people
Underwriting *livelihoods* by ensuring a greater diversity of sources of income and subsistence
Enhancing the *empowerment* of local communities through technologies available within their own resources and own control

Adapted from Koziell (1998) and Thrupp (1998).

suiting one or other part of the field. The association of crops in an intercropped field may often show subtle differences related to natural conditions. Here there is a relationship between agro-biodiversity and biophysical diversity.

In another frame of analysis, crop choice often differs between rich and poor farmers. There are many other differences, for example in use of livestock and their manure, and of purchased inputs. The type of conservation practices adopted is strongly influenced by the resources available to different groups of farmers, thus affecting the pattern of management diversity, and feeding back to enlarge the differentials in natural land quality. Thus all elements of agrodiversity are indeed interrelated, and none can be considered without taking each of the others also into account.

4. Design: the benefits of understanding agrodiversity

To where does agrodiversity analysis lead? To some, agro-biodiversity is a means of conserving diversity of landraces, though this in situ conservation paradigm has been questioned.[4] Other authors put the case for diversity as the basis for sustainable intensification (e.g. Thrupp, 1998). In Table 1 the elements of agrodiversity are linked with development-related issues. Agrodiversity must above all be a utilitarian concept, providing professionals with a framework to understand biological diversity in a landscape of people, enabling decision-takers to identify priorities in both using and protecting biodiversity, and assisting planners in the design of interventions.

[4]Wood and Lenné (1997) argue persuasively that, while there are considerable advantages in conserving a dynamic traditional system of agrodiversity management, it cannot be the whole answer. Formal agricultural research is still essential.

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