# Integrating stakeholders' goals, research disciplines and levels of scale

***In developing sustainable agro-ecosystems as part of landuse planning, several difficulties are encountered. Firstly, agricultural production systems show large variability and secondly, mono-disciplinary research conducted on sites of which the representativity is unknown is of limited value. Another shortcoming of various methodologies for landuse planning is that they are only directed at one level (village, region, province) and do not take into account the interrelation between these levels. This article describes an approach recently designed to try and overcome these shortcomings.***

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An evaluation of methodologies revealed that the "ideal" method for development of sustainable agro-ecosystems should include:

- integration of disciplines, farmers' goals and planners' visions
- identification and quantification of the most important processes of complex agro-ecosystems
- identification of constraints at different levels
- up and down scaling of research results.

The newly formulated methodology Land Use Systems Analysis (LUSA) tries to build on earlier lessons and combine high-tech assessment methodologies, such as multicriteria computer models, with participatory methodologies. LUSA aims to govern the successful management of resources to satisfy changing human needs, without degrading the environment or the natural resource base. It analyses in five steps processes and components of landuse systems in an integrated and multidisciplinary way, resulting in quantified and clearly presented alternative landuse options (van Duivenbooden, 1995).

This article describes the experiences so far with LUSA within the "Consortium for sustainable use of Inland Valleys in Sub-Saharan Africa". In this consortium National Agricultural Research Systems of eight West African Countries and five International Agricultural Research Centres collaborate.

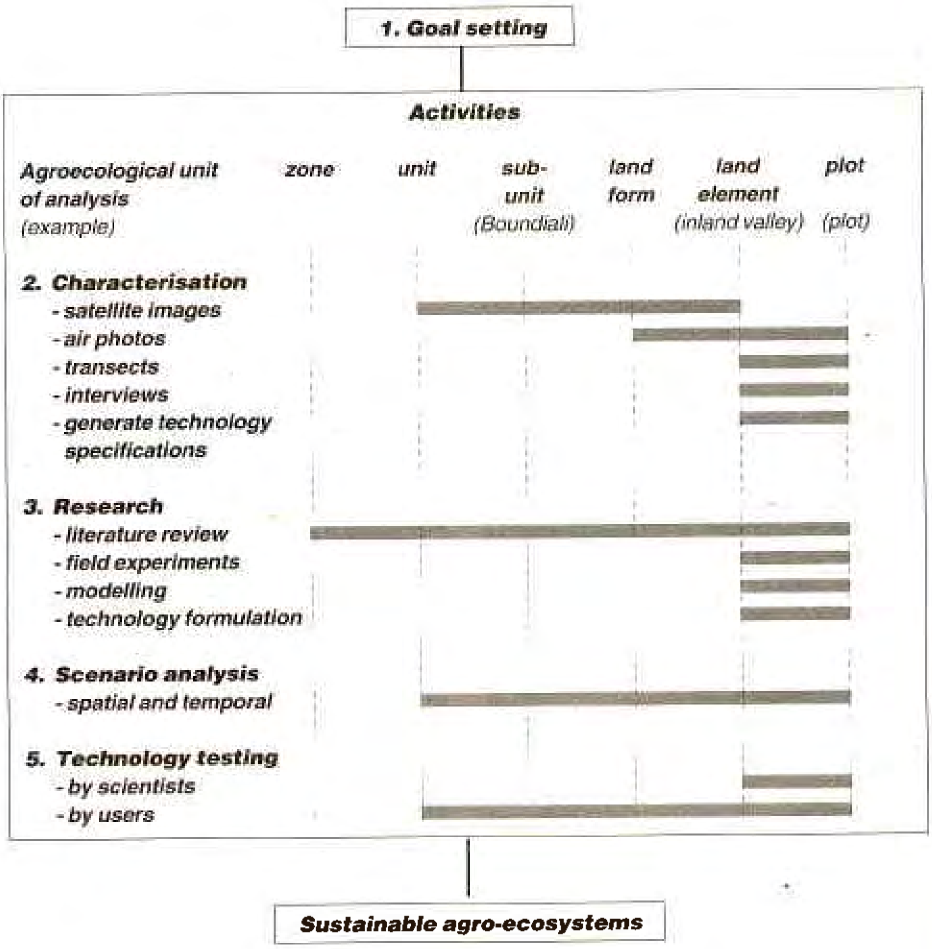



***Figure 1. Simplified diagram of activities within Land Use Systems Analysis and their degree of detail (van Duivenbooden, 1995).***

## Methodology

Figure 1 shows the five main activities distinguished in LUSA. The first activity is the definition and formulation of common goals of farmers, researchers and landuse planners. This activity may appear to take some time at the beginning, but after formulation of goals the efficiency of the following steps will be much higher.

The second activity is to make a comprehensive description of the actual agro-ecosystems at different levels of scale, i.e. on the basis of bio-physical parameters (climate, lithology, land form, soils and hydrology, land cover and land use; Andriesse et al. 1994). Land use is described including its socio-economic identifiers (labour, capital input and management). Four levels are distinguished: macro level (scales between 1:1,000,000 and 1:5,000,000), reconnaissance level (1:100,000-1:250,000), semi-detailed level (scales 1:25,000-1:50,000), and detailed level (1:5,000-10,000). With the level of detail, the unit of analysis changes accordingly, as schematically indicated on the horizontal axis of Figure 1. Consequently, the degree of detail of information gathered is strongly related to the level of characterisation. Zooming in (or scaling down to a lower level of characterisation, or desaggregating), implies greater detail of increasingly dynamic parameters, while at the same time certain macro-level parameters are more or less static (e.g. climate and lithology at detailed level). On the other hand, when scaling up (or aggregating), details distinguished for variables at a lower level (e.g. crop rotations) are disregarded at a higher level. Compared to soils and climate, land use involves the most dynamic set of variables: cropping and farming systems. At the semi-detailed level, results of transect surveys are presented in so-called agro-ecosystem diagrams (Figure 2), and a number of landuse and physical characteristics is quantified (van Duivenbooden & Windmeijer, 1995). In the semi-detailed and detailed characterisation, farmers participate actively. For instance, interviewing male and female farmers is used to gather local knowledge, opinions, goals and information on land-use and production constraints.

The third activity is to select representative sites for research. Research is restricted to the most important components and flows of landuse systems and their socio-economic circumstances. This research is also done on various units of analysis (Figure 1).

The fourth activity is the analysis of prospective development scenarios ("where do we want to be") with multicriteria computer models. While taking into account spatial and temporal relations, results reveal the type of technical and political development measures necessary to bridge the gap between present and commonly defined future land uses and their effects for a region. Data to feed this multicriteria model can be generated with various tools, such as crop simulation models.

The last activity is to test the recommended technologies and management practices by both farmers and scientists by putting them into practice.

Research, scenario analysis and technology testing are closely linked and carried out more or less concurrently. In this way the viewpoints of various stakeholders for development of sustainable agro-ecosystems are also framed, while making use of the complementarity of their viewpoints and research methodologies.

To increase exchange of research results, they should be made available to the various users. As the five steps will result in a large amount of data, storage of information in a GIS-linked database is indispensable. This database is then used to establish relations between parameters at different levels of scale and from different disciplines. The efficiency of data exchange is further increased when common research methodologies are used.

## Results

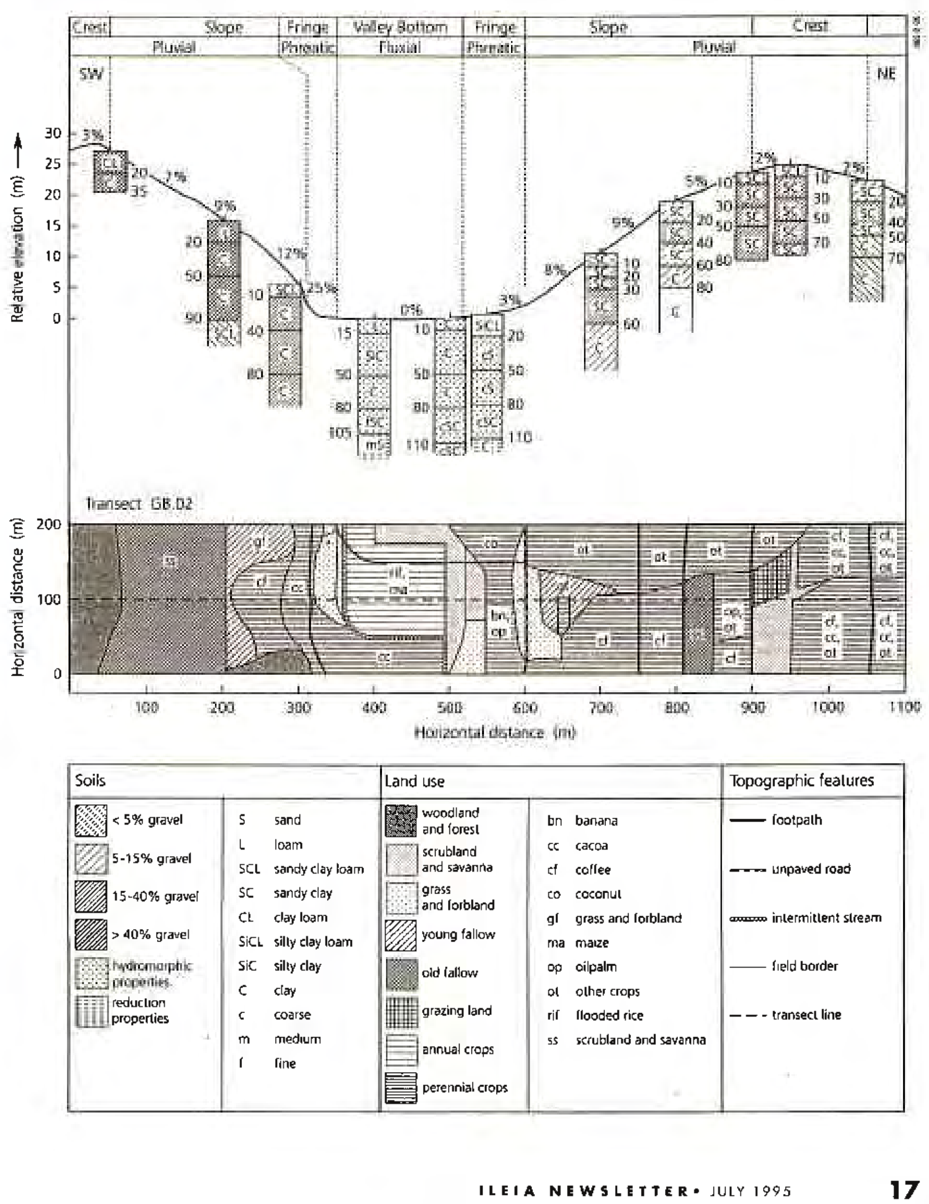
LUSA has only recently been developed on paper and a few projects have been evaluated according to these new concepts resulting in a number of recommendations (van Duivenbooden, 1995). For instance, much more attention is to be paid to the formulation of common goals of researchers, farmers and landuse planners. These are too easily overlooked, or taken for granted. In addition, research results should be "translated" into outputs that are understandable for farmers and development agencies.

Within the "Consortium for sustainable use of Inland Valleys", the multiscale characterisation activities (step 2) completed so far include the macro, reconnaissance and semi-detailed characterisation in a few West African countries. In Ivory Coast, for instance, results of the semi-detailed characterisation method show clear differences in land use and physical characteristics within inland valley systems and among them under different agro-ecological conditions. Agro-ecosystem diagrams (Figure 2) provide quick and clear insight in the actual agro-ecological characteristics of inland valleys and where they are used.

Results revealed further that there are clear relations between parameters of the higher level characterisation and the results of the semi-detailed characterisation. The morphology of inland valleys is strongly related to the agro-ecological zone, and differences between lithological formation are much more pronounced in the drier Guinea Savanna Zone than in the Equatorial Forest Zone. Differences in population density, a parameter used at the reconnaissance characterisation, explain very well the differences in landuse intensities (semi-detailed level).

Results of bio-physical characteristics of inland valleys could be extrapolated to inland valley systems. However, since a socio-economic characterisation has not yet been carried out, the upscaling of farmer's ideas and production constraints to larger areas is much more difficult on the basis of the relatively small number of interviews. Another difficulty was the qualitative nature of information collected from farmers during the interviews at the semi-detailed level. A visit to extension services or development agencies may yield additional quantitative information in future characterisation work. This highlights again the importance of linkages between farmer extension services and agricultural research. In another project, the limited formulation of development goals by farmers and development agencies more or less forced researchers to decide on development options in their scenario analyses. Data availability and formulation of goals thus considerably hamper the linking of high-tech and participatory methodologies. Hence, the use of high-tech tools or participatory methodologies for a specific project depends on the goals of that project or organisation.

Within the framework of the Consortium, scenario analysis and technology testing have not yet been carried out. In a different project, results of a scenario analysis with a multicriteria computer model showed the conflict between the potential of the natural



resource base and the actual landuse practices of farmers (i.e. mining of soil nutrients). However, policy measures to reverse that trend are difficult to formulate without the participation of the involved ministries, development agencies and donors.

## Conclusion

LUSA is a framework which allows a combination of high-tech assessment methodologies with participatory methodologies. Basic ingredients of this approach are the required integration of goals, disciplines and levels of scale, and common methodologies. Participatory methodologies do not only refer to inclusion of farmers, but to those of other stakeholders as well. Quantification is another key issue that facilitates comparison of different agro-ecosystems, development of sustainable agro-ecosystems and linking of high-tech and participatory methodologies. Implementation of holistic research and development programmes needs a contribution of the different ministries, research institutions, farmers organisations, extension services and NGOs. In case such a programme covers more than one country, a network or consortium is the most appropriate organisational structure. Through joint research targeting and priority setting, duplication of efforts and waste of money and time can be avoided, and due to the optimum dissemination of information and results, countries will profit from research carried out elsewhere.

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Papers available from the author.