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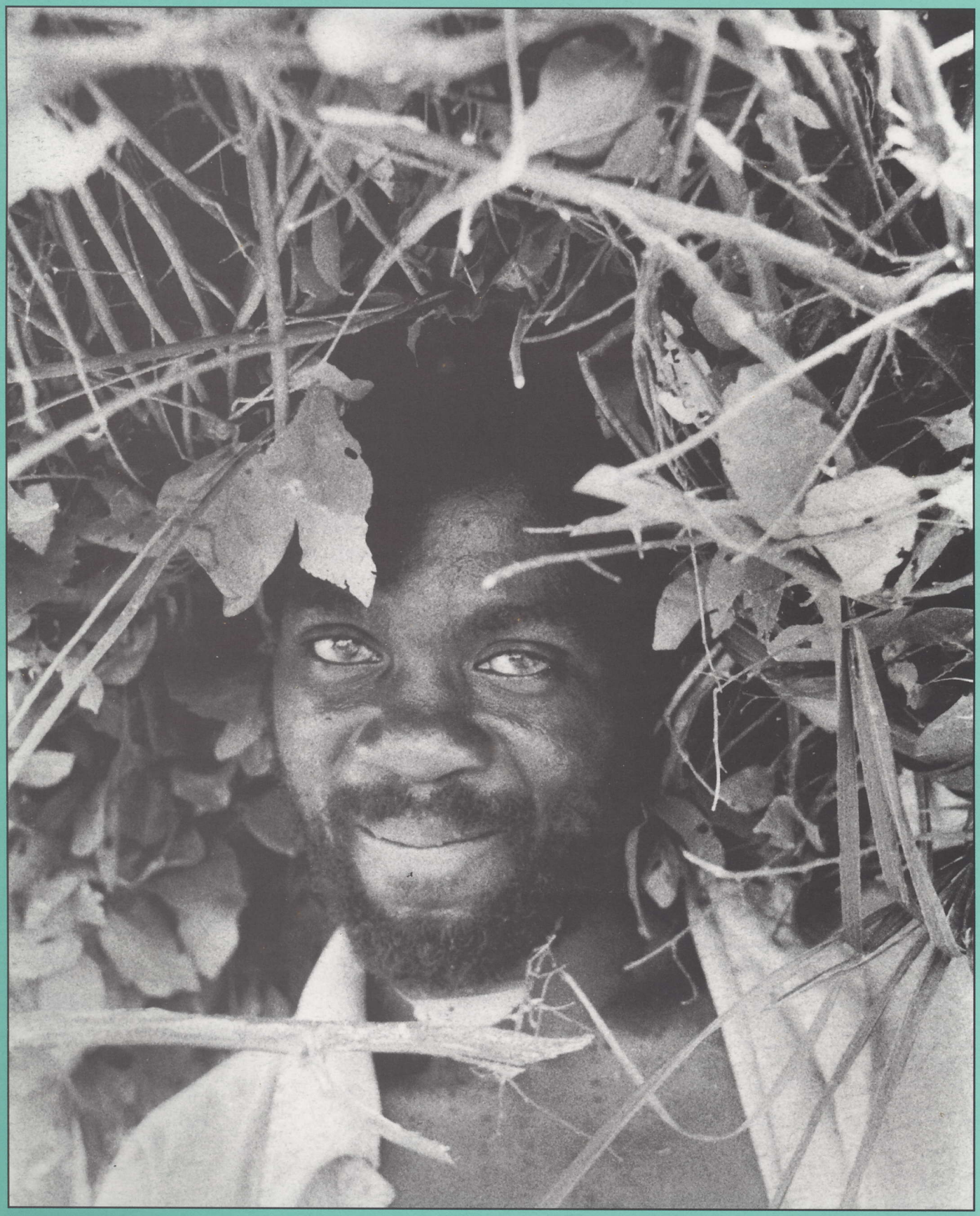
ILEIA NEWSLETTER

FOR LOW EXTERNAL INPUT AND SUSTAINABLE AGRICULTURE



RESEARCH AND REALITY

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NEWSLETTER

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ILEIA (Information Centre for Low-External-Input and Sustainable Agriculture) was established in 1982 by the ETC Foundation and is funded mainly by the Netherlands Ministry of Development Cooperation. Project funds are assured till early 1999.

ILEIA's long-term objective is to contribute to a situation in which Low-External-Input and Sustainable Agriculture (LEISA) is:

- widely adopted as a valid approach to agricultural development, complementary to high-external-input agriculture,
- recognised as a means to balance locally available resources and local knowledge with modern technologies requiring inputs from elsewhere,
- valued as a useful perspective in planning and implementing agricultural research, education and extension,
- developing and consolidating its stock of knowledge and scientific basis.

LEISA is agriculture which makes optimal use of locally available natural and human resources (such as climate, landscape, soil, water, vegetation, local crops and animals, local skills and indigenous knowledge) and is economically feasible, ecologically sound, culturally adapted and socially just. The use of external inputs such as mineral fertilisers, pesticides and machinery is not excluded but is seen as complementary to the use of local resources and has to meet the above-mentioned criteria of sustainability.

ILEIA seeks to reach these objectives by operating a documentation centre; publishing a quarterly newsletter, bibliographies, resource guides etc; holding workshops; and supporting regional networks in the Third World.

CARTOON by Eddie Handono, Studio Driya Media, Indonesia

COVER PHOTO: Gilles Nicolet

DEAR READERS

Do today's research and development methods fit farmer's complex reality and the need for sustainability? Which methods can better deal with, for example, the increasing diversity of farming conditions, interactions between micro and macro scales, different stakeholders and economic assessment? Or do we need more fundamental decisions about values and objectives to reorient agriculture? Insight in the nature of sustainability and its demands has to increase, but how? Our ignorance and scientific uncertainty about the complexities of sustainable agriculture make that participatory learning as well as scientific rigour are needed.

This issue presents examples of learning processes in which scientists and farmers try to match participatory with scientific methods and try to dig deeper in the methodological and practical consequences of ecological and cultural diversity and sustainability. These issues pose huge challenges to researchers and development workers. Clearly the articles in this Newsletter are not the final words to be said on this. We look forward to receiving your experiences and opinions on these matters.

Our challenge for this issue was to write about these complex issues in understandable words. Research, experimentation and innovation are as much a concern of farmers and development workers as they are of scientists. If the expertise of all stakeholders is to be used, communication has to be improved. Please let us know if you think we have not succeeded.

Something that really worries us is the decrease in the number of articles written by non-Western authors. Are we on the wrong track, are we getting too much involved in the academic debate? Or do we use the wrong channels to request articles? We simply cannot believe that the 6000 non-Western readers of the ILEIA Newsletter have nothing to contribute to the exchange of practical experiences on development of sustainable agriculture. Do not hesitate but write, the ILEIA Newsletter depends on you!

The Editors

Photo: Jürgen Hagmann

High quality experiments

By commenting on each others' on-station and on-farm research efforts, farmers and scientists try to analyse factors influencing crop performance. Farmers' qualitative analysis through observations and discussions helps to explain the variety in hard data. Staff of the Conservation Tillage Project in Zimbabwe describe how this collaborative experimentation process worked in practice.

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Variation: problem or solution?

Since the beginning of this century, researchers have tried to eliminate the impact of yield variation in their desire to control and standardise agricultural production. Farmers, however, exploit every form of variation to make the most of their environment. Bart de Steenhuijsen Piters reports on a study in Cameroon, where a multidisciplinary research team resided for three years in a village and collected data integrating both conventional and participatory methods. They learned that yield variation had different backgrounds, leading to different strategies for optimising agricultural production. Diversity and variation are important sources of information and should not be eliminated from the research!

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Experiences from the field

In Kerala, India, many parties are involved in different types of research. Scientists carry out experiments under controlled on-station conditions and in farmers' fields, NGOs work with the communities in catchment areas or with farmers, and of course farmers experiment on their own farms. Based on his own experiences, V. Santhakumar writes about the limitations of each of these approaches. All these initiatives have their own contribution to make, but being aware of their limitations might help to make action plans more realistic.

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SEARCHING FOR NEW METHODS

The quest for sustainable agriculture brings about a search for new approaches to and methods for research and development. Especially the complexity and diversity of sustainable agriculture challenges professionals. In this editorial, key issues raised in the articles of this issue are placed in a wider perspective.

Coen Reijntjes and Margreet Moolhuijzen

Photo: Daniel Cáceres

Researchers commonly try to ban "undesired variation" to make "scientific" statistic analysis and standardisation possible. However, to make optimum use of resources and minimise risks, diversity in space and time is often deliberately exploited by resource poor farmers. Differences in environment, culture, preferences, knowledge and skill and differences in access to resources and markets make that farmers have very diverse production strategies. Understanding these differences and exploiting "meaningful" diversity is therefore a precondition for improving agriculture, especially in heterogeneous environments. Therefore, new research methods are called for.

De Steenhuijsen Piters (p 6-7) presents an example from northern Cameroon showing how diverse landuse systems can be and what consequences this has for research. Sharland (p 8) points at the wide diversity of growth conditions in fields of small farmers and the difficulties this creates for statistics. Vel (p 21-22) shows that differences in how farmers value resources and social relations are important aspects of diversity too. How often do researchers, economists and developers underestimate diversity and therefore come to wrong conclusions, useless recommendations and wrongly designed projects?

"Participatory" and "scientific"

As farmers are "the experts" in dealing with local diversity and as the need for new techniques in heterogeneous situations is very farm and farmer specific, participation of farmers (men and women) in research is now becoming more and more common practice. Defoer (p 9-11) and Hagmann (p 12-13) show how "participatory" and "scientific" research methods can complement and strengthen each other at farm level. Both methods have their strengths and weaknesses. But how to combine them in the most effective and efficient way?

"Scientific" conventional research has a tendency to be reductionistic. It is often limited to technology development, market farming, particular commodities, scale levels, factors, etc. Complex problems are reduced to models that provide a simplified simulation of reality. These modelling practices often provide an increased insight in complex relations. However, research results are hardly fed back to the subjective reality of farmers. Also integration of different scale levels, like the impact of district and national policies on farm household decision making and vice versa, or the importance of spatial variability of natural resources at different landuse planning levels, is poorly developed.

Development workers also suffer from reductionism: they often address a single group of farmers, one region or catchment area, and limit activities to only a few components of the farming system. Participatory technology development is often limited to only farm households and tends to focus on only a few aspects of the development process, i.e. problem identification and evaluation of tested technologies.

A wider perspective

Causes of unsustainable and inefficient agriculture are found at farm level as well as regional, national or international level. They are rooted within as well as outside agriculture. It is now being recognised that agriculture cannot be made efficient and sustainable by focusing research and development at commodity crops and animals or production problems at farm level alone. Research and development now starts to deal with agriculture in a wider perspective. Different "stakeholders" and different "levels of scale" are acknowledged and complementarity with policy development is sought.

Improving stakeholder interaction

Not only farmers take decisions that affect agriculture. People involved in agribusiness, extension, research, policy making,

banking, education and, not to forget, consumers have a stake in agriculture as well and therefore we call them stakeholders. They all have their own interests in and ideas about agriculture and sustainability. Interaction between different stakeholders, eg. to exchange information, to set research agendas, to make transactions or to formulate policies is often far from ideal. This leads to ineffective technology and policy development and marketing. Engel (p 14-15) presents a method for (participatory) analysis of interactions between stakeholders. Becoming aware of the ineffectiveness of these interactions is the first step towards improvement. To improve networking sometimes can be more effective than to improve research.

Linking macro and micro

In reaction to the challenges mentioned above attempts are being made to integrate research and development, combining research with landuse planning and policy development. Such programmes use a wide range of methods. They combine participatory and conventional methods with high-tech methods such as satellite images (SPOT), Geographical Information Systems (GIS), computerised data processing, modelling and linear programming.

International research centres and western universities, often in cooperation with national research centres and NGDOs, are starting this type of collaborative research and development programmes (Van Duivenbooden, p 16-17). These large "macro-micro" programmes, which are an attempt to improve sustainability of agriculture in a broad and systematic way, may lead to important insights. However, the high-external-input character of such programmes, in terms of funds and know-how for the "high-tech" methods, and the dominance of biophysical sciences risk influencing participatory learning processes in a negative way. And participatory learning is crucial to sustainable development.

Data don't speak for themselves

In diverse situations statistical analyses are difficult to make (Sharland p 8) and not very reliable (Hagmann p 12-13). Instead, analysts often substitute coefficients derived from elsewhere. Thus, in many cases the apparent rigour of calculations is misleading (Moris and Copestake 1993). But does participatory inquiry offer an alternative? It is commonly believed that this provides subjective information. Terms like "informal" and "qualitative" are used to imply poorer quality or second-rate work. Rigour and accuracy are commonly assumed to be missing from such inquiry. But the choice of methods has increased to guarantee trustworthiness. However, also with conventional methods, absolute trustworthiness will never be possible, as criteria for trustworthiness themselves are value-bound. Therefore, the process of gathering information, and being sure that no key elements have been omitted should provide the guarantee. By knowing about the process, information users should be able to judge whether to trust the findings or not. Data, qualitative nor quantitative, do not speak for themselves (Pretty 1994 and De Steenhuijsen Piters p 6-7)!

Economic appraisal

Agriculture is commonly analysed on the basis of monetary criteria. For economic analysis of sustainable agriculture, ecological and sociocultural criteria also need to be included and, as much as possible, quantified and valued in monetary terms. Ruben and Heerink (p 18-20) point at the need for financial appraisal and economic evaluation to improve insight in the economic feasibility of alternative practices. However, they have to admit that readily available procedures to account for additional criteria for ecological and social sustainability are difficult to find. Even if we do not agree with the limited focus of economic analysis, still these analyses define very much the feasibility of farming practices as farmers as well as funders to a high extent are guided by profitability.

Vel (p 21-22) shows that, nevertheless, it is not uncommon for economists and farmers to use different rationales for analysing farming practices. To understand low-external-input farming and for (participatory) development, insight in "indigenous economics" is a necessity. In most traditional societies the indigenous economic system is gradually being replaced by "market economics". Are, for that reason, these societies becoming less sustainable?

Comparing systems with different rationales and different resources only on the basis of monetary data is, in our opinion, insufficient and can lead to wrong conclusions. Users' values, goals, preferences and circumstances need to be taken into account and the opinion of the users should complement and give meaning to economists' financial data.

Not all conventional economic methods seem to us equally useful in assessing sustainable agriculture. For instance, contrary to the opinion of Ruben and Heerink (p 18-20), we have strong doubts about the usefulness of production functions. Such functions can be established more easily for chemical agriculture than for organic, low-external-input and sustainable agriculture. The relations between inputs and outputs in these complex and diverse systems are difficult to measure and depict in simple functions.

As long as decision making in agriculture by policy makers as well as farmers is based on financial appraisal which "externalises" the ecological and social effects, this will lead to unsustainability. But what alternative methods of economic evaluation could be used?

Relearning holistic assessment

Santhakumar (p 24-25) complains that the "goals" of farmers, development workers and scientists have been narrowed down to increasing production and profitability. The need for sustainability urges development professionals and farmers to also look at environmental and social production goals. But how to make agriculture contribute again to "holistic" goals?

Sriskandarajah et al (1991) propose to look at farms as "sustainable learning systems in constant coevolution with their environment." The focus should not be on development of new technologies for sustainable farming systems as such, but on helping farmers and rural people to create new learning systems - new ways for them to learn how to create new sets of persistent relationships between themselves and the biophysical and sociocultural environments that surround them.

On creating such learning systems some authors report. Rist (p 23) writes about how the agroecology research programme of AGRUCO, Bolivia, evolved into an interface for intercultural dialogue between the scientific and the indigenous worldview. In this way AGRUCO tries to contribute to social processes, which permit the reaffirmation and innovation of the objectives, perceptions, interests and relations of different stakeholders.

The Center for Holistic Resource Management (Vanderburg p 26-27) developed a learning and testing approach which starts from setting the "holistic goal" instead of being trapped in continuous problem solving.

Bimbao et al (p 28-29) present a method for farmers and other stakeholders to learn about sustainability. By focusing on four indicative criteria: diversity, recycling, biomass production and economic efficiency sustainability can be discussed and plans can be made for improvements.

Conclusion

Challenging new approaches and methods are developed to make research and development more appropriate. Most of the approaches and methods presented in this issue of the ILEIA Newsletter are still very fresh and need further ripening. Still, they indicate new directions. These are only a few examples and, for sure, there must be many more valuable methods. ■

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from frustration to information

Diversity in agroecosystems

Since experimental research on agricultural stations began, over 150 years ago, variations in yield have been observed and, although undesired, they were not viewed with concern. It was not until the beginning of this century that researchers began to bother. The solution to handle this "undesired variation" came from statisticians, who elaborated on the problem of "the error of a mean" and the analysis of variance. This analysis eliminated variation and corresponded well with the desire to control and standardise the environment of agricultural production and to homogenise farm management as much as possible. Also new approaches such as Farming Systems Research and new analytical concepts in conventional agronomy followed this standardisation. Now the debate on the treatment of variation is reopened.

Bart de Steenhuijsen Piters

Evidence exists that within agroecosystems heterogeneity is more likely than homogeneity (de Steenhuijsen Piters & Fresco, 1994). Variation in soil properties and in crop growth may be an asset for farmers (Huxley, 1986). Yield variations therefore have to be considered largely as the result of deliberate and structural human action when confronted with a heterogeneous environment and within a specific cultural and socio-economic context.

This article presents the results of an interdisciplinary study of the Gaban village in northern Cameroon. The sources of yield variations at field and farm household level within one agroecosystem were investigated, combining biophysical, crop genotype and management characteristics of the fields with ethnic and socio-economic characteristics of the households and the farmers. The research team resided for three years in the village and collected data integrating both conventional quantitative and qualitative participatory methods.

The village of Gaban is located in the Far North Province of Cameroon, near Kaélé. The climate is semi-arid (700-800 mm/year) with one rainy season (four to five months). The various processes of soil formation have led to important pedological heterogeneity. Heavy, fertile vertisols are alternated with lighter cambisols and shallow planosols. The vertisols, being concentrated in the lower parts of the watershed, are submerged during most of the rainy season. The natural vegetation is a savanna of shrubs and trees.

The population of Gaban is composed of two ethnic groups: the autochthonous Moundang who settled 200 years ago, and the Toupouri who have arrived recently (since 1970). The village has approximately 3000 inhabitants, distributed over 350 households (an average of ten members, 5 of which are potential workers). The principal economic activities are crop production, but livestock and off-farm activities (beer brewing and trade) are also important. On the lighter cambisols and planisols, rainfed sorghum, cotton, cowpea, groundnut and Bambara groundnuts are grown, often in association. On the heavy vertisols, a transplanted dry season sorghum crop, *mouskouari*, is grown. Flanking the ephemeral streams, fruit trees and cassava plantations are found and irrigated vegetable cultivation is practised. The fallow land and the secondary savanna forest serve as pastures for livestock of local farmers (Moundang and Toupouri) and nomadic pastoralists (Fulbé and Arab nomads).

Diversity and yield variations

Within the village striking variations in yields were observed, not only in yields realised by Toupouri and Moundang farmers, but also between individual Moundang farmers. These variations could not be explained by a conventional analysis of variance. Further interpretation of results learned that yield variation had different explanations, including diverse strategies for optimising agricultural production.

The first difference observed was that Toupouri farmers obtained higher sorghum yields thanMoundang farmers (in 1992 at average 3100 kg/ha versus 2100 kg/ha). This difference in yields could finally be explained by social-cultural practices of the Toupouri farmers. High yields are realised by land and labour intensive cultivation practices (i.e. good timing of practices and intensive crop husbandry). Toupouri farmers have occasionally access to extremely large amounts of labour, due to "working parties" with other Toupouri farmers. In return to this "neighbour help", large sorghum beer parties are organised. The beer parties preserve the semi-collective and highly productive system of sorghum cropping and guarantee a high labour availability. These labour requirements cannot be met by the individual Moundang production system. Besides, it also explains why the dominant sorghum cultivar on Toupouri fields is *gling*, a cultivar which is hardly edible but highly appreciated for beer brewing!

Secondly, it was observed that the rainfed sorghum and cotton yields of individual Moundang farmers showed high variation. This could be explained by defining specific field types, which are distributed in space (see figure 1). However, more important is that field types are not equally distributed between the Moundang households. Resource-rich households, who also own cattle, dominate the nearby fields, situated up to 600 m from the homestead. These nearby fields allow for (semi) intensive, (semi) continuous cultivation of sorghum, which is possible due to large amounts of organic manure, good timing of practices and high labour inputs. However, most land of the resource-poor households is located more than 1 kilometre from the homestead and these soils are more subject to soil fer-

Photo: Bart de Steenhuisen Piters

Yield samples of mouskouari sorghum fields.

tility decline, further enforced by the fact that resource poor households hardly own cattle and thus lack manure. Only extensive sorghum and cotton cultivation in a 1:1 rotation is possible and fallow is needed after four to five years of cultivation.

Also the female farmers of the village turned out not to be a homogeneous group, showing striking variations in yields. The Toupouri female farmers obtained highest sorghum yields of all farmers in the village (at average 3700 kg/ha). This could technically be explained by their extremely high labour input in weeding, but behind this is a cultural reason. Toupouri female farmers have the obligation to feed the family for six months. To facilitate this, a husband gives one field to his wife and helps her with ploughing and sowing. Because the remaining sorghum after six months of family consumption is the only source of income to the female farmer, she will invest all available labour in producing a sorghum surplus. This seems to be economically and agronomically irrational, but makes good sense from the women's point of view.

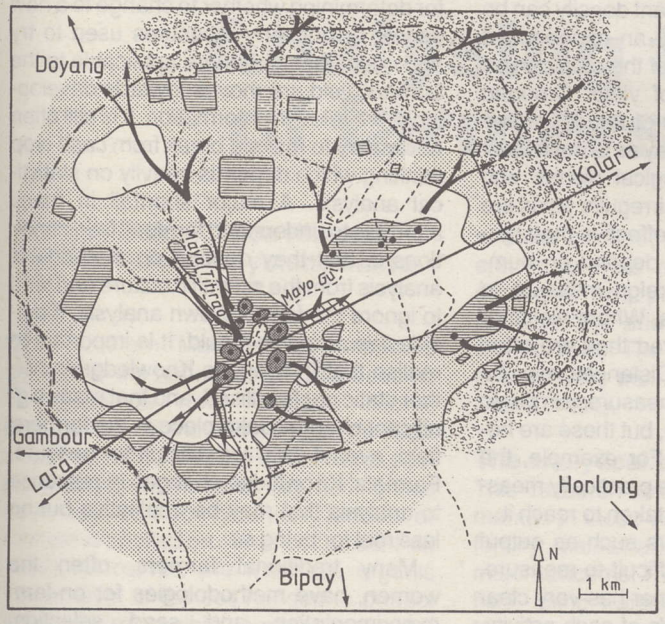
Understanding diversity

It is clear that intensification of sorghum production in the Gaban village cannot be realised by developing one general strategy, but needs different strategies for each group of farmers, coping with different potentials and bottlenecks. This study shows that diversity and variation should be regarded as important sources of information instead of eliminating them from the research. Moreover, within the context of our quest for sustainable agriculture, they might prove to be a good basis for discussion and innovation. Understanding diversity may be the greatest challenge facing agricultural research and extension since the identification of variation at the beginning of this century.

One of the main questions is how to define the "meaningful diversity" of an agroecosystem as an input for research. Not all diversity is functional or desirable, like, for instance, the diversity caused by socio-economic inequality between Moundang farmers. Defining target groups with "fashionable" criteria may be as harmful as any generalist approach. Moreover, who is to define "meaningful diversity"? Participatory methods in which farmers have a voice in their classification are important, but the analytical criteria of the researcher and personal criteria of solidarity and affection of the farmer may result in contrasting classifications. In this discussion also higher level authorities and experts must participate, although a dialogue between these different parties will not always be an easy one.

Ethnicity, socio-economic characteristics and gender are not independent causes of diversity, but are strongly interrelated and sometimes difficult to disentangle. Moreover, farmer diversity may cause diversity of fields and variations in yields, but vice versa the latter may reinforce farmer diversity too. Therefore, diversity in agroecosystems is a complex of interrelated factors covering several scales of aggregation. Further elaboration of this "cross-scale analysis" of agroecosystems is needed.

Research on variation and diversity in agroecosystems differs from conventional agricultural research in the way data are interpreted and to a lesser extent in the use of new methods and techniques. Therefore, major flexibility is demanded of the researcher who must be able to analyse and combine both quantitative and qualitative data and information. Accordingly, it is a question of being conscious of diversity, accepting it as a relevant, realistic phenomenon, rather than a "new approach". ■



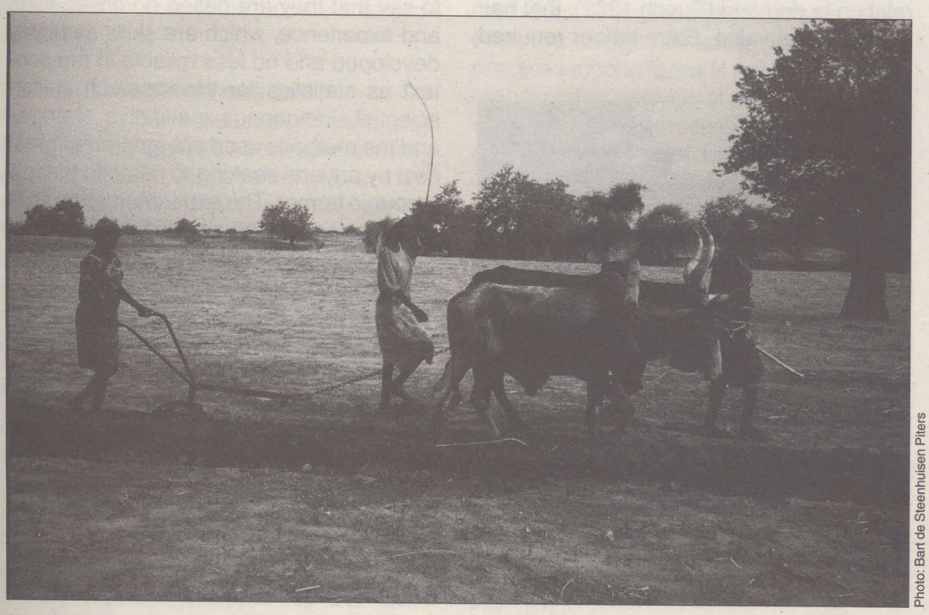


Photo: Bart de Steenhuisen Piters

Moundang female farmers ploughing a field with animal traction.

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The lure of statistics

Most low-external-input agriculture is fundamentally different in nature from the agriculture familiar to researchers. Much of it is associated with food rather than cash crop production and is based upon priorities and objectives very different from the commercial sector. Research for low-external-input systems needs to question some of the assumptions that have dominated cash crop thinking. One of these is the importance of statistics.

Roger W. Sharland

An important factor influencing much research is the professional status given to research and the way that status is maintained (Chambers 1986). It is generally recognised that low resource agriculture does not easily lead to high scientific recognition. The pressure is on researchers to embark on lines of study which will result in the publication of papers of sufficient scientific merit to further their professional career. The papers are written for the scientific world and almost invariably depend on statistics for substantiation. Mixed cropping and other practices associated with food crop systems are very difficult to analyse statistically, despite some complicated statistical methods, reducing their appeal to such researchers.

Magical power of numbers

Statistics are neutral, but can have effects which are not themselves neutral. The orderliness of statistics favours the simplicity of high-input cash crops over the great variability and complexity of most food crop systems. The order of statistics compares well with that obtainable in sole cropping with the precise spacings, timings and dosages so often accompanying cash crops. The innumerable variables that food crop farmers contend with do not lend themselves easily to statistics.

Statistics has a strong influence on agricultural research. It is like a mystical force that has given research stations power. In some cases this power has been maintained by ensuring that the almost magical power of numbers is not questioned. This can thus easily lead to manipulation, whether deliberate or just misguided.

Statistical Analysis is one of the major agricultural tools in what Chambers has termed "Normal Professionalism" or "First Thinking" (Chambers 1986). Normal Professionalism is a term that reflects the forces within a profession which tends to draw all practitioners in the same general directions. In agricultural research this is reflected in the importance given to statistical results, the assumption that crops should be grown in pure stands, so normally line planted with precise spacing. The food crop farmer is seen as "primitive" or just not understandable. It is a force that is strong in most agricultural disciplines, but especially the higher status levels of research. It is certainly stronger than the relationship to people.

Experienced farmer's eye

In traditional societies, although people may be numerate, measurements are not considered as precise a determinant of practice as hard won experience. The experienced farmer determines the state of regeneration of a fallow, for example, not by the number of years it has been fallow, but by the state of the vegetation. The condition of a crop and the plant density can be determined efficiently by an experienced eye so that observation of the crop can be an accurate indicator of yield. Cropped areas are frequently not of regular shape but cultivated in such a way as to make best use of beneficial ecological niches and avoid poor areas. These irregular fields are difficult to measure and effective management of them does not depend on numbers. Weights are a foreign measure to many traditional cultures. Where yields or seed inputs are measured they are often calculated by volume. Distances may be measured using bodily measures similar to the English cubit or pace, but these are frequently not significant. For example, the distance to a field is more practically measured in terms of the time taken to reach it.

Other important factors such as output per unit of labour are difficult to measure, but the experienced farmer has very clear ideas of the labour needs of each activity, survival depending on accurate assessment. Labour itself has different qualities in relation to demand (Bunch 1982), that has no numerical value. Extra labour required at a bottleneck season is of more value than labour needed at a slacker period. All these factors are anathema to the normal professionalism that attributes very high status to statistics and quantitative analysis, but low status to qualitative factors, which actually need far greater skill to use.

Photo: Roger Sharland.

Mixed cropping near Moru homesteads in Sudan - not the easiest fields for statistical analysis.

Analysis and experimentation

Complicated statistical analyses have been developed to analyse very small increments in yield and to determine whether they are significant. This is important for the profits of a commercial farmer dependent on expensive inputs. For the food crop farmer, the yield increment is of no interest unless it is significant enough to be seen. This judgement is quite adequate for determining whether to change to a new variety or not. Any measures used to try and make research more applicable to the farmers' field are moves towards developing more relevant information. It is still often necessary to make a break from cash crop thinking which depends heavily on statistical analysis. A major shortfall in many attempts to understand farmers' field conditions is that they depend on methods of analysis from the scientific culture and tend to ignore the farmers' own analysis, if outside this scientific mould. It is important to realise that Indigenous Knowledge is neither static nor fossilised, and that many significant changes take place in the farmers' field, even if they are difficult to measure. Farmers' Knowledge changes in response to analysis that may be qualitative but no less real for being so.

Many traditional farmers, often the women, have methodologies for on-farm experimentation and seed selection. These sometimes seem to be nebulous ideas of intuition. It would be more correct to say that they are based on observation and experience, which are skills as highly developed and no less reliable in the context as statistics for the research station scientist. Indigenous qualitative changes and the methods used are ignored at great cost by anyone seeking to relate to the low resource farmer. The experimentation itself must be recognised as valid even without statistical support, and may also be regarded as a field of great scientific value. ■

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Visualising the diversity of their strategies allows farmers to evaluate their practices and allows researchers and extensionists to better guide farmers in improving these practices. Monitoring of crucial parameters based on farmers' criteria may further help to finetune extension programmes and policies.

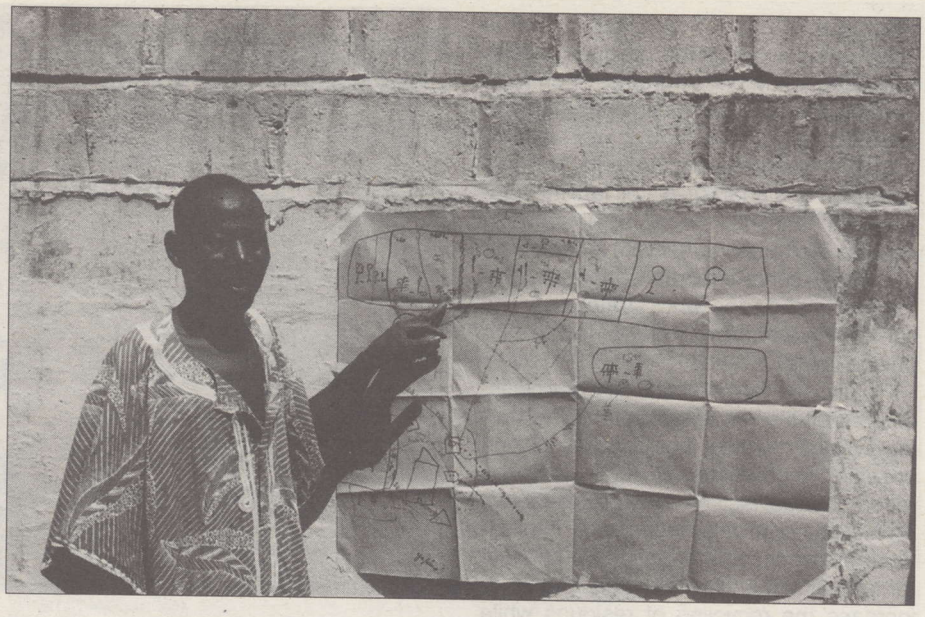

Photo: Thea Hilhorst

Analysing the diversity of farmers' strategies

Toon Defoer, Thea Hilhorst, Salif Kanté, Souleymane Diarra

In Southern Mali, fallow periods to regenerate natural soil fertility become increasingly rare. Although income from cotton (combined with credit facilities), has made fertiliser investments possible, substantial soil fertility mining has been reported since hardly any fertiliser or manure is applied on cereals (Van der Pol, 1992). Moreover, the minimum organic matter level of the soil needed to protect soils from irreversible degradation is actually threatened. Maintenance of soil fertility demands more intensive management strategies to guarantee sustainable productivity.

Flexible research needed

Changes in the production system also increase differences between farming households. The large variation in soil fertility management practices partly reflects the diversity in access to resources such as good quality land, labour, livestock and knowledge (ESPGRN, 1994). Increasing diversity of farming systems places higher demands on research and extension. Technologies proposed as recipes for the "average" farmer become less and less relevant. Therefore, effective tools to analyse the differences between farmers' management practices are urgently needed. Farmers, as resource managers, will have to play a major role in this. A participatory research-action approach has therefore been developed by ESPGRN (Equipe Systèmes de Production et Gestion de Ressources Naturelles). It enables farmers, together with researchers, to analyse and understand farmer strategies and practices of soil fertility management and to identify sustainable technologies. The aim is to guide farmers in improving their practices (Defoer and Diarra, 1994).

The analytical phase

This research-action approach is implemented in those villages that reported soil fertility maintenance to be one of their major concerns. The analytical phase in the field, using Participatory Rural Appraisal techniques, consists of four steps and takes three days. Step one, two and four take place in village meetings, while the third step is implemented at farm level. First, the diversity of fertility management practices among farms is explored through mapping and analysis of present resource use. Then a village map is made by a small group of villagers of both sexes. At the same time farmers' criteria identifying and explaining the diversity of fertility management practices are identified. This is done separately by older farmers, women and younger farmers. Researchers have suggested this division, but in the end, villagers define the groups. After each group has prioritised the criteria, the outcomes are brought together in a list of key criteria.

Secondly, with the help of a number of well-informed farmers a rapid census is done to determine the values of the key criteria for each farm. The name of each household head is written on a separate card. On the back of the card, a value for each key criterion is written.

Then a representative group of farmers is invited to classify all farming households according to the level (quality) of soil fertility management (see box). The farmers decide on the number of classes and their definition. Generally, they create three classes: good, average and bad. The cards are then taken one by one. The names of the household heads are read and farmers decide together in which class the card should go. After being classified, the cards are turned. The values written on the back are compared between farms of the same class and between classes. Discrepancies are intensively discussed. The cards are then placed on the village map. At least two farms are chosen from each class, preferably with clear differences in soil type and key criteria, for farm level discussions the next day. Selection is done by the researchers in consultation with the farmers. The management of women's private fields is also discussed with women of the selected households. These farmers, both men and women, will eventually become "pilot" farmers.

Thirdly, resource flow models are made by the pilot farmers in order to analyse their fertility management practices. After a walk around the farm, the members of the household are asked to draw on a large sheet of paper different farm components such as fields (common and individual), grain and fodder stores, animal pens, compost heaps, etc. The types of soils, acreage, erosion spots and erosion control works are also marked. On each field, both present and preceding crops are marked. Then farmers draw arrows to represent resource flows between fields and other farm units. The utilisation of last year's crop residues of each field is depicted and estimated, which indicates the level of recy-

cling. The number of carts transported is noted and the part of the residues used is estimated using pie diagrams. Then fertiliser (organic and inorganic) application on present crops is visualised as well as other resource flows entering the farm. This visualisation and analysis of soil fertility management and the level of integration enables farmers together with researchers to identify improvements adapted to the farmers' conditions and strategies. The same exercise is done with women on their private fields.

Finally, pilot farmers from different classes present the resource flow models during a village meeting, their conclusions and possible improvements. After that, the researcher/adviser gives some feedback on the concepts and the technical implications of the recommendations proposed, for each of the classes. The aim is to increase the recycling of residues while taking into account the farmer's productive resources and strategies. This presentation aims at stimulating other farmers (of the same classes) to consider similar improvements, taking into account their possibilities and limitations. A separate meeting is organised with the women of the village, and the same discussion is held.

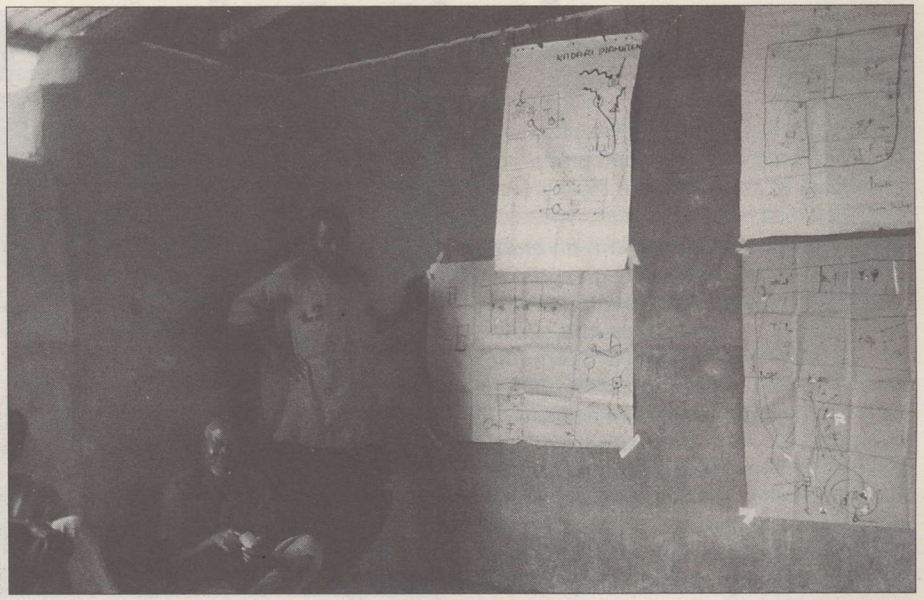

Photo: Thea Hilhorst.

Maps and resource flow models are presented and discussed during a village meeting. This stimulates other farmers to consider similar improvements.

The planning phase

A farmer workshop, exchange visits, and participation in demonstrations are then organised. Farmers are exposed to new technologies and to the experiences of other farmers. Then each pilot household discusses and visualises their plans for the next season. A new resource flow map of their farm is drawn. These individual plans, based on farmers' production objectives and available resources, are intensively discussed between farmers and researchers. Given the emphasis on regular feedback to the entire village, the proposed plans are also presented in a village meeting, followed by a discussion on the technical implications.

The monitoring phase

For research purposes, all information on the maps is transferred through monitoring sheets into a data base (D-base and analysis in SPSS (Statistical Package for Social Sciences)). These data include household characteristics, farm features (crop acreage, soil types, livestock, etc.) and the flow of resources (estimated use of residues, fertiliser, organic matter, etc). Some data such as labour and yield are collected afterwards. Following villagers identification of key criteria determining differences in soil fertility management, crucial parameters towards sustainable management have been selected. These parameters are mainly related to the degree of crop-livestock integration, nutrient recycling and available productive resources. These data enable ESPGRN to monitor changes regarding soil fertility management for the different classes in the test villages and to identify major constraints. Later, this will be translated into a monitoring system for farmers and extensionists.

Some results

Only some results of the different steps of the research-action approach are presented here. For more information on the use and analysis of resource flow maps, the reader is referred to Lightfoot et al. (1994). Criteria to identify differences in soil fertility management are mostly related to the level of resource recycling. The way different groups (older men, women, younger men) reasoned was quite comparable. Their lists are generally complementary although the final prioritisation may differ. According to them, methods to produce organic manure, crop residue use in cattle pens and the amount of compost produced and transported to the fields differ substantially between farms. Also anti-erosion measures and application of recommended chemical fertiliser doses vary greatly between farms. The groups indicated several causes for these differences. Access to productive resources such as family labour, cattle and carts play a major role. Also the need to pay attention to maintenance of soil fertility seems to play a role: farms that have few fallow land available and soils of bad quality are likely to put more emphasis on manure production. Also knowledge, courage, as well as the decision making structure of a household are mentioned (see also Vierstra, 1994). Finally, prices affect soil fertility management as shown by the priority given to cotton.

The reliability of farmers' classification could be analysed by computing the values of the key criteria, obtained through the rapid census. This analysis shows a clear relation between management practices and available resources. In Southern Mali, farmers are thus aware of the management strategies of their colleagues and able to point out the major differences.

The combination of analysis and exposure to information on new technologies motivates farmers to take action. Pilot farmers as well as their neighbours are indeed planning a more intensive use of crop residues. In one test village, half of the farmers have stored considerable amounts of fodder and many new compost pits are made. This happened in a period of six months after the first analysis. An essential element of the approach is the regular feedback of pilot farmers' results and reflections to the village. These group sessions allow for a comparison between farmers with the same resources and objectives and may also result in communal decisions such as limiting the clearing of new fields in sensitive areas, or a more rational use of communal pastures.

The research-action approach allows for the monitoring of changes, their effects and limitations. The parameters used are based on the key criteria selected by the villagers, which facilitates communication between farmers and researchers. This was possible since farmer criteria are in line with researchers criteria for the evaluation of soil fertility management. However, researchers need more precise values, opting for quantification when possible. For farmers, a more general estimation seems to be sufficient for decision making. ESPGRN intends to validate farmers' criteria and to "use" the complementarity with researchers' views and parameters, to guide farmers in improving soil fertility management.

Eventually, this monitoring will result in recommendations to different groups of farmers and the extension service on the most optimal and sustainable use of their resources from an ecological and economi-

cal point of view. Also, the insight gained on farmers'decision making regarding soil fertility management may become relevant for policy makers. It allows for predictions on possible reactions of the different classes of farmers towards new technologies, certain incentives or changes in the macro-economic environment. As such the methodology may also help to bring decision makers and farmers closer together. ■

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Analysis of the classification

Soil fertility management practices per class of farmers

	class I	class II	class III
Compost production	3	0.7	0.3
Litter use	3	0.8	0.4
Erosion control	3	2	1.3
Fertiliser dose applied	1	1	0.8

(figures are averages from values attributed to farms for each class; 3 is the highest value per farm and 0 the lowest; for "fertiliser dose applied": 1 = dose applied and 0: dose not applied).

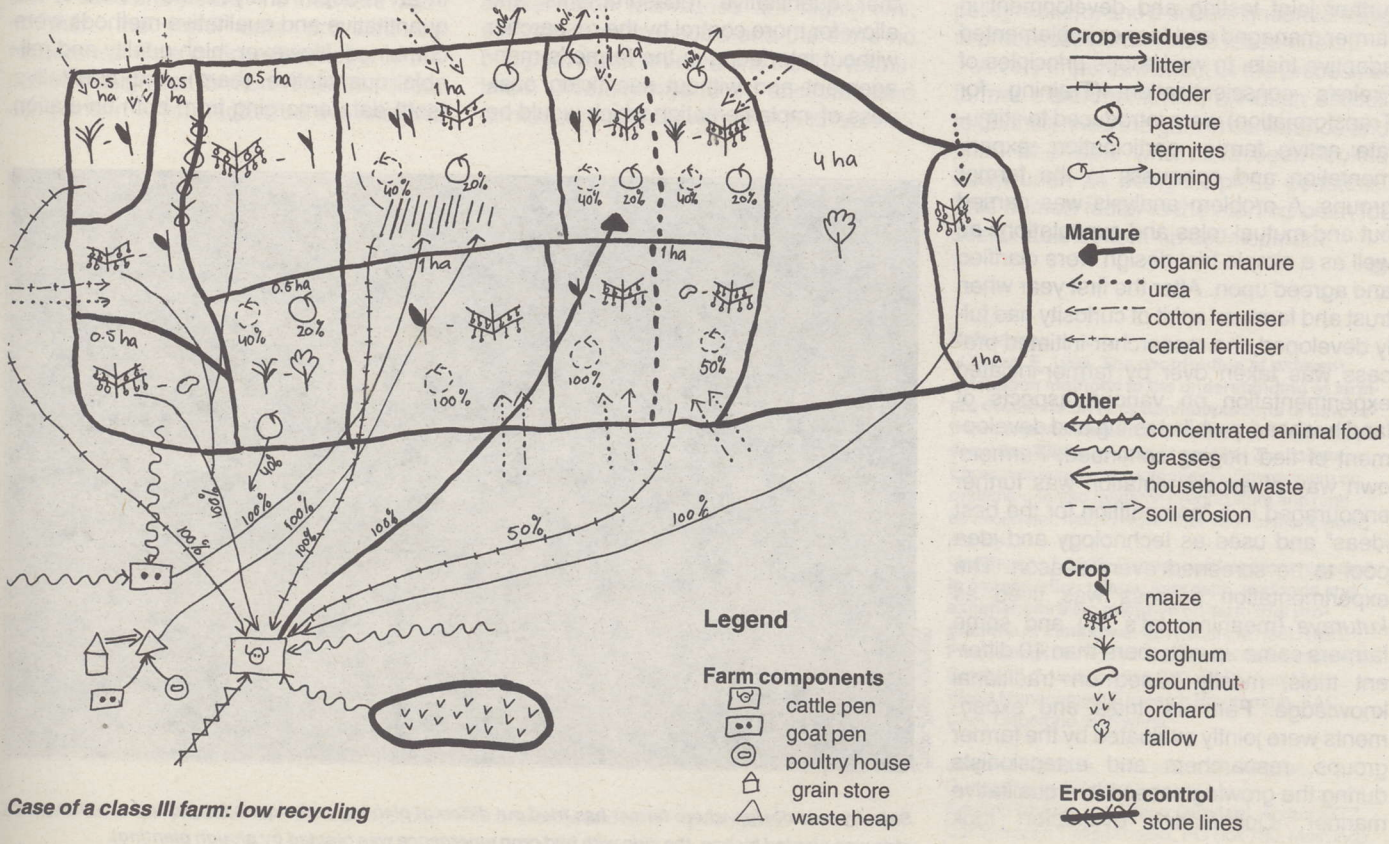
Compost production, litter use and erosion control are substantially higher for farms of class I, compared to class II and III.

Causes of differences in soil fertility management practices per class of farmers

	class I	class II	class III
Cattle (Nb)	25	8	2
Family labour(Nb)	7.4	3.7	1.8
Acreage (Ha)	17.2	8.5	5.0
Cattle/Ha	1.6	1.0	0.5
Ha/family labour	2.4	2.3	3.3
Carts (Nb)	1.2	0.9	0.2

The number of cattle, family labour and the acreage is highest for class I. The number of cattle/ha, an indicator of the acreage that can be manured, is also the highest. The acreage cultivated per family labour of class III is considerable higher than of the other classes; a high acreage/active does not seem to allow a satisfactory soil maintenance and fertility management.

Comparing sub-classes of the good managers: the best ones do not have the highest livestock number, neither the highest number of family labour; farms with high livestock numbers have multiple systems of animal pens and are less effective in producing manure, compared to farms with less livestock. It's possible that in big farms, decision making becomes very complicated, with less "room" for introducing new technologies. The maximum acreage seems to be around 20 ha, above which fertility management becomes less efficient. Finally, other factors are often mentioned as important but are difficult to define: knowledge (training), motivation, courage and internal household organisation.



Case of a class III farm: low recycling

Integrating formal research into a participatory process

The Conservation Tillage Project has been involved in tillage and soil and water conservation research using a combined on-farm and on-station research approach since 1990. The initial objective was to test and develop tillage systems for soil and water conservation for smallholder farmers in Zimbabwe. Quantitative research data were obtained by both the on-station and the on-farm component. Farmer participatory research on-farm also focuses on qualitative aspects in farmers' experimentation, adaptation and adoption process. A major challenge has been the integration of quantitative research into the process of farmer participatory research.

Jürgen Hagmann, Edward Chuma and Oliver Gundani

To build trust between farmers and researchers and to get the research process started, farmers were familiarised with several conservation tillage techniques. These techniques corresponded to their priority need in the semi-arid area, namely water conservation. One technique, tied ridging, was suggested for further joint testing and development in farmer managed and farmer implemented adaptive trials. In workshops principles of Freire's conscientisation (Training for Transformation) were introduced to stimulate active farmer participation, experimentation and openness in the farmer groups. A problem analysis was carried out and mutual roles and expectations as well as a simple trial design were clarified and agreed upon. After the first year when trust and farmers' spirit of curiosity had fully developed, the researcher-initiated process was taken over by farmer-initiated experimentation on various aspects of land husbandry while testing and development of tied ridging continued. Farmers' own way of experimentation was further encouraged in a "competition for the best ideas" and used as technology and idea pool to be screened every season. The experimentation process was titled as *kuturaya* (meaning: let's try) and some farmers came up with more than 10 different trials, mostly based on traditional knowledge. Farmers' trials and experiments were jointly evaluated by the farmer groups, researchers and extensionists during the growing season in a qualitative manner. Quantitative evaluation took place in feedback and planning meetings after the results had been analysed. As many farmer-initiated trials and ideas showed high potential but did not allow a quantitative comparison, they were jointly screened for either further testing and development using the simple paired design, for further testing on the research station or for promotion if the idea was extremely successful and clear.

Integrating formal research

To evaluate the performance of the tested techniques it was necessary to understand the processes determining their performance using a combined analysis of several methods. The following methods are applied:

- The core method for the researcher-driven quantitative technical evaluation is a simple paired treatment design where the traditional practice as control plot is right next to the improved technique in the same field. After explaining the basic principles of comparison (e.g. for tillage: same planting date, same population, same fertilisation rates) farmers manage their trial field and observe the performance of the two treatments.
- Check plot pairs which are close together in order to avoid high variability in soils and fertility are marked by the researchers. These check plots are used for further quantitative measurements and allow for more control by the researcher without interfering in the farmer's management and without sacrificing easiness of implementation which would be the case in completely randomised block designs. Results are analysed on the basis of the relative performance of the improved technique in comparison with the traditional technique. For statistical analysis each farmer's field is considered as a randomised block with five replicates. (See figure 1).
- Qualitative observations are made and informal discussions are held with farmers during weekly visits. This tool has proved to be the most successful method to monitor the farmer's trial management and adaptations. The continuous, long-term interaction with individual farm families revealed how farmers' rationale and attitude towards technologies are influenced by the coping strategies within their livelihood system. It also revealed that farming circumstances are highly diverse. They vary between families and are dynamic within families.
- Joint evaluation tours with sharing experiences and results in group discussions among farmers revealed farmers' understanding of the techniques and processes and provided information on implementation.
- Formal questionnaire surveys are used to learn about the attitudes of participating and non-participating farmers towards certain techniques.

Hard and soft data contradict

In an in-depth analysis the results of the quantitative and qualitative methods were combined. However, high quality and reliable quantitative (hard) and qualitative (soft) data emerging from both on-station

Photo: Jürgen Hagmann

Side by side design where farmer has tried out different planting techniques for groundnuts (the good side was planted by hoe, the side with bad crop emergence was planted by plough planting).

and on-farm research were often contradictory. Tied ridging, for example, yielded significantly lower than the conventional practice on-station whereas on-farm this technique improved yields significantly. Factors like variability of soils, fertilisation and farmers' management practices greatly influenced the performance of the technique. The performance of tied ridging varied also highly between farmers and the statistical analysis of the hard data collected on-farm showed that the farmer was always a significant actor in terms of e.g. yield and labour requirements. Farmers' management practices were the overriding factor which determined the failure or success of the technique.

The diversity of results forced farmers and researchers to analyse the underlying factors and processes influencing the performance. Only farmers' qualitative analysis monitored through informal observations and discussions and in joint evaluation tours can explain the variety in hard data and help to understand the processes. Numerous farmer techniques, ideas and modifications from farmers' evaluation based on soft data were taken to the research station to be quantified under controlled conditions and to understand the processes and interaction between various factors in more detail. During workshops and "look and learn" visits to the research station which became a "think tank for technology options", these hard data were again fed back to farmers who commented and explained the causes and effects from their perspective. In general, however, farmers' evaluation of technologies valued qualitative criteria like risk and labour distribution or simple criteria like size of cobs and yield of the total field higher than the hard data provided by researches. The major advantage of the paired design for farmers was the direct comparison which facilitated the analysis

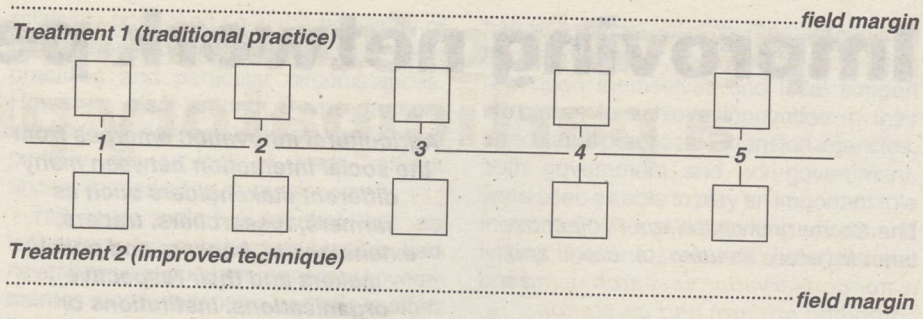


Figure 1: Paired treatment design with 5 plot pairs.

and understanding of processes (learning by experimenting).

Qualitative data essential

Without the qualitative socio-economic and socio-cultural data gained through informal observations and discussions the formal surveys could not have been interpreted meaningfully. Based on our experience, we can say that a combination of quantitative and qualitative methods to evaluate results of farmer experimentation and research is the basis for meaningful technology development and spreading. Qualitative data and evaluation contribute more to the understanding of diversity and should be taken as the basis for quantification. Topics arising from qualitative assessment forced us to broaden the scope of the project as we were driven by the farmers' perspective of their farming system with the relevant problems.

Dealing with diversity

Analysing the variety of hard data led to the conclusion that tillage and soil and water conservation techniques are highly site, soil and farmer specific and therefore no blueprint recommendations can be formulated. Diversity has to be accepted and farmer participatory research and technology development must be geared towards the development of a matrix of interactions between factors influencing the performance of such techniques. For promotion and extension, instead of teaching techniques, technical options, this matrix and the processes should be explained. Farmers should be encouraged to experiment with technical options using their conventional practice as control plot. The process of experimentation serves farmers, extensionists and researchers as a tool to gain experience-based knowledge on processes and site and farmer specific adaptations required to improve production. Extension based on farmer experimentation and sharing of knowledge among farmers would lead to more farmer-to-farmer extension.

Conclusion

The integration of formal research into the participatory technology development process enabled both farmers and researchers to jointly develop technologies and have the benefits in terms of data (researchers and policy makers) and a deeper understanding of processes (farmers and researchers).

A very important effect of the process of farmer experimentation, although difficult to quantify, was the gain in confidence and pride of people who have been looked down upon as being helpless peasants. This human factor is the starting point for sustainable bottom-up development. ■

Photo: Jürgen Hagmann

Farmer and his son proud of their innovation, a new way of making and watering compost.

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Improving network performance

Agricultural innovation emerges from the social interaction between many different stakeholders such as farmers, researchers, traders, extensionists, bankers and policy makers and their respective organisations, institutions or agencies. They all try to improve what they are doing continuously. Of course, each of them looks at agricultural development from a very different angle and as a consequence, has very different purposes in mind. Yet their social interaction determines to a large extent what type of technological development will eventually be achieved. To develop sustainable forms of agriculture, therefore, technology development is not enough. We have to address the interaction between relevant stakeholders as well.

Paul G.H. Engel

Evidence shows that farmers are not only active experimenters, they are active networkers as well (e.g. Alders et al., 1993). But also NGOs, researchers, agro-industries, policy makers and traders actively seek relationships with others to exchange knowledge, information and experiences and to build alliances to develop and implement new ways of doing things. We call such efforts networking. Networks are more or less formal, more or less durable relational patterns that emerge as a result. They form part of what we might call the social organisation of innovation.

Traditionally, extension is concerned with interaction between researchers and farmers mostly. Traditional extension sees itself as an intermediary between the two. From a networking perspective, quite a different understanding of extension emerges. Research-extension-farmer links become just one subset of linkages relevant to agricultural innovation and, under many circumstances, not even the most important one. Linkages between farmers themselves, between farmers and traders or between farmers and local authorities might turn out to be much more relevant to fostering sustainable development. Particularly when, as is increasingly the case, government research has very little to offer to support, for example, small producers. In such cases, extension should focus its efforts on fostering those linkages instead of sticking to its traditional role.

Facilitating interaction

Moreover, when we talk about sustainable agricultural development, no clear universal solutions exist. Solutions are to be developed locally, building on mutually agreed principles rather than recipes. An extension service can therefore no longer be seen as a "channel" that transfers technical solutions from those who know to those who do not. Instead of being preoccupied with particular solutions, extension should focus on facilitating interaction. In other words, it should occupy itself with the process rather than the product of agricultural innovation.

RAAKS

Rapid (or Relaxed) Appraisal of Agricultural Knowledge Systems (RAAKS) is a participatory action-research methodology to improve networking among people and organisations relevant to agricultural innovation. It helps stakeholders in agricultural development to ask and discuss among themselves questions related to the effectiveness of their networking efforts. In order to obtain new ideas and insights, do we relate to the right people? Do we make use of the sources of knowledge and information in our own community well enough? Do we ever speak to people who look at agricultural production from a really different angle? What could be done to communicate with researchers more effectively? In fact, all of us network, but when do we really assess how well we are doing, what barriers block progress and what can be done about them?

RAAKS has been designed and developed at the Communication and Innovation Studies Department of the Agricultural University of Wageningen, the Netherlands, as part of its Agricultural Knowledge and Information Systems Research Programme (Engel, 1995). It helps stakeholders to formulate what type of innovation they want, to look critically at the way they are organised to achieve it and it helps them to formulate specific measures to overcome constraints or grasp opportunities. RAAKS offers a combination of different analytical perspectives to stimulate reflection and debate and a procedure for organising team work and stakeholder participation. A joint reflection on current networking behaviour and a debate of possible measures to improve it are central ingredients.

RAAKS is *not* an extension approach, although it may help extension agencies to develop more effective strategies and extensionists to become more effective network facilitators.

Put to practice

The EEC-sponsored PRIAG Basic Grains programme of six Central American countries aims at improving the relevance and impact of research and extension for small grain producers. RAAKS was used as an instrument to generate recommendations for action. Teams were selected and trained to perform RAAKS exercises in selected grain growing regions (Engel, 1995). One of the issues brought up by the analysis was the importance of understanding diversity in the social organisa-

Photo: Bertus Haverkort.

tion for innovation: different categories of producers are served by different networks. Of course, industrial farmers obtain their knowledge and know-how in a different way than subsistence farmers do. However, as the Central American cases indicate, the same holds true when comparing 100% subsistence farmers (let's call these A-type farmers) with subsistence producers who also sell part of their produce on the market (B-type farmers). As a result, the problems faced by these two subcategories of producers vary widely and the approaches towards supporting them should as well.

Mapping information channels

In fact, A-type farmers had generally not been considered as beneficiaries of research and extension programmes at all. Technical packages had never been developed to fit their needs and information reaches them mostly indirectly, through contacts with B-type farmers or sometimes local traders. These in turn receive most of their information through representatives of private multinational companies who sell inputs and/or services. Public institutions often play a secondary role in providing grain farmers with technical recommendations. Therefore, particularly among A-type farmers, knowledge on basic issues like e.g. improved varieties and their adaptation, integrated pest management, cultivation methods is relatively poor. And so is the familiarity of researchers and extensionists with their practices and particular circumstances. However, also among B-type farmers adoption of improved technologies is often partially due to lack of credit, difficult access to marketing channels, etc.

The team further concluded that, as technology for subsistence farmers had never been an important concern of government research, extension had little to offer. It would be better for these farmers to rely on other sources of knowledge, information and experiences, like, for example, farmers from nearby regions, non-governmental organisations or professionals working with local authorities. Moreover, the teams underlined the lack of coordination or even disarticulation between public, private and non-governmental institutions with respect to supporting small grain producers.

Capacity building

As a result of this exercise, recommendations were formulated by the teams in close collaboration with the stakeholders in the respective regions. These recommendations provided answers to the question: What can be done to support small grainproducers more effectively? Of course, for each region the recommendations were completely different. They ranged from re-orienting research and extension policies, to establishing documentation and information centres, to (re)activating a number of inter-institutional coordinating mechanisms, to stimulating farmer study clubs. The authorities were asked to invest in capacity building rather than direct technical support to farmers. A general tendency in the recommendations was to recognise on the one hand the withdrawal of government services and, on the other, the need for farmers to rely upon themselves and local support structures to achieve innovation in their agricultural practices. Extension agencies, both government and non-government, were seen as able to play an important role in promoting local networking efforts and linking these to relevant (inter)national ones.

Reaching out

Networking requires courage, knowledge, skills and appropriate instruments. It requires "daring to share" (cf. Alders et al., 1993). To invest in relationships with others means reaching out, actively searching for different views, unknown practices, taking serious even what cannot (yet) be unexplained. This takes courage. It also takes knowledge and skills to know where to look, whom to contact, how to communicate and how to learn from it. Networking does not provide us with ready-made solutions, it requires stakeholders to transcend the boundaries of their own (professional) practices, to draw out their own lessons and to develop their own practical applications of what they learned. This process can be helped when adequate conditions are created. In my view, the task of governmental or non-governmental agencies which support sustainable agricultural development is to help create such conditions.

RAAKS offers stakeholders an instrument to evaluate their joint performance in this respect. It helps them to reflect critically upon the way they are interacting and to improve their networking if necessary. Moreover, RAAKS fieldwork and training has proved successful in helping professionals to develop a more systematic understanding of networking for innovation, of its relevance to achieving meaningful change, and it has permitted a sharpening of their analytical skills with respect to the social organisation of innovation in practical situations (Engel, 1995). ■

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Farmer-research-extension linkages are the only road to innovation. Farmer networks play an important role as well.

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.

Niek van Duivenbooden

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.

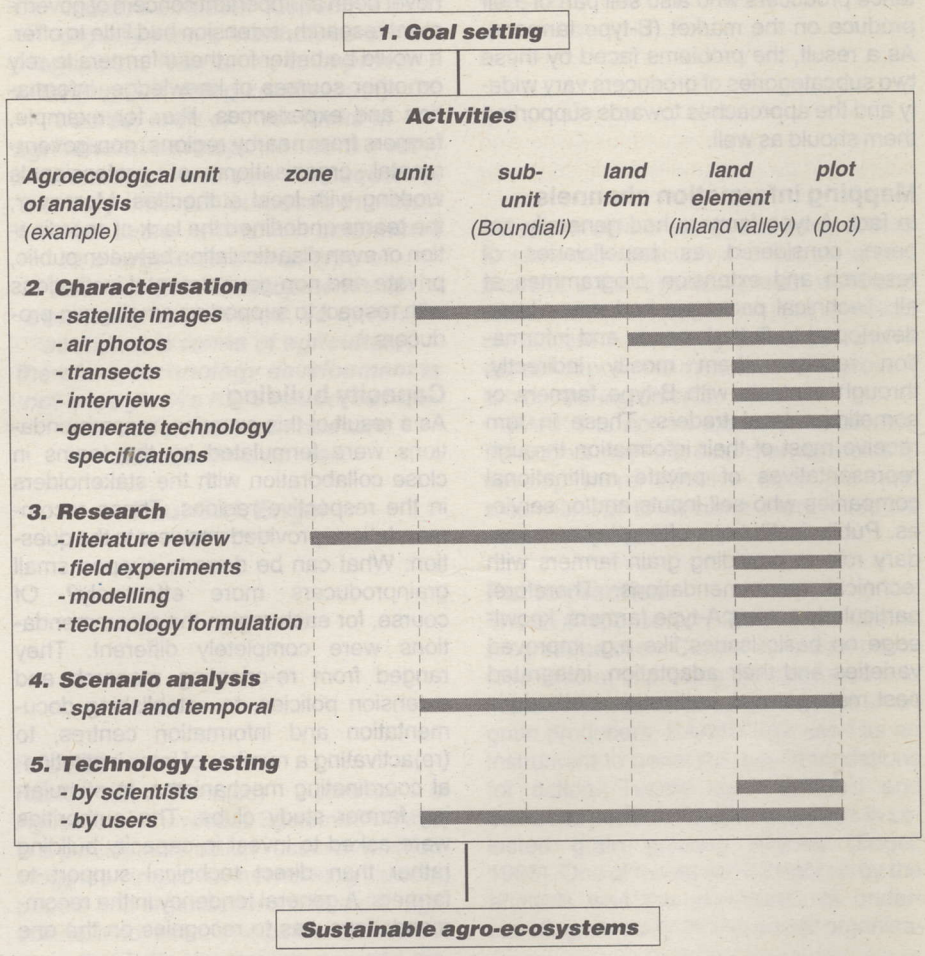


Figure 1. Simplified diagram of activities within Land Use Systems Analysis and their degree of detail (van Duivenbooden, 1995).

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 landuse 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

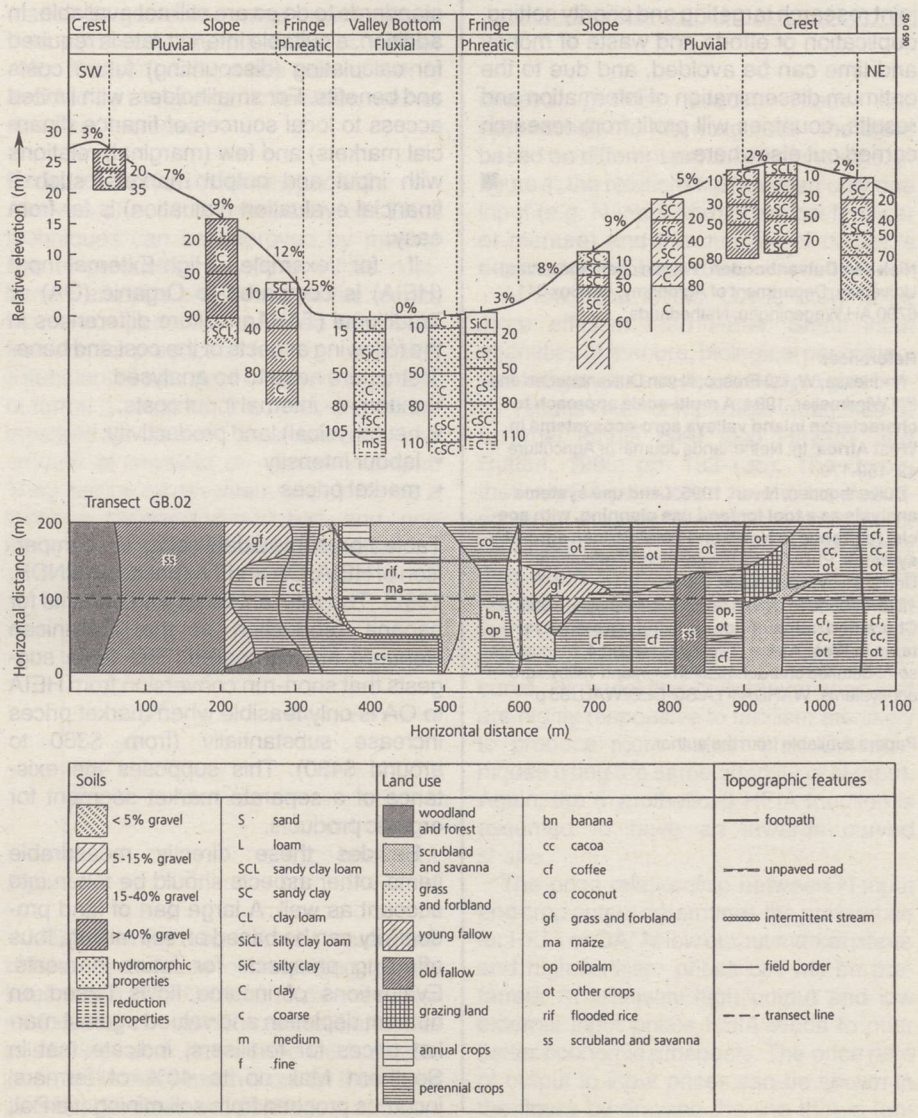
LUSA has only recently been developed on paper and a few projects have been evaluated according to these new concepts resulting in a number of recommendations (van Duivenbooden, 1995). For instance, much more attention is to be paid to the formulation of common goals of researchers, farmers and landuse 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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Economic evaluation

In the ILEIA Newsletter a broad number of relevant practical experiences in making farming systems "sustainable" at farmers' level are reported. The economic appraisal of these practices, however, receives relatively minor attention, while costs and benefits are not always clearly identified. Also, a positive cost-benefit relation does not mean that adoption is feasible for all types of farmers. Therefore, methods are required that permit the appraisal of different technical options from the viewpoint of farmer economy. However, suitable methods for economic appraisal of sustainable agriculture are still little developed. Moreover, guidelines for economic policies that may enhance farmers to adopt LEISA practices are not readily available. In this article the appropriateness of some basic tools for economic appraisal are discussed.

Ruerd Ruben and Nico Heerink

Quantitative assessment of the attractiveness of production techniques is usually realised within a cost-benefit framework. Private or financial cost-benefit evaluation uses market prices to value inputs and outputs. With appropriate policies to correct for market imperfections, environmental off-site effects could also be incorporated into input costs or output price, but acceptable standards to do so are still not available. In addition, a suitable interest rate is required for calculating (discounting) future costs and benefits. For smallholders with limited access to local sources of finance (financial markets) and few (marginal) relations with input and output markets, such a financial evaluation (valuation) is far from easy.

If, for example, High-External-Input (HEIA) is compared to Organic (OA) or Traditional (TA) Agriculture differences in the following aspects of the cost and benefit structure need to be analysed:

- external - internal input costs;
- net (physical) land productivity;
- labour intensity
- market prices

Table 1 presents a data set for the comparison of HEIA, OA and TA (based on UNDP, 1992). The relevant costs and benefits for banana production in the Dominican Republic are compared. The table suggests that short-run conversion from HEIA to OA is only feasible when market prices increase substantially (from $330 to around $430). This supposes the existence of a separate market segment for organic products.

Besides these directly measurable items, other aspects should be taken into account as well. A large part of land productivity can be based on soil mining, thus affecting prospects for future harvests. Evaluations of income flows based on nutrient depletion and valued against market prices for fertilisers, indicate that in Southern Mali up to 40% of farmers' incomes proceed from soil mining (vd Pol, 1992). These benefits will decrease in time and should be taken into account within a multi-year framework. Sometimes environmental (repair) costs are included in the cost price, but this procedure generally will depress production and is not warranted as long as producers decisions are based on real market prices.

The data presented in table 1 indicate that, in these cases, physical labour productivity (measured in kg/man-day) in OA

Table 1
Financial comparison of banana production in HEIA, OA and TA

Parameter	HEIA	OA	TA
Production (tons)	36	29	16
Fertilizer input			
N (kg)	400	-	-
P (kg)	100	-	-
K (kg)	400	-	-
Compost (ton)	-	2	-
Manure (ton)	-	58	-
Input costs (US$/ha)			
NPK	602	-	-
Manure/compost	-	462	-
Pesticides	110	-	-
Labour input			
man-days	321	468	156
costs (US$/ha)	1030	1503	501
labour productivity (kg/man-day)	112	62	103
Total Costs (US$/ha)	1741	1965	657
Gross Income			
at market prices[1]	11880	9570	5280
at modified prices[2]	11880	12470	6880
Net Income			
at market price	10139	7605	4623
at modified prices	10139	10505	6223

Source: UNDP, 1992.
Notes:
[1] Market prices are US$ 330/ton;
[2] modified prices offer a premium of US$ 430/ton.

# of LEISA farming

production is far behind the levels reached in HEIA as well as TA production due to higher labour input for weeding and manuring.

The actual income from land and labour resources can also be higher or lower than the income obtained if they would have been used in another way (alternative use value). Where off-farm employment is an important additional income source, the organic farmer has less and the traditional farmer has more time left for this activity when compared to the HEIA farmer. Depending on the relative price payed for off-farm labour this can favour development of organic farming or can be a constraint. The same reasoning is valid for land resources.

Economic evaluation

For farmers, financial costs and benefits are not the only relevant parameters for selecting techniques, as profit maximisation is usually not the ultimate goal. Other less tangible economic benefits that should be valued include the reduction of risk, less dependence on markets to guarantee household food security, reduced credit demand and several cultural gains. Sustainable land use is not always an explicit priority at farm level and has to be made consistent with other household objectives. A composite index of household utility could be derived, in order to evaluate the possible acceptance of alternative techniques by farmers. Food security, risk avoidance, access to a range of services (education, health) and especially leisure contribute to utility. But readily available procedures to account for these additional factors are more difficult to find.

The assessment of risk is based on reduced yield variance due to, for example, improved soil management (soil moisture and organic matter content). Moreover, price risk depends among others, on the coincidence of harvest time (yield co-variance) among farmers in the same region. Small farmers are considered to be risk-aversive, thus willing to sacrifice part of their income for risk diversification. This trade-off should be included into the cost-benefit framework.

Pricing procedures also directly affect the results of financial evaluation. Production for home consumption could be valued at higher prices, if e.g. alternatives are absent on the local market. The cost of labour proves to be a very debatable issue. For on-farm labour a reservation wage can be determined as a kind of minimum remuneration required to mobilise labour resources for a particular type of work. Otherwise also leisure time has to be valued, as it clearly contributes to household utility. In case additional labour demands are met with family labour, leisure decreases. This may be compensated by relying on hired labour. This often means that more produce is sold on the market (to guarantee wage payment) and thus reinforces the influence of market risks. Consequently, while natural risk is avoided by using organic fertiliser, market risks may increase.

Photo: Bertus Haverkort

Better access to inputs and improved market infrastructures will lead to more favourable prices and thus farmers will be induced to produce for the market.

Production function approach

Analysis of economic feasibility of LEISA techniques can be improved by making use of production functions. While cost-benefit analysis only offers partial results from a comparison of a limited number of farmers, for production function estimates a substantial data set from a wider number of farms is required. Production functions measure for different input quantities the amount of physical or monetary output. They can be represented graphically as a function between production and one input, keeping all other inputs constant.

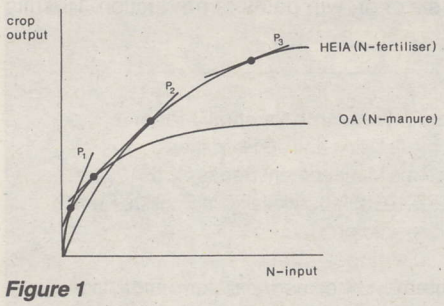

Figure 1

HEIA and OA use different inputs and different techniques for producing agricultural output. The OA approach emphasises the use of organic manure, biological pesticides and home-produced seeds, while HEIA relies much more on the use of chemical fertiliser and pesticides, and purchased (hybrid) seeds. These two approaches to farming are therefore based on different production functions. In figure 1, the relationship between only one input (e.g. N-input from chemical fertiliser or manure) and the quantity of output is depicted for HEIA and OA.

At low input levels, OA is likely to be more efficient than HEIA. Small input quantities of manure, biological pesticides, and indigenous seeds are likely to give better results than comparable quantities of external inputs (see also Hayami and Ruttan, 1985: pp. 133-136). The (hypothetical) OA production function is depicted as an inwards curved line, because of the law of diminishing returns which states that when increasing amounts of inputs are being used additional output per unit input will decrease. At a certain point, the OA curve will intersect with the HEIA-curve. High-yielding (hybrid) varieties that are highly responsive to fertiliser are likely to produce more output than OA-techniques using the same quantity of N-input. Again, the (hypothetical) HEIA function is assumed to have an inwards curved shape.

The price relationship between N-input and crop output determines the preference for HEIA or OA. At low output market prices and high fertiliser prices OA will be preferred. At relatively high output and low external input prices HEIA tends to offer better economic prospects. The price ratio of output to input prices can be shown in the figure by drawing the line that is tan-

gent to the curve. When the ratio of input to output price is high (p1), the angle between the line and the x-axis is large and OA will give the highest profit. When the ratio of input to output price declines (p2), the angle becomes smaller. For one price ratio, the line that is tangent to the OA curve is also tangent to the HEIA curve (marginal output equals marginal input for both techniques). When the price ratio declines further, HEIA becomes more profitable than OA.

The shapes of the production functions may vary for different soil types. On deep fertile, well drained soils with less acidification risks the production function will assume a more steep form, as there is a greater crop response to N-fertiliser input. Therefore, the point where the same line is tangent to both the OA and the HEIA production function will be located more to the left (i.e. at a lower input level) and at a higher level of output per hectare. This explains why OA techniques are assumed to be used mostly in less favourable conditions, mainly to increase soil buffer capacity.

Markets

Market prices and conditions directly influence the feasibility of market oriented production systems. Improvements in (transport) infrastructure, information availability, access to credit and other improvements in the functioning of markets will usually reduce the costs of purchasing inputs and increase the farm gate price received for crop output. When prices become favourable small farmers producing mainly for self-sufficiency will be induced to produce for the market and - after the input-output price ratio has passed a certain critical level - to adopt high external input production techniques. Therefore, agriculture which uses mainly internal inputs tends to be restricted to an environment with low market development and in the long term its opportunities to improve its economic performance may belimited (Leegte, 1994).

Decisions on land use and resource allocation may be influenced by the government through agrarian policies that modify the economic environment and thus the outcome of the production process. For example, the above picture may change when prices of important external inputs are such that they reflect external environmental costs. The incorporation of environmental costs related to high chemical input use will raise the ratio of input to output prices for high external input agriculture. As a result, its profitability declines and organic fertilisers and biopesticides are likely to be preferred by more farmers.

Another way of promoting OA is to increase the price of products produced by using OA techniques. The example given in table 1 indicates that a price increase of at least 30% is required to enable profitable production with OA techniques. Such a price premium can be reached only after a period of adjustment, when the organic nature of the product can be certified and marketing channels are established to specialised wholesalers and retailers. Financing mechanisms are to be defined that permit the coverage of lower net benefits during this transitional period.

Conclusion

Introduction of OA practices means a fundamental change in input requirements and will be accompanied by changes in land and labour productivity. Prices of inputs and outputs determine to a large extent the economic feasibility of OA. Small farmers with limited land resources will give priority to high land productivity at lowest possible risk. Moreover, the effects of different production techniques on labour demand and internal division of labour should be taken into account. If OA requires more labour, the sacrifice of farm households in terms of leisure or external wage income may limit its adoption.

Economic comparison of different approaches to farming could be reinforced by making use of a production function approach. Alternative production systems can be compared if they produce similar output while production takes place with different combinations of inputs. External effects can be taken into account (by looking at the joint output), while the long-term impact on soil structure requires an analysis of growth paths of production. Results are especially useful for the analysis of effects of price policies and to orientate rural extension and technology appraisal.

The ratio of input to output prices determines the feasibility of each production technique. High external input prices compared to market prices tend to favour OA, but rising output prices will again promote a shift to HEIA. Therefore, different types of farmers can select specific production techniques as most profitable, depending on their resource availability (soil quality, land tenure, labour availability) and the effective prices they meet.

Empirical analyses of the economic rationality of LEISA and OA are urgently needed. They should be based on empirical data sets describing farmers' behaviour. Detailed registration and analysis of input use and output level, their prices and relative scarcity, and the impact on labour use will offer valuable insights into the conditions that could favour HEISA or LEISA. ■

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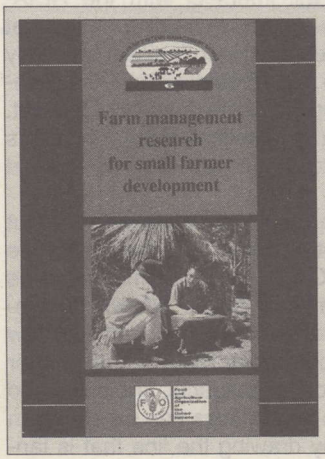

Farm management research for small farmer development by JL Dillon and JB Hardaker.
FAO Farm Systems Management Series No 6, 1993.
302 p. ISBN 92-5-103305-6. Available in English, French and Spanish.

A classical publication on conventional farm and village level economic assessment of smallholder agriculture in developing countries. The book has recently been updated with new methodologies developed in Farming Systems Research, Rapid Rural Appraisal and Policy Analysis. Use of computers in data analysis is included too. Participation of farmers in economic assessment is not yet considered. (CR)

Indigenous Economics: a different rationale

More and more scientists now accept that farmers' indigenous technical knowledge plays an important role in deciding about agricultural innovations. However, when farmers assess new activities they do not consider technical criteria only. Rural people's economic decisions are also determined by their specific social and cultural context. The considerations of farmers in making choices on production, exchange and consumption can be called indigenous economics. Development workers need to acquire knowledge about the indigenous economics of the society in which they work, if they want to understand the priorities and constraints of the people involved.

Jacqueline Vel

From 1984 to 1990 I worked for the Christian Church of Sumba in their project for rural development PROPELMAS. Sumba is one of Indonesia's most isolated and poor islands. Gross Domestic Product per inhabitant is less than 50 dollars annually. The island is sparsely populated. The landscape is dominated by rolling limestone hills, dry and barren in the eastern part of the island, and covered with grass and shrubs in the middle and western part. PROPELMAS is located in the middle part. The rainy season lasts for about seven months, with average rainfall of about 1500 mm annually.

The rural population makes a living of a combination of dryland farming, rice cultivation on fields at the bottom of the valleys and extensive animal husbandry. Dryland farming mainly follows local traditions, using no external inputs at all. For recently introduced crops, partly grown as cash crop and partly for home consumption, some external inputs are used, such as improved seeds and pesticides. In rice cultivation use of external inputs is also very limited, since Sumbanese farmers prefer to spend the money they have on school fees or hospital treatment rather than use it to buy fertiliser or insecticide.

PROPELMAS aims to stimulate sustainable development in its broadest sense. Local people's priorities are to produce a sufficient amount of food for subsistence all year round, to keep up with social and religious obligations, and to earn money to be able to pay for the increasing amount of expenditures for tax, education, transport, health care and also modern household requirements. Sustainable agricultural development in this context includes soil conservation and increasing the production level without using external (chemical) inputs.

Farmers' rationale

Increasing agricultural production to obtain more food and money involves a change. What are the ecological, social, religious, technical and economic constraints in increasing agricultural production? Assessing the potential for change and the feasibility of alternative ways of production can be done by (outside) experts, economists or agronomists, who either concentrate on the effects on farmers' income or on a agro-technical input-output ratio. But what considerations do farmers themselves have if they think about changing agricultural practices or adopting new activities? To be able to answer these questions it is necessary to understand the existing local economy. The economy comprises all activities concerning production, distribution and consumption of material goods and the way in which these activities are organised. The following examples illustrate the rationale behind Sumbanese indigenous economy, and how it differs from western (economic text book) ideas on economics. The first example shows how value is attributed to resources which are important in agricultural production. The second example addresses the issue whether farmers are free to change their way of farming according to their own wishes.

The value of buffalos

I was confronted with the Sumbanese way of attributing value to buffalos when I attended a funeral for the first time. On the day of the funeral, processions of relatives enter the settlement from all directions. Some groups carry large pigs, others bring decorated buffalos. Two or three pigs are slaughtered immediately to provide the guests with a fine meal. At the first funeral I attended I witnessed (to my utmost horror) the slaughter of 25 large buffalos at the end of the ceremony. What a loss! Buffalos are very important in the indigenous economy of Sumba. In rice cultivation herds of buffalo are used to prepare the soil by trampling. Not every farmer owns buffaloes. Those without buffalos participate in working groups connected to a herd of buffalo owned by other people to get their fields trampled. Off-season, group members take turns in herding the buffalos, during the working season they work together in the rice fields, cultivating both their own field and those of the buffalo owners. Buffalos are also the major constituent of a bride price. They are never slaughtered just because people want to eat meat. The Sumbanese would consider that a shameless act and a total loss. Only for very special and urgent purposes it would be acceptable to sell a buffalo, eg. to pay for university fees or an operation in hospital. So a buffalo has many values on Sumba: a social value, an agricultural value and a market value. Yet, it can be slaughtered at a funeral without force or regret because of its religious value. Slaughtering is believed

Photo: Jacqueline Vel

I witnessed the slaughter of 25 large buffalos at a funeral. This has a religious value: it allows the buffalo pass from this world to the world of the deceased.

to allow the buffalo pass from this world to the world of the deceased. The deceased ancestors, *marapu*, are powerful because they are the intermediaries between god and the living. They control people's fate and if they are not respected properly, they will cause disease and misfortune. If one firmly believes in *marapu*, then slaughtering buffalos is not a shameless act of capital destruction, but a logical, even rational, contribution to the welfare of the family.

Who decides on change?

Who decides what is to be done with the family's buffalo? Who decides to start a new agricultural activity? These questions address the way in which the indigenous economy is organised. On Sumba, this organisation is traditionally very hierarchical. Within clans the oldest generation of men have the power to decide on land allocation, labour use and livestock. Social status also plays a role in this hierarchy, with the noble lords at the top and the slaves at the bottom. As a consequence, even at present, no household can completely decide for themselves what they do, how they make a living. There is at least a mutual dependency. A traditional pattern of dependency relations exists between old people who own land and buffalos, but are no longer capable to work their land and care for their animals, and young people who do not own land and buffalos, but are willing to work for others.

Recently a third party entered this pattern: the urban officials, who can provide rural people with money. The indigenous economy of rural Sumba has always been an in-kind-economy (Vel, 1994). Exchanges are numerous, of various types and they take place in different exchange circuits. However, exchanges for money -selling and buying- were confined to rare cases of trade with strangers. Even today most exchanges are in kind. Yet, all Sumbanese require money now. One would expect that they would think about producing surplus to sell on the market. Of course this happens, but to the Sumbanese an even more logical way to get money is to seek good relationships with people who earn a salary. In exchange for often unspecified services the person with a monetary income gives part of his salary to his farmer relative. For example, children of farmers stay with relatives in town, who pay their school fees and provide them with board and lodging. In return the children work as household servants after school hours and their parents cultivate a rice field in the village for their urban relative. In this way exchange networks are created which directly link urban and rural people. Urban officials sometimes decide what is happening on village fields and a large part of the official's salary is not spent for his own household.

Expert vs indigenous economics

Therefore, taking decisions on economic activities is not just a matter of economics, in the sense of universal economic science. The story about the value of buffalos on Sumba shows how difficult it is for outside economists to predict how agricultural resources will be put to use. In the process of resource allocation, criteria related to market value, practical value, social value and religious value are involved. How these various criteria are balanced and compared can only be addressed by the farmers themselves. It would be very difficult to make a sound cost-benefit analysis of all these uses of a buffalo on Sumba. Most costs and benefits involved cannot be expressed in monetary values: there is no fixed price for labour, people never pay buffalo owners for using their animals, what is the value of a bride compared to the value of two years university education? In my opinion, the best economists can do in this situation is to listen to people explaining their considerations in deciding how to use their buffalo (or other productive resources), providing information on alternatives and helping people to formulate the choice in terms of their own criteria. These criteria are not fixed or static. They change over time, along with the changes in religious adherence and as a consequence of education and contact with people from other areas. People mix old and new norms and values, negotiate to make the mix correspond better with their own interests. Development workers participate in this negotiating process.

The story about exchange networks poses more questions. What is the boundary of an agricultural household? Who benefits from income generating activities for the farmers in the village: the farmer's family or their urban network partner? If a change in agriculture changes the ratio of capital and labour input, what are the consequences for the partners in such an exchange network? The latter question is especially relevant in discussions concerning the assessment of LEISA. In exchange networks like these on Sumba a large part of farmers' monetary expenditures, including the costs for external agricultural inputs, is paid by their urban partners. A shift in agricultural technology towards a type of cultivation which uses less external inputs but is more labour extensive, would be a burden for the farmers' household and financially favourable to the urban network partner. Perhaps this is a rare case, but the general conclusion holds that in decisions concerning agricultural technology more actors are involved than just the farmers who actually cultivate the fields.

Photo: Jacqueline Vel

Children stay with urban relatives who feed them and pay their school fees. In return, parents cultivate a rice field in the village for their urban relative.

Respecting a different rationale

Taking people seriously is the basic attitude of researchers and development workers who study indigenous knowledge and practices. With regard to economic issues this means that the norms, values and practices of the members of a specific society are respected and not a priori condemned as irrational and therefore irrelevant. This does not have to imply that one should take a local economy for granted. Development workers are always involved in stimulating changes. In changing agricultural techniques participatory technology development (PTD) is the method by which outside experts and farmers join hands to think of the best alternative in their specific situation. Studying indigenous economics opens the way for "participatory economic development". In such a process development economists learn local idiom and translate intended changes in concepts which make sense in the daily lives of the farmers involved. ■

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Jacqueline Vel, Molenstraat 79, 6721 WL Bennekom, Netherlands.

Diversity in knowledge systems

Science is not universal

The agroecology programme of the university of Cochabamba (AGRUCO) started its activities in the Bolivian Andes in 1986 with the aim to contribute to sustainable development. This article describes how the programme changed from a transfer-of-technology agent to an institution seeking the enhancement of the intercultural dialogue.

Stephan Rist

The programme was launched on the basis of the European approach to ecological agriculture. Ecological agriculture mainly concentrates on biological processes, which in the field, however, did not permit to take socioeconomic, cultural and political aspects into consideration. The concept of the programme therefore gradually changed towards agroecology, which sees the agroecosystem as the result of a co-evolution of society and nature (Noorgaard, 1987). We saw ourselves obliged to investigate thoroughly the philosophical and mental basis underlying the present agroecosystem as expressed in the Andean cosmovision. While studying the Andean cosmovision, a series of observations, made during on-farm research, were quite important: the majority of social and technological events such as the celebration of feasts, ploughing, sowing or harvesting are always preceded by rituals, in order to ask permission and assistance of Pachamama (Mother Earth and fountain of life) and a number of other spiritual beings. It also became apparent, that this symbolic dimension of reality is one of the constituent elements of regenerating and creating knowledge, practices and technologies.

Three dimensions

In the Andean world view nature, society and the spiritual world are inseparable as they are in constant and dynamic interaction with each other. None of the components is superior. For Western science the interaction of society and nature is not hard to understand. However, to comprehend the Andean cosmovision it is necessary to include the transcendental component as well. Scientists find this rather difficult. Spiritual beings not only inhabit the planet earth but also dwell in the more distant spheres of the universe. This leads to the holistic understanding that man is simultaneously rooted in the earth and in the universe. The following example illustrates how this cosmovision influences the explantation of natural phenomena.

Every year on Carnival Tuesday the campesinos go to their fields to celebrate their crops, just then in full growth, with a ritual called *ch'alla*. This ritual is held in honour of the Ispalla spirit. "Ispalla is the soul and spirit of all food... It is Ispalla who gives life to human beings, animals and plants. Therefore we harvest some plants, put them on our shoulders and make them feel happy by dancing with them to our music". A good crop, qualitatively and quantitatively, depends not only on appropriate technology but also on the positive motivation - through the rituals - of the transcendental world.

Science explains only one dimension

Having achieved this first understanding of Andean cosmovision, a difficulty with the agroecological approach arose: although the agroecology approach is holistic and interdisciplinary, it still defines itself as a "science". It is based on the biological and historic materialism and furthermore claims to be objective and universal. One of the fundamental differences between agroecology and Andean cosmovision is related to spiritual life: because it is admitted only at a subjective level it cannot interact with "objective" science. In none of the scientific disciplines could we find elements which would allow us to link the scientific and the Andean explanation of the phenomena. For instance, from a scientific point of view it is inadmissible that a ritual such as *ch'alla* could have a positive influence on the quality or quantity of crops, whereas from the point of view of the great majority of the peasants it is absolutely certain that *ch'alla* is effective. This gives them reason to invest a considerable amount of time and means in their rituals. We were confronted with a typical problem of modern science in the sense that "only the surface of things is explained, only one dimension of the reality" (Havel, 1994).

Revaluing world views

How should the two world views interrelate, knowing that the scientific worldview presents itself as universal but cannot explain the effects of rituals? It was important for us to realise that in social and historic sciences numerous studies exist which prove that "modern sciences" are the result of the social construction of knowledge and hence only one system among many others (Chambers, 1994). Based on this fundamental conclusion we managed to assign ourselves - as a university programme and formal representative of science - a new role in the interaction with Andean cosmovision: taking both systems as the expression of knowledge valued by two different cultural systems. This allows us to overcome supposed incompatibilities. Understanding both systems as the result of social construction of knowledge does not deprive either of them of their legitimacy. Scientific knowledge system merely loses the right to claim universality. On the other hand, for the Andean knowledge system this signifies a revaluation by being put on equal terms with other existing systems.

The equal relation between different cultures with their respective knowledge systems marks the beginning of an intercultural dialogue which, instead of seeking the domination of one over the other, tries to induce the reciprocal enrichment as a contribution to create more sustainable societies as a result of cultural diversity. The acknowledgement of the importance of the intercultural dialogue should not stay a mere theory but it should lead to the redefinition of institutional and methodological aspects. As a first step, we had to abandon our identity as "development programme" in the conventional sense: it is not any longer the programme which, through "planned interventions" is the cause or the "motor" of the evolution of the target group. Due to the emphasis given to the participation of the peasant as a social actor, mainly in the field of research activities, we became aware that our institutional objectives had gradually shifted: from the initial approach of transferring ecological agriculture technology, we evolved into an institution seeking the enhancement of the intercultural dialogue. ■

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A number of research projects are implemented in Kerala which can be considered under the headings of post-Green-Revolution agriculture, low-external-input agriculture or sustainable agriculture. These are implemented by many people like scientists of government departments and research stations, activists and the technical staff of non-governmental organisations and concerned and innovative farmers. These projects conducted in Kerala can be classified into four types: conducted in controlled situations in research stations or demonstration plots; conducted by scientists in farmers' fields; conducted at the level of villages or watersheds; conducted by farmers on their own farms. Based on case studies, this article discusses certain limitations of these types of research.

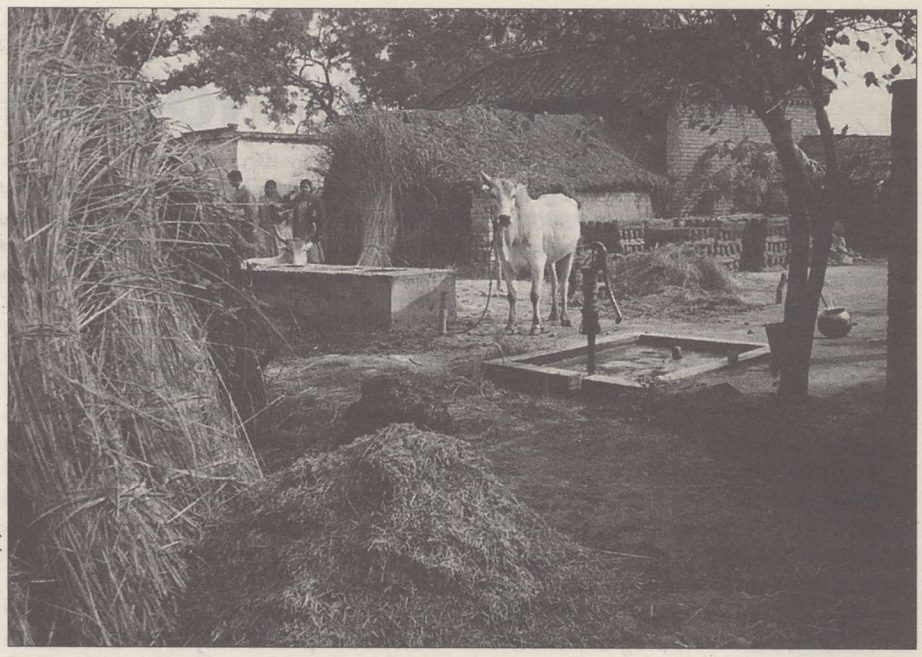

Photo: Coen Reijntjes

Research on sustainable agriculture compared

V. Santhakumar

The experiments conducted by scientists in experimental stations provide rigorous quantitative data on certain practices. For example, Kerala Agricultural University has conducted a series of experiments during the eighties comparing the performance of organic manure and inorganic fertilisers. The ranking of yield rates for different sources of manures for different seasons, as shown by these experiments, are listed in Table 1. Based on these data, the following three modest conclusions can be made:

- "Organic manure alone" is consistently superior than "inorganic manure alone".
- Organic manure, if necessary, can be used to replace the chemical fertiliser.
- Complete non-use of organic manure is definitely an inferior practice, even in terms of the yield rate.

Thus this study clearly showed the need for using organic manure. However, the basic limitation of this study is that it does not address the questions of the cost and the availability of organic manure. In order to compensate the use of chemical N, the study used 18,000 kg/ha of cattle manure or green leaves. What is the source for this large quantity of organic manure? What would be the cost of organic manure compared to chemical fertilisers? How do subsidies on chemical fertilisers affect this cost comparison? Considering the biomass resources available to the farmers of Kerala, what would be viable combinations of organic and inorganic fertilisers? All these questions are left unanswered. Thus the basic limitation of this study is that it is conducted in a situation which does not reflect the realities of day-to-day life of farmers in the region.

Scientists study farmers' fields

Knowing that this humid-tropical region sustains a well-developed form of home-gardens in its dryland, scientists of the Kerala Agriculture University recently made a number of attempts to study the problems and potentials of this type of cultivation. This study is part of the Farming Systems Research in the university. Conventional scientists faced a crucial problem of methodology. Homestead cultivation sustains a large number of trees and plants yielding a variety of commodities. A few of these products are not so commercially valuable but very useful for home consumption. The homestead generates inputs like organic manure and ash to be used for subsequent cultivation. Certain commodities like timber for house construction are produced over a long time-cycle. All these peculiarities of homestead cultivation are not easily amenable to the methods of the scientists who were dealing mainly with the inputs and outputs of a single crop plantation or who were well versed with statistical data collection through questionnaires. Instead of using methods of participatory appraisal, scientists resorted to the statistical data collection which ultimately left out many important features of the household cultivation. The fact that the researchers who did these studies were mainly trained in natural science (and agronomy) or economics and not in anthropological methods might have contributed to this situation.

Village level studies by NGOs

Recently a number of NGOs started to conduct village or community level projects to study and formulate strategies for the sustainable management of natural resources like land and water. They use participatory methods, incorporate farmers' viewpoints and consider socio-economic, cultural and technical factors together in a holistic manner. However, based on a few case studies in Kerala, I would argue that these studies also have several limitations.

A micro-watershed project is implemented in the Nellaya village of North Kerala by an NGO (Kerala Sasthra Sahithva Parishad). The project's objective was to develop appropriate strategies for the sustainable use of land and water resources. Instead of bringing the watershed under a major irrigation project, they designed alternative plans to use locally available water efficiently and develop sustainable landuse plans which are in tune with this. The NGO used several strategies to elicit farmer's viewpoints. A number of small group meetings were conducted. Group activities in which local people and project activists did physical labour together were also organised to reduce to communication gap. The political, religious and other

The homestead generates many important inputs, like manure, that are invaluable for farmers, but not always counted by scientists.

group leaders were consulted and asked to help in getting the support of the villagers. Local people were motivated to prepare non-technical maps of local resources like ponds, streams and forests and of the problem areas like highly eroded patches, to develop "resource consciousness" in their minds. The project activists collected information on the meteorological and hydrological parameters of the region. They also collected data on the existing landuse pattern of the area and on the socio-economic status of the villagers.

Limitations

Though the whole effort yielded quite a lot of useful information on the watershed and its inhabitants, I do feel in retrospection, that the collected information and the development programmes formulated on the basis of this information have several limitations.

There was an implicit objective in the project to maximise agricultural production in the watershed (of course, on a sustainable basis). Increasing agricultural production significantly (in conventional terms) implies a change in land use, which presently supports a wide variety of plants and trees, into small-scale plantations of a few crops which yield large benefits according to the present market situation. Having done a study on agriculture in the area, the project staff and the NGO felt bad about not recommending strategies for increasing agricultural production in monetary terms.

The NGO subscribed to an attitude in development planning in which most of the investment for rural development has to come from the government. The preferences of the local people were highly influenced by the fact that they did not have to bear the cost of the projects. In a state like Kerala where the educational status of the villagers is relatively high, there is a widespread awareness on the "providing" ability of the different agents of the government and other organisations. The participatory approaches used in this case were unable to delineate these biased preferences of the villagers.

It was difficult for the NGO, project staff and the local people to accept the fact that there are "natural limitations" to increase the yield to the level achieved in other regions of India where green revolution was successful (in increasing the yield). Agricultural science literature has pointed explicitly and the individual experiments conducted in Kerala have shown implicitly that the characteristics of the humid-tropical regions (such as low sunlightduring monsoons, monsoon-dependant cultivation in major part of the area, heavy and uncontrollable runoff through the fields) limit the yield rate of paddy. However, accepting that there are certain "natural constraints" is totally against the widely held notions on the ability of science and technology. The prevailing hope that the technological package of the Green Revolution (or Post-Green Revolution) will eventually be successful in Kerala in increasing the agricultural productivity considerably, distorted the thinking of the project staff and local people.

Countless value

Like the farming system studies of the university, this study also faced the problem of accounting non-monetised commodities like organic manure, fuelwood, non-marketable medicinal plants and those commodities which are produced over a long-term period such as timber. How to advocate the replanting of trees yielding timber once in fifty years, plants yielding organic manure and medicinal parts and trees like jack (which supply a part of the staple food during a lean season) when most varieties of jack fruit fetch very low prices in the market?

The distortions existing in the market for several commodities further complicate the accounting problem. What is the real value of fuelwood when kerosene is supplied with a direct subsidy? What is the relative advantage of using organic manures when chemical fertilisers are being supplied at heavily subsidised rates? What is the incentive for continuing an indigenous multi-food crop system when a particular grain is supplied through the controlled market? The impact of these market distortions prevail even after they cease to exist. The habitual changes of the people and the long-term impact on the land-use pattern brought about by these distortions will continue to prevail for a long time. The NGO study described here could not consider these external economic factors adequately.

What is clear from this study is that the use of participatory approaches and the closer interaction of the project agency with people by itself does not guarantee a better understanding of the problems of the agricultural system or an easier planning for sustainable agricultural development.

Effort of innovative farmers

A number of farmers in Kerala today practise innovative methods of sustainable agriculture. As they constantly interact with their agricultural system, their understanding is more holistic. Since agriculture directly contributes to their life, they can value the non-monetary benefits offered by the system. However, the generalisation based on these experiments are very problematic. The size of the farm is an important factor. In general those farmers who practise some form of sustainable agriculture are relatively large land owners. They can afford to ignore a part of the monetary income. The contribution from other sources of income like jobs, business, etc. can also make it easier for farmers to afford sacrifice part of the monetary benefits generated through the adoption of a plantation-based system of marketable crops.

The objective of this article is not to neglect the importance of all these experiments of sustainable agriculture. All of them provide important information, evidence and morale boosting for building a sustainable agricultural system. However, knowing their inherent limitations would help us in making our objectives and action plans more realistic. ■

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Table 1 Effect of organic and inorganic manures
Ranking of sources in the order of yield rates

Source	Year and Season* of Experiment												
	79A	79B	80A	80B	81A	81B	83A	83B	84A	85A	85B	86A	86B
P	2	1	1	1	1	1	1	1	1	1	3	1	2
Q	1	8	5	8	2	5	5	7	7	5	5	5	5
R	4	2	2	3	3	2	3	2	3	2	2	3	4
S	7	7	8	7	5	8	6	8	8	8	8	7	8
T	3	3	3	2	6	4	2	3	2	3	1	2	1
U	8	6	7	5	7	7	8	5	6	6	7	8	6
V	5	4	4	4	4	3	4	4	4	4	4	4	3
W	*6*	*5*	*6*	*6*	*8*	*6*	*7*	*6*	*5*	*7*	*6*	*6*	*7*

Sources and Doses:

P: Cattle Manure (CM) 18000 kg/ha
Q: Green Leaves (GL) 18000 kg/ha
R: CM+GL 9000 kg/ha each
S: N Fertiliser 90 kg/ha
T: CM 9000 kg/ha + N 45 kg/ha + P 45 kg/ha + K 45 kg/ha
U: GL 9000 kg/ha + N 45 kg/ha + P 45 kg/ha + K 45 kg/ha
V: CM+GL 4500 kg/ha + NPK (45+45+45)
W: NPK (90+45+45)
A: First Season
B: Second Season

Holistic Resource Management

Communities take development decisions

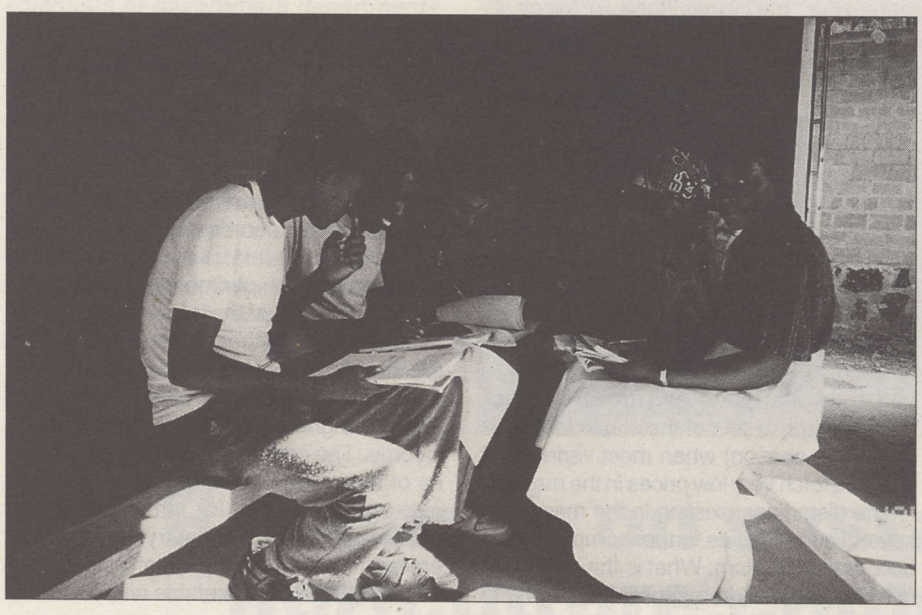

Photo: Arne Vanderburg

In the international development community most efforts to better the lives of poor people focus on the use of improved technologies, or making better use of traditional practices, to address the increasing variety of problems that people are facing worldwide. The Center for Holistic Resource Management takes a completely different approach, saying that in trying to improve their lives by solving their problems people end up in an endless cycle: when one problem is solved, there is always another to replace it. This constant attention to problems keeps people from looking beyond their difficulties and prevents them from working on a plan for truly improving their condition. Holistic Resource Management focuses on helping people change the way they make decisions - from decisions made to solve problems to decisions that lead people toward a defined future. This future is defined by a holistic goal set by the people who make up the group or community - the whole.

Arne Vanderburg

The "whole" consists of the people, the economic resources and the natural features or resources of a given area. When people learn to practice Holistic Resource Management they begin to make decisions that are at once socially, economically and ecologically sound. Once a group of people have clearly described the whole of which they are part, they set a temporary holistic goal that describes what they want their group or community to be like in social, economic and ecological terms. From that point on, every major decision that the group proposes to make is first tested to see if it will help lead the community toward or away from that holistic goal. As the community becomes more skilled in using this new way of making decisions, they increasingly take responsibility for their own future. While they may still seek advice and technical assistance from outside groups, everything that is proposed as help by such development assistance groups is accepted or rejected based on whether it will lead toward achievement of the holistic goal.

In order for communities to be prosperous and stable, the people who live in those communities must be fully responsible for all decisions about their future. The only experts on that community or area are the people who live there. If people are going to move beyond their problems they must be able to describe a vision of their future health and prosperity and identify a way to begin working toward fulfilling that vision. Without this vision or holistic goal, communities will endlessly depend on government programmes and outside organisations that specialise in recommending solutions to problems.

Setting the goal

At the Africa Centre for Holistic Resource Management's regional training centre near Victoria Falls, a group of 11 men and women from the Hwange communal lands are currently learning how to help others in their individual communities practice holistic decision making. In the first three day training session, attention was given to the different ways people make decisions in their lives. Traditional problem oriented decision making was contrasted with goal focused holistic decision making. Using examples from the lands surrounding the training site people could see how conventional decision making has led to deterioration of land and communities as it usually focuses on the symptoms rather than the underlying causes. The main point illustrated was that without a clear sense of where they are going, decisions are randomly made in an effort to try to solve the most obvious problem or current crisis.

For training purposes, trainees then practised forming an holistic goal for a "typical" village community in the Hwange communal lands area. The holistic goal that the group came up with included Quality of Life values such as "self-sufficiency, pride and dignity, stable families, better education and healthier people". The ecological (resource base) part of the goal included "streams flowing once more, underground water rising in boreholes, abundant grass and high biodiversity along with increased livestock and wildlife". An holistic goal is temporary in as much as the people in the whole will continue to make changes until it clearly says what they want for the community, a process that can take months or even years. But first it is important to get the main parts in place and then move on, knowing that from time to time the holistic goal will be reviewed. The strength of the process is in quickly learning how to use that holistic goal to guide decisions. At no point in the goal is there any mention of how something will be done. For instance, in the above example "increased livestock" is given as something the community has said they want. But what kind of livestock, where they will be kept or how many are questions that will all be tested. Experience says that in all decision making, people usually end up in conflict and disagreement over how to do something. The "how tos" in holistic management are all decided by the testing.

Testing decisions

It was in testing some common decisions to see if they would help the group achieve their holistic goal that the trainees from the Hwange communal lands became very excited. Testing means that you ask a series of seven questions about every major decision you plan to make. One question asks whether a proposed decision will or will not help to improve ecosystem processes such as water and mineral cycling. Another asks people to identify the biggest obstacle to achieving their

holistic goal, the weak link, and whether this decision will really address that weak link. Other questions ask whether a given decision will cause the people to become dependent on an outside energy resource, or put them into endless debt to some donor agency. Whether a proposed decision will address a cause or an effect (symptom) is also part of the testing. In all cases, the final question is whether this decision in any way conflicts with the quality of life and cultural values that are in the group's holistic goal. If it fails this last test, then a proposed action will never meet any definition of sustainability. However, an important point is that sometimes you will still go ahead and make a decision that fails the testing because it may be the only thing that will allow you to survive until the next day or next year. But now this will not be done in ignorance and you know what must be done to avoid this in the future.

Using this process to test several proposed decisions, trainees are gaining the awareness that they can take charge of their own lives. For example, one proposed decision tested was a group coming in from the outside to offer aid to deepen boreholes which are going dry. This was rejected as it dealt only with a symptom of a deeper problem. Education and training did pass the testing as it was determined that there was a need for people to understand that bore holes drying up was just a symptom of deteriorating land and that through better decision making they could reverse this deterioration. They also tested the current production of wood carvings that people in the community sell on the main road to South Africa. This did not pass the testing because they realised that for a single large carving, they were consuming large amounts of a wood that was limited in quantity and that would bring in a relatively small income. What did pass the testing was producing more, but smaller, higher quality carvings that could be sold at considerably higher prices.

Reducing the number of livestock and getting still more outside advice on range management were both tested and rejected as a means to reverse the land deterioration. People could easily see that too many animals was not the problem as the training area we were in had been fenced off from livestock for many years and was even more bare than the surrounding stocked lands. They realised there was no point in reseeding the rangelands when there was already an abundance of seed in the ground as evidenced by the growth of grass and weeds annually in all lands they disturbed regularly through cultivation. Proposed ideas of contour ridging to conserve water were rejected, using the cause or effect test, because these were clearly only tackling symptoms of a non-effective water cycle - the same thing which was causing the boreholes to go dry.

Tools

Tools refer to any action or artifact used by people to produce an effect. There are no tools that are preferred, recommended or even banned in the practice of Holistic Resource Management as nothing will be used or done until it is first tested to see if it will lead toward achieving the holistic goal. Every creative idea or technology is considered equally - whether from the world of western technological development or from a more traditional, indigenous base. And once a decision is finally accepted, it is closely monitored to ensure progress is still being made toward the holistic goal.

Monitoring and replanning

As people in the Hwange communal lands begin to use holistic decision making, they will start monitoring all decisions that pass the testing. In decisions directly affecting the land, which many of the ones in this area will be since they are trying to reverse land deterioration, they will be assuming that each decision is wrong. They will then develop criteria, or indicators, that will tell them when their decision is not leading them to the holistic goal. As soon as one of these indicators is observed (such as increased bare space between plants or even small signs of increased erosion) they will replan. An important point in holistic management is that the objective is not to see whether one reaches the holistic goal, but to make decisions, monitor and replan to make sure that the holistic goal is achieved.

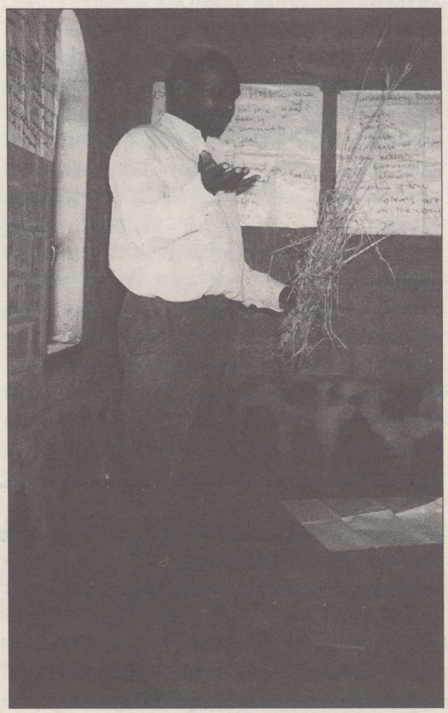

Photo: Arne Vanderburg

Peter Phiri, training coordinator for the regional centre near Victoria Falls, Zimbabwe.

Currently, there are Holistic Resource Management training programs occurring in a variety of locations including Burkina Faso, Zimbabwe, India, Australia, Mexico, Canada and the United States. For anyone wanting to know more about Holistic Resource Management, they should contact the address given below, or the Africa Centre for Holistic Resource Management, PO Box MP 266, Mt. Pleasant, Harare, Zimbabwe (phone/fax: +263 4 732360).

Role of research

Since no idea or technology is automatically excluded as being too "high-tech" or on the other hand, "too simple", the need for western models of research and technology development is as strong as ever. As people seek ways to achieve their holistic goal, they need as many alternatives as possible from which to make their choices. But the difference is in the weight that is given to these alternatives. It is accepted that practices developed by indigenous peoples through many years of experience in a given setting, may be more valuable for that setting than a learning that comes from even the best planned development agency funded research programme. As a result, all alternatives are tested toward the goal and are valued equally. This also means that outsiders proposing research and technological solutions must become skilled in explaining to a given group of people how what they are proposing will actually help the community achieve their holistic goal.

Limitations

To date we have found no limitations to the use of holistic decision making. As it is a process for making better decisions in any setting, there are currently no situationally dependent changes recommended. There are accepted differences around the world, from culture to culture and even within cultures on how people learn, and it is important that anyone trying to facilitate others learning Holistic Resource Management be extremely familiar with local learning styles and traditions. It is the Center's preference that all training at local levels be conducted by people who are from the specific geographical and cultural region where training is taking place. That is the reason that the efforts to spread Holistic Resource Management are directed toward the training of locally based trainers. ■

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Learning about sustainability

Resource poor farmers often find themselves "trapped" in extractive ways of farming. They do not know what to do. This article describes a participatory process for NGOs to assist farmers get out of the trap. Using a set of sustainability indicators farmers and NGO staff brainstorm ways to experiment with, and monitor changes in, the sustainability of their farming system. This process was developed over three years of collaborative work between farmers in two communities of Cavite province, the Philippines, the International Institute of Rural Reconstruction and the International Center for Living Aquatic Resources Management.

Mary-Ann Bimbao, Teresita Lopez and Clive Lightfoot

Because all of us know so little about sustainability it is difficult to prescribe ways to measure it. What we can do though, is start a process to learn about it. Such learning experiences improve our understanding and, over time, make farming practices more sustainable.

A learning process cannot cope with all factors involved at once. We started talking with farmers about ecological aspects such as the number of species they used, the amount of recycling of farm wastes and the productive capacity of their fields. We also talked about the costs and returns of farming. Obviously, there is more to sustainability than this. Equity and food security are also important, but there again, so are many other biological, socioeconomic and institutional factors. Farmers helped us find indicators from a long list of important factors. In making their suggestions they gave consideration not only to the importance of factors to them, but also to indicators that would suggest direct actions they could take. As our understanding increases the indicators will no doubt be changed. Thus, the following indicators were chosen:

A. *Species diversity* is the number of species cultivated or caught by the farmers, in other words how many plants and animals are being used.

B. *Recycling* is the number of flows of biological material such as manure, compost, straw, leaves, rice bran, etc., that occur between different species, in other words how many waste products are being reused.

C. *Capacity* is the amount of biomass produced on all the natural resource types, in other words the total production of the farm.

D. *Economic efficiency* is a ratio of the profits (including non-cash) over the costs (including labour), inother words how much income was generated by each dollar or peso spent.

Because sustainability is not about getting the highest result in any one indicator, but rather, achieveing a balance between all of them we draw the results out in a "kite" diagram as shown in Figure 1. Thus, the larger the area created by the kite the more sustainable the farming system.

Bioresource flows

Data for making a kite diagram can be obtained by preparing a "bioresource flow diagram" and estimating values for each indicator. A bio-resource flow diagram, as shown in Figure 2, is drawn by first sketching cross-sections of each natural resource type that is used by the household (eg. flat lowlands, sloping uplands, ponds, and streams). "Use" here does not only refer to land owned but also common property and open access resources as well. Next, on to each natural resource type cross-section are drawn icons of each species used (eg. rice, grass, mango trees, goats and fish). Lastly, arrows to represent biological material (the bioresources such as manure, rice hulls, straw) that are recycled within the farm are drawn to complete the diagram. This process has been more fully described in previous articles in the ILEIA Newsletter.

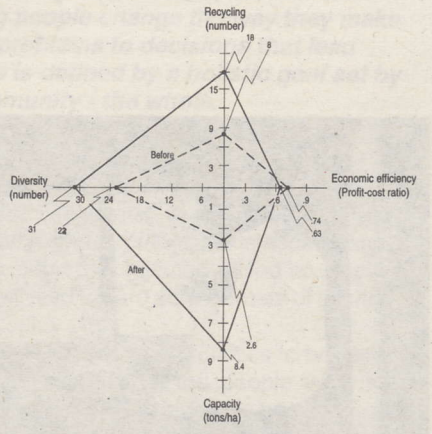

Figure 1. Farming systems performance indicator kites before and after integration, Philippines.

Estimating indicators

Estimating some of the indicators is easy. For instance, the number of species and the number of flows can be obtained by simply counting the species icons and flow arrows on the diagram. However, estimating the amount of biomass produced on all the natural resource types and profit is much harder. To estimate biomass produced, farmers must not only remember all the harvests from each natural resource type and all the waste materials taken for recycling, but also estimate the changes in standing biomass of the materials left behind - how much larger has the herd grown, how much larger are the trees? These are not easy estimates to make. Moreover, if estimates are attempted for each species then the task quickly becomes impossible. Lumping species into groups gets us around this problem. We lump all livestock species, all tree species and all crop species together. While this estimate is not accurate it does give us a "feel" for the tons of biomass produced by each natural resource type. Over time, as farmers' ability to estimate biomasses improves, so will the accuracy of the data.

Estimating economic efficiency is just as crude, if not more so. The input-output data for each species group, as shown in Table 1, require farmers to put a cash value on recycled wastes. Clearly, this kind of economics can only give us a general impression. Undertaking rigorous whole farm budgeting, however, requires a level of data gathering way beyond the means of farmers and most NGOs.

Beware that only very rough estimates can be obtained from farmers' memory. Trying to remember how much of a crop was harvested at the end of the season might be easy but recalling how much manure was used is much harder. The accuracy of farmers' estimates can be greatly improved if they record inputs and outputs directly on their bioresource flow diagrams as they occur.

Brainstorming

Farmers and NGO staff use the bioresource flow diagram and the kite diagram to brainstorm ways to improve sustainability. With the two diagrams side by side the "facilitator" asks the farmers to explain the performance of each indicator and give ideas on

Table 1. Data required for each species group

Cash costs	Noncash costs	Primary produce	Farm wastes
external materials	external materials	sold	sold
hired labour	internal materials	household consumption	farm use
rents, fees and loans	hired labour	stored/change in stocks	others (exchange)
	family labour	others (gifts, debts)	
	rents, fees and loans		

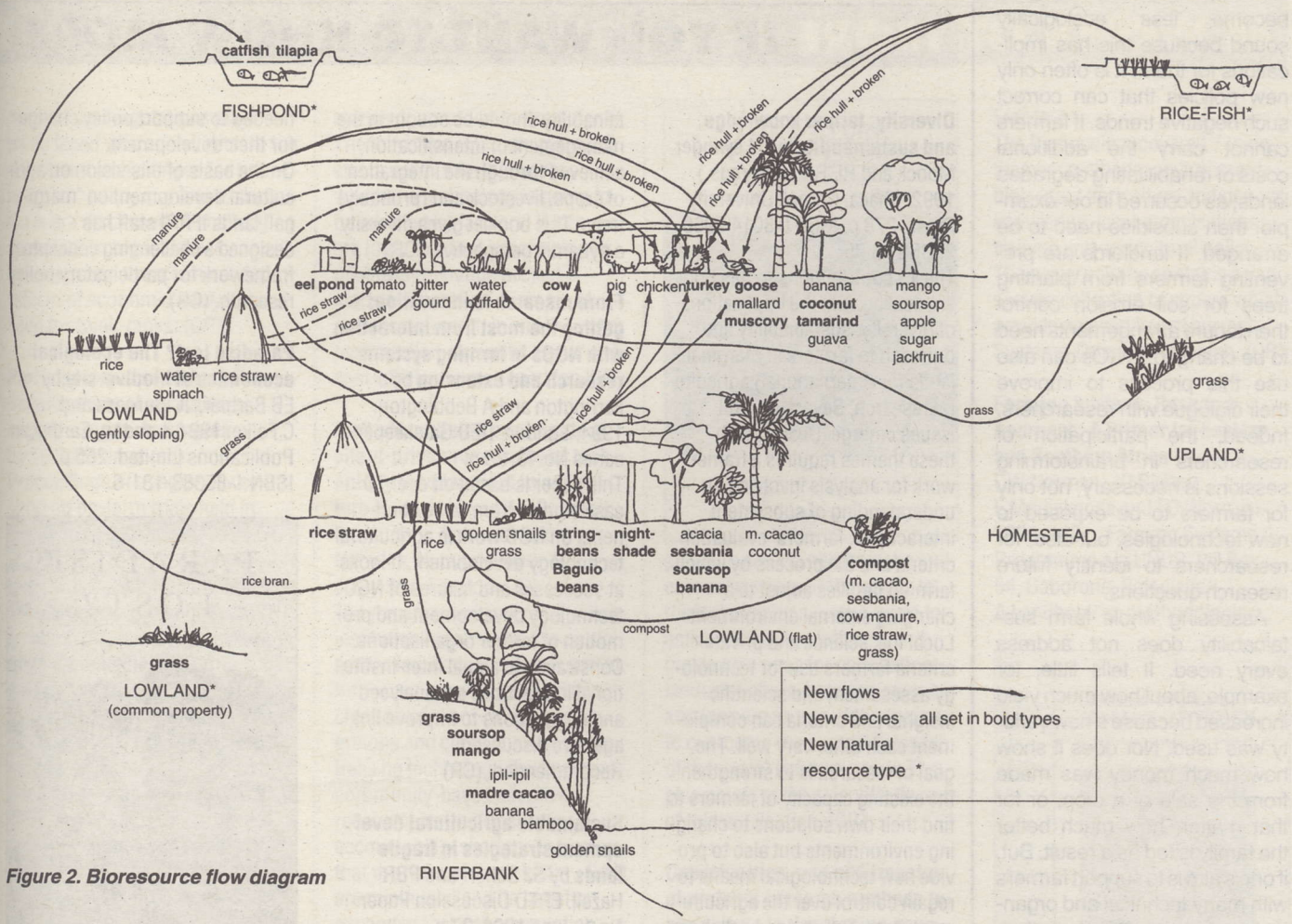

Figure 2. Bioresource flow diagram

how it could be improved. Once the farmers have finished NGO staff and other "outsiders" are asked for their ideas.

Typically, the species diversity indicator stimulates discussion on how new species can be added. For the farm presented in the figures the addition of catfish, tilapia and stringbeans were among the species that increased the diversity indicator from 23 to 31. The recycling indicator prompts discussion on new flows of organic wastes. Figure 1 shows that the number of flows increased from 8 to 18. Figure 2 shows that cow manure, sesbania and gliricidia leaves and rice bran were among the new flows. Here, farmers often introduce the idea of recycled materials substituting for purchased inputs. Ways to reduce cost are discussed through the indicator for economic efficiency. Figure 1 shows no improvement here. Farmers explained that was because many of the improvements made (such as new vegetable plots and tree lots) have not borne fruit yet. Techniques for rehabilitating degraded land and water are the subject when ideas for increasing the capacity of natural resources are discussed. Figure 1 reports an increase in production from 2.6 tons per hectare to 8.4 tons. Much of this increase, as shown in Figure 2 came from livestock and recycled farm wastes. Often these discussions go beyond technical ideas to ideas on how farmers might organise themselves to gain better access to natural resources.

At the end of the brainstorming sessions farmers record the new ideas on their bioresource flow diagram. A future farming system might be shown through changes in their natural resource types - contour terraces on sloping uplands, raised beds and ponds in lowlands. More icons are drawn to represent new species and more arrows to show increased recycling. Thus existing and future farming systems are captured in one diagram, as shown in Figure 2. After this, farmers and NGO staff get together and plan the needed experiments and developments. Often farmers will decide to work together to improve a natural resource. They may build a dam or contour sloping lands together. They will experiment with new crops or animals or using crop wastes that were never used before. There will of course be things that cannot be done. NGOs might take these to the appropriate research and development institutions or use them in their advocacy work with policy makers.

What farmers learn

Brainstorming sustainability indicators nearly always results in farmers learning something useful: a new plant they can feed to their animals, or a new waste they can fertilise soil with. They often learn things they can do together, like impounding water for irrigation and fish culture. And, they learn about natural resources, how to estimate their productive capacity, value standing biomass and value farm wastes.

There are, of course, times when the diagrams cannot help. They do not, for example, tell which specific enterprise is making the most profit or loss. Moreover, they do not help farmers decide how to divide up their meagre supplies of manure between the vegetable plot, the maize garden and the fish pond. Nevertheless, participatory procedures do allow farmers to have a greater say in what kinds of technical and organisational help they need. Many of their ideas will challenge the NGO - perhaps to find an alternative low external-input-technology or perhaps to gain access to a water resource.

Implications for NGOs

The learning process described here helps NGOs identify new technical and organisational inputs. Instead of providing external inputs like high-yielding varieties and chemicals to increase production of specific crops, NGOs now procure local seeds for soil erosion control and animal fodder. They also get people together so that landlords, whether government or private, can be approached to gain access to grazing lands or water resources.

More importantly, this analysis helps NGOs keep track of impact on the farming system. Tracking negative trends can be more important than successes! Policy makers need to know when farming systems

become less ecologically sound because this has implications for them. It is often only new policies that can correct such negative trends. If farmers cannot carry the additional costs of rehabilitating degraded lands, as occurred in our example, then subsidies need to be arranged. If landlords are preventing farmers from planting trees for soil erosion control then tenure arrangements need to be changed. NGOs can also use this process to improve their dialogue with researchers. Indeed, the participation of researchers in brainstorming sessions is necessary, not only for farmers to be exposed to new technologies, but also, for researchers to identify future research questions.

Assessing whole farm sustainability does not address every need. It tells little, for example, about how much yield increased because a new variety was used. Nor does it show how much money was made from the sale of a crop, or for that matter, how much better the family is fed as a result. But, if one's aim is to support farmers with many technical and organisational inputs and track their impact on the sustainability of the whole farming system then this process might be a way to start. Lastly, if this process helps farmers become partners in learning what is sustainable agriculture, then much could be gained. ■

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Clive Lightfoot, ILEIA, PO Box 64, 3830 AB Leusden, Netherlands.

Further reading

- Lightfoot C, PT Dalsgaard, MP Bimbao, and F Fermin. 1993. **Farmer Participatory Procedures for Managing and Monitoring Sustainable Farming Systems**. *Journal of the Asian Farming Systems Association*. 2(2): 67-87.
- Lightfoot C and R Noble. 1993. **A Participatory Experiment in Sustainable Agriculture**. *Journal for Farming Systems Research and Extension*. 4(1): 11-34.
- Lightfoot C, M Prein and T Lopez. 1994. **Bioresource flow modelling with farmers**. *ILEIA Newsletter* 10 (3). 22-23.
- Ofori J, M Prein, F Fermin, D Owusu and C Lightfoot. 1993. **Farmers Picture New Activities**. *ILEIA Newsletter* 9(1): 6-7.

MORE IF YOU WANT TO KNOW MORE IF

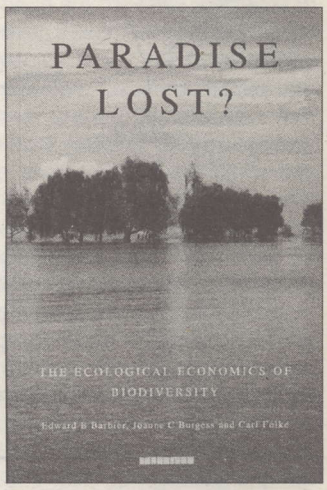
Diversity, farmer knowledge, and sustainability by J Lewinger Moock and RE Rhoades (eds.). 1992. Ithaca, Cornell University Press. 278 p. ISBN 0 8014 9968 2, US$ 18.95.
The 13 contributions to this book are dealing with the implications of diversity, sustainability and outreach to farmers in marginal lands for (international) agricultural research. Several central issues emerge. Dealing with these themes requires a framework for analysis involving an understanding of subsystem interactions, farmers' evaluation criteria and the process by which farming families adjust to a changing external environment. Local folk science and private criteria farmers use for technology assessment and scientific insights and criteria can complement each other very well. The goal of research is to strengthen the existing capacity of farmers to find their own solutions to changing environments but also to provide new technological means to regain control over the agricultural system. Full-fledged collaboration with farmers in applied research programmes is considered necessary to involve farmers in technology generation and evaluation. An appropriate range of technological and agricultural development options are needed as a response to diversity. Due to these new demands international and national agricultural research faces great institutional challenges. An interesting collection of papers on problems agricultural research wrestles with. (CR)

Crop-livestock farming systems in the semi-arid zone of Sub-Saharan Africa: Ordering diversity and understanding change by M Mortimore and B Turner. 1993. Agricultural Administration Network, Network paper 46. London, ODI. 33p. Diversity is a fundamental property of primary production in Africa. This paper provides a framework for the typology of farming systems based on the dynamics of agricultural intensification. This typology is said to be necessary to order diversity, understand change and design interventions. The authors conclude that the link between the characteristics of farming systems and environmental sustainability should be sought in the management of intensification, achieved through the integration of crops, livestock and (probably) trees. This booklet gives diversity a dynamic perspective. (CR)

From research to innovation: getting the most from interaction with NGOs in farming systems research and extension by J Farrington and A Bebbington. 1994. London, IIED Gatekeeper series No.43. 23 p.
This paper is based on over 70 case studies from three continents on NGO work in agricultural technology development. It looks at successes and failures of NGO technology development and promotion of farmer organisations. Constraints to actual inter-institutional interactions are analysed and suggestions to improve linkages are discussed. Recommended. (CR)

Sustainable agricultural development strategies in fragile lands by SJ Scherr and PBR Hazell. EPTD Discussion Paper No.1, June 1994. 37 p.
Community mapping of resources for policy analysis: proposed conceptual framework by G Bergeron, SJ Scherr and M Lopez Pereira. EPTD Discussion Paper, December 1994, 29 p. International Food Policy Research Institute, 1200 17th Street, Washington DC, 20036-3006 USA.
Under population and market pressure, one can expect an endogenous process of intensification, through land improvement, tenurial and institutional changes and "re-ordering" of the landscape. But this process is not automatic. Factors influencing the pace and scale of land transformation include: farmer knowledge on the degradation of resources; incentives for long-term investment; capacity to mobilise resources for land investment; level of economic returns to such investment; and factors affecting the formation and function of local groups to help mobilise resources and coordinate change at the landscape level. Current policies often work to constrain, rather than support, this process. As "marginal lands" play a growing role in food production, new research is needed to support policy change for their development.
On the basis of this vision on agricultural development on "marginal" lands IFPRI staff has designed a challenging conceptual framework for participatory policy research. (CR)

Paradise lost? The ecological economics of biodiversity by EB Barbier, JC Burgess and C Folke. 1994. London, Earthscan Publications Limited. 265 p. ISBN 1-85383-181-6.



This book is the outcome of a unique collaboration between economists and ecologists initiated by the Beijer Institute of the Royal Academy of Sciences. The result is what the authors call "ecological economics", a new category of analysis to address problems of economic and environmental interaction. The authors state that the current biodiversity crisis will require fundamental changes in our economic, environmental and social relationships. The theme of this book is how we could manage these changes. After a profound analysis of the biodiversity crisis, its implications and causes, four research cases are presented.

These cases provide detailed analysis of biodiversity loss in selected natural systems and management and policy options to preserve the wholescale ecosystems. At the end of each case challenges are discussed that need to be addressed to improve the method of ecological-economic analysis. The concept of ecological limits to economic activity is posed and the role of

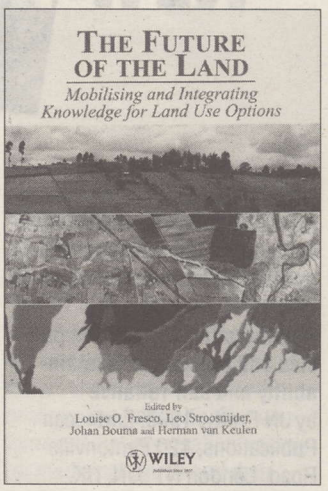
markets and regulations play when faced with such limits. In the conclusions challenges for future research, policy and human behaviour are discussed. A challenging contribution to biodiversity conservation and the much needed reform of economic analysis! Feed for think-tanks. (CR)

Participatory research and development of agricultural engineering technologies by TE Simalenga (ed). Proceedings of a regional workshop on on-farm trials held in Embu, Kenya, February 1994. 75 p. AGROTEC, PO Box BW 540, Borrowdale, Harare, Zimbabwe. The participants, all conducting research on technology development for smallholder farmers, analysed "why the adoption rate of technology packages is low" and "what is wrong with our present system of research and extension". Case presentations and field visits provided the basis for discussing participatory research. It was concluded that participation in research by all interested parties is a major mis-sing link in the thinking and carrying out of conventional research. The report presents the process of critical self-analysis, an outline of participatory research and some interesting case studies on on-farm research. Informative for researchers who intend to institutionalise participatory research. (CR)

A question of management: the pros and cons of farmer and researcher managed trials by R Swinkels, K Shepherd and B Jama. In: *Agroforestry Today* Oct - Dec 1994, p 3-7. This article examines both farmer and researcher controlled on-farm research in agroforestry. The authors look at what kind of data and information each provides, inherent problems and how each type of research fits into an efficient and streamlined research process. In the collaborative research project of ICRAF, KEFRI and KARI in Maseno, Kenya three types of trials are now being used. The first type is the exploratory and informal farmer managed trial to point researchers in the right direction. Fully researcher managed experiments are used to compare the biological performance of agroforestry treatments. The third type is farmer managed and is used to further assess whether a technology is going to be adopted by farmers. If farmers are likely to adopt a technology a pilot dissemination project is started. A practical example of complex research in which farmer participation, scientific rigour and cost-efficiency are aimed for.(CR)

Institutionalising participatory client-driven research and technology development in agriculture by JA Ashby and L Sperling. Agricultural Administration Network, Network Paper 49, July 1994. London, ODI. 21 p. The paper reviews ways by which institutions can respond to participatory research and development. Important issues dealt with are: creation of client-driven agenda options and client control; decentralising technology development; community-based adaptive research; institutionalising accountability sharing. To ensure that the risks of Participatory R&D are minimised and its benefits expanded the authors mention three important issues. Clarifying the respective roles of farmers and scientists to minimise the risk that client involvement might compromise the quality of scientific research. Reorientation of delivery systems such as credit, extension and seed multiplication. Equity between the more and less fluent groups of farmers, and between the requirements of present and future generations should be safeguarded. Participatory R&D is maturing! (CR)

The future of the land: mobilising and integrating knowledge for land use options edited by LO Fresco, L Stroosnijder, J Bouma and H van Keulen. 1994. Chichester, John Wiley & Sons. 409 p. ISBN 0-471-95017-3. This publication contains the papers presented on a international interdisciplinary conference with the same title held in Wageningen, the Netherlands on 22-25 August 1993. The book is structured around issues of land-use planning methodology at different scales (supranational, national, regional and farm). The book aims at illustrating common features in landuse

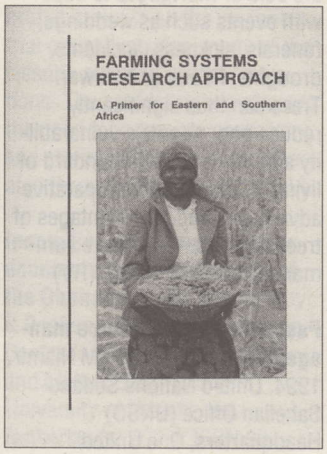


planning among agroclimatic and economic zones in the world. In the last chapter a plea is made to activate existing platforms and create new ones for negotiating landuse options between planners and farmers as one of the means to overcome the current "silence of the users" in future years. This plea points at the scientific flavour of this publication. (CR)

Opportunities, use and transfer of systems research methods in agriculture to developing countries edited by P Goldsworthy and F Penning de Vries. 1994. Kluwer Academic Publishers Group, PO Box 322, 3300 AH Dordrecht, Netherlands. 366 p. ISBN 0-7923-3206-7. These are the proceedings of a workshop on systems approaches and modelling for agricultural development organised by the International Service for National Agricultural Research (ISNAR) and the International Consortium for Application of Systems Approaches (ICASA). It assesses the state of the art of systems approaches in agricultural research, resource management and rural planning. It also gives an impression of the evolution of this interdisciplinary field and its use in national and international research centres. A book for specialists. (CR)

Systems-oriented research in agriculture and rural development. Papers presented on the International Systems-Oriented Research Symposium in Montpellier, 21-25 November 1994. CIRAD-SAR, BP 5035, 34032 Montpellier cedex 1, France. 1007 p. ISBN 2-87614-181-7. Papers are in English or French. The Symposium covered 7 main themes: methods, environment, high-input agriculture, indigenous knowledge, local organisations, training and agricultural policy. The heavy volume contains a very diverse collection of papers which provide an overview of current Systems-Oriented Research. (CR)

Farming Systems Research Approach: A Primer for Eastern and Southern Africa by DW Norman, JD Siebert, E Modiakgotla and FD Worman. 1994. 148 p. Farming Systems Programme c/o UNDP, PO Box 54, Gaborone, Botswana. A handbook on methodologies



used in Farming Systems Research (FSR), based on the experiences of the Farming Systems Programme in Botswana. The book provides a good overview of the different steps that should be taken in FSR. Farmer participation is a basic part of the approach although the book pays relatively little attention to it. Linkages with other actors besides farmers and station based researchers are discussed to some extent. Sustainability issues are hardly dealt with. One can conclude that FSR has become a consolidated research approach. But isn't it time to reorient FSR on the methodological demands of participatory development towards sustainable agriculture? (CR)

NEW IN PRINT

Women and water resources: continued marginalisation and new politics by F Cleaver, D Elson. 1995. Development and Project Planning Centre, University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK. 18 p. (IIED Gatekeeper series SA49). International Institute for Environment and Development (IIED), 3 Endsleigh Street, London WC1H 0DD, UK.
This paper stresses the potential and importance of trees as savings and security for many rural poor of the South. The many examples of poor people using trees as a long-term strategy to provide security or insurance against all kinds of contingencies, have long been overlooked and neglected. Trees or tree products are either used directly or they are sold or mortgaged to cope with events such as weddings, funerals, sickness, accidents, droughts, floods or civil war. Trees can thus significantly reduce poor people's vulnerability and improve their standard of living. The different comparative advantages and disadvantages of trees and other assets are summarised and discussed. (RV)

Pastoral natural resource management and policy by M Niamir. 1994. United Nations Sudano-Sahelian Office (UNSO) Headquarters, One United Nations Plaza, New York, NY 10017, USA. 93 p.
Proceedings of a workshop on pastoral development in Africa. African pastoralists face huge problems, both environmental (recurrent droughts, degradation of fallow land), social (breakdown of traditional resource management systems, population increase leading to displacement of pastoralists) and political (loss of mobility, national policies favouring crop production). Most pastoral development efforts in the past have aimed at livestock development and worked out negatively. Gradually, and with past failures in mind, a new approach to pastoral development is emerging, with a better understanding of range ecosystems and in which pastoral policies receive main attention. Various recommendations are given for improved range management, addressing issues such as decentralisation of power, recognition of the role of indigenous knowledge and participation of users in the design of resource management systems. An important publication, aiming at development professionals. (WB)

Regenerating agriculture: policies and practice for sustainability and self-reliance by JN Pretty. 1995. Earthscan Publications, 120 Pentonville Road, London N1 9JN, UK. 310 p. ISBN 1 85383 198 0 (pbk). £ 12.95.
Identifies the common elements of success in implementing sustainable practices in agriculture. Data stem from projects and programmes from various countries and ecozones. As the title suggests, there is a clear emphasis on policy frameworks and institutional processes in which sustainable agricultural practices may develop. With its rather austere and dense lay-out, the book is not a manual-type of publication, but rather a study about the nature of sustainability, primarily intended for a professional audience. (WB)

Health and sustainable agricultural development: perspectives on growth and constraints by VW Ruttan (ed.). 1994. Westview Press, 5500 Central Avenue, Boulder, Colorado 80301-2877, USA. 170 p. ISBN 0 8133 8838 4. £ 26.50.
An original subject, not normally treated separately in publications about sustainable agriculture. Health is looked at from four different angles: health policies, the current status of disease in the tropics, the relationship between health, environment and nutrition, and the implications of health for agricultural development. The publication is meant for a specialist audience of health, agricultural, and social scientists. Much knowledge is assumed at the readers' level, and it is not easy to distil a general conclusion from this book, apart from the observation that research systems should be designed in such a way that health issues are fully taken into account. (WB)

El machete verde: manual campesino by D Gagnon (ed.). 19??. SUCO, AP 1735, Managua, Nicaragua. ENLACE, AP 1735, Managua, Nicaragua. Contains 21 booklets.

A very beautiful information kit with many, superb drawings and a minimum of text. All major technical issues of farming in Central America are presented in such a way that the kit is ideally suited for extension, training and education in Spanish-speaking countries. One can only admire the intellectual effort that goes into condensing, often difficult, subjects into a few pages of drawings. Unfortunately, we have no information as to price and availability of this information kit. (WB)

Hair sheep production in tropical and sub-tropical regions: with reference to northeast Brazil and the countries of the Caribbean, central America, and south America by M Shelton, EAP Figueiredo (eds.). 1990. Centro Nacional de Pesquisa de Caprinos, Ministerio da Agricultura Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), Sobral CE, Brazil; Small Ruminant Collaborative Research Support Program (SR-CRSP), Univ. of California, Davis, CA 95616-8700, USA. 167 p.
Sheep make up only a small portion of the animal population of the tropical regions of Central and South America and essentially all of these are hair type sheep. In view of the great potential of this species, research has been undertaken by the Empresa Brasileira de Pesquisa Agropecuaria and the Small Ruminant Collaborative Research Support Program to increase sheep production in this area. The results of this collaboration served as a basis for this publication. It includes contributions on reproduction and genetic improvement; nutritional requirements, forage resources and supplemental feed resources; health management; sheep production systems; and products and marketing. This publication will also become available in Portuguese. (IHG)

Sheep production and management in a Mediterranean climate: the agropastoral system of Morocco by YM Berger, A Kabbali, GE Bradford (eds.). 1989. Small Ruminant Collaborative Research Support Program (SR-CRSP), Univ. of California, CA 95616-8700, USA. 251 p.
Highlights the role of sheep in agricultural systems. It seems the importance of small ruminants is often underestimated in national production statistics. It is the merit of the Small Ruminant Collaborative Research Support Programme to have carried out research programmes on the role of sheep and goats in developing countries and to have made information available to smallholders on the use that can be made of these animals. Sheep and goats play a very important role in agricultural systems around the Mediterranean and thrive well under these climatic conditions. This publication reports about a SR-CRSP project studying the cereal-sheep agricultural system of Morocco. Target audience is extension personnel dealing with small ruminants, particularly in the Mediterranean region. The publication is technically oriented. Ways of how to best convey the extension message were clearly not the first priority when writing this book. (WB)

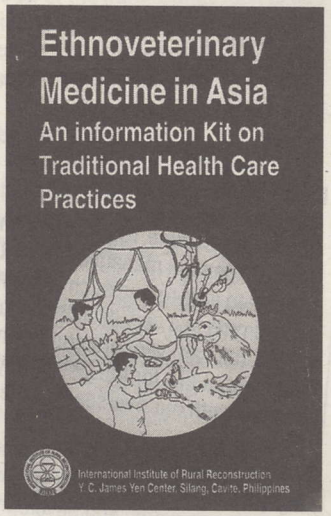
Plants for use in permaculture in the tropics by FW Martin. 1994. Yankee Permaculture, PO Box 672, Dahlonega GA 30533-0672, USA. (Yankee Permaculture Series of Permaculture Papers 31). 54 p.
Permaculture is a concept of land

NEW IN PRINT

utilisation based on the use of perennial and multiple-purpose crops. Although an approach to ecologically sound agriculture, land use and life style, this manuscript will be useful for anyone planning their own food production system or for a small farm in the tropics. Major characteristics of the most useful multi-purpose plants are summarised. Food crops get different ratings for multiple uses, such as food, feed, fibre, construction, fuel, soil amendment, erosion control and microclimate modification. Appended is an international list of groups serving as resources for tropical permaculture and a list of (mainly US) suppliers of planting material. A lot of practical information in a very condensed review. (IHG)

Coming to life: biotechnology in African economic recovery by C Juma, J Mugabe, P Kameri-Mbote (eds.). 1995. African Centre for Technology Studies (ACTS), PO Box 45917, Nairobi, Kenya. 192 p. ISBN 9966 41 087 2. Zed Books, 7 Cynthia Street, London N1 9JF, UK.
Pleads for increased use of biotechnology in order to boost Africa's economic recovery. This publication looks at technology policy formulation in a number of African countries and concludes that national policies lack coherency to make adequate use of what knowledge is available at the indigenous and global levels about biotechnological processes. The author argues major institutional and policy reforms and increased application of science and technology findings are necessary for Africa to meaningfully deal with its ecological and economic problems. The message of the book is important, but, unfortunately, its lay-out does not make for easy reading. (WB)

The Oxfam gender training manual by S Williams ; J Seed, A Mwau. 1994. Oxfam, 274 Banbury Road, OX2 7DZ, Oxford, UK. 634 p. ISBN 0 85598 267 5. £ 30.00. Oxfam Publishing, 274 Banbury Road, OX2 7DZ, Oxford, UK.
A huge training manual in the field of gender awareness, describing a large number of participatory activities previously tested in workshops and training courses and drawing on Oxfam's own experience with gender training over the past few years. The manual is designed for NGO staff and gender trainers. Central theme is its focus on self-awareness work, as the key to insight in gender inequalities. Only increased awareness can bring about the change in attitude necessary at planning and operational levels of development agencies. Despite its size, over 600 pages, the use of the manual remains easy because of the book's very clear structure. All working sessions have been timed. A very useful publication. (WB)



Ethnoveterinary medicine in Asia: an information kit on traditional animal health care practices. 1994. International Institute of Rural Reconstruction (IIRR), YC James Yen Center, Silang, Cavite 4118, Philippines. 145, 143, 72, 40 p. ISBN 0 942 717 627.
Ethnoveterinary medicine, the science of traditional livestock practices, contains valuable alternatives for Western veterinary medicine as remedies are adapted to local culture, are inexpensive and locally available. Little information exists, however, on practices that work and can be recommended. IIRR brought together individuals from different tropical Asian countries, with experience in the application of ethnoveterinary medicine at field level or who had tested such remedies with farm animals. The manual was compiled from contributions, experiences and views generated at a workshop organised by IIRR. The set is divided into four booklets, three of which are on specific topics: ruminants (small and large), swine and poultry. The fourth booklet contains general information, mainly on medicinal plants and their application. The kit is well-structured and contains very clear illustrations. (IHG)

People, plants and patents: the impact of intellectual property on biodiversity, conservation, trade, and rural society by the Crucible Group. 1994. International Development Research Centre (IDRC), PO Box 8500, Ottawa, Ontario, Canada K1G 3H9. 118 p. ISBN 0 88936 725 6. CA$ 12.95.
A report on intellectual property and its implications for agricultural development, written by a group of scientists, trade diplomats and policy makers. Throughout the book, a number of policy recommendations are given. Biological diversity is seen as the key to sustained agricultural productivity. The Group provides many examples of what may have negative effects on the conservation of biological diversity. To cite but one example: at this moment, most of the genetic material in germplasm collections is kept outside the country of origin, by international institutions, in which farmers are not represented. Although the issues of patents and intellectual property are, obviously, included in the GATT trade agreement, the terms of that agreement are sufficiently vague so as to allow various interpretations of how to protect-patent legislation of plant varieties. A carefully edited publication, with a very nice lay-out, but mainly intended for an audience dealing with policy issues. (WB)

Participatory rural appraisal: practical experiences by J Nabasa, G Rutwara, F Walker, C Were. 1995. Natural Resources Institute (NRI), Central Avenue, Chatham Maritime, Kent, ME4 4TB, UK. 52 p. ISBN 0 85954 392 7. £ 7.50.
Within the recent explosion of publications on Participatory Rural Appraisal (PRA) this booklet takes the commendable position that PRA is not an end in itself, not a panacea to all development frustrations, but rather an effective means to establish true partnership among all involved in development activities. Based on solid and longer-term experiences in Uganda the booklet describes how PRA methods and techniques can be used in various combinations and in various stages of a participatory agricultural development process. Although the context is that of a researcher initiated and driven research process, as the elaborated example on the on-farm trial cycle illustrates, many of the lessons are valid in other situations. The booklet rightly stresses the need for adequate processing and storing of information generated through PRA activities. (LV)

Innovation adoption as a socio-economic process: the case of the Ghanaian cocoa industry by K Boahene. 1995. Interuniversity Center for Social Science Theory and Methodology (ICS), University of Utrecht, the Netherlands. 209 p. ISBN 90 5170 333 3. Thesis Publishers, Amsterdam, The Netherlands.
Tells the tale of cocoa in Ghana, where hybrid varieties had been introduced to help revive the declining cocoa output. An appreciable number of farmers have not adapted these modern hybrids. This book examines factors which influenced the acceptance of modern varieties by farmers and broadens conclusions towards adoption of agricultural innovations. It also shows that the individual farmer's socio-economic situation and farming conditions exert much influence on the farmer's final decision as to which varieties will be planted. The language used in this thesis is economic and statistical. Therefore, readers need to be academically oriented. (WB)

ILEIA NEWS

Rectifications

On page 32 of this year's March issue, ILEIA was wrongly mentioned as the source from which the book "Planning with pastoralists: PRA and more" can be obtained. GTZ (Division 422, PO Box 5180, D-65726 Eschborn 1, Germany) is the sole publisher of the book.

On page 4-6 two articles were published on the activities of VACVINA in Vietnam. One of the authors, Rosemary Morrow wrote to us: "By a serious oversight on my part I did not mention that Mr. Phi Van Ha was the manager of the QSA/VACVINA project on the sand dunes. I want to credit him with excellent administration and implementation of this project. I am very sorry that his name was not in the article and would like this omission rectified as he accomplished the work so ably."

When introducing our new staff in ILEIA News, we forgot to mention what Maja Kooistra's task will be within the team. She will be ILEIA's research coordinator.

Contributions

The following articles have been received by ILEIA and will not (yet) be published. If you are interested in the subjects, please request a photocopy from Lila Felipie at ILEIA.

- Doshi, RT. **City farming - Bombay experiment.** Describes a method of growing crops in old sacks, using biomass available in the city (e.g. sugarcane residue) and kitchen waste.
- Kumar, A.**Valley cultivation: in harmony with nature.** Describes the agricultural system of the Apatanis tribals of Arunanchal Pradesh (wet rice cultivation in terraced valleys), India.
- Nagarajan, R, Neelanarayanan, P and Kanakasabai, R. **Barn owl: a potential rodent pest control agent.** The role of the barn owl in rodent pest control is investigated and a conservation and propagation strategy is given.
- Oqbuinya OP. **Landcare: a conditional imposed necessity in Nigeria**. Without going into much detail, this article describes some features of Nigerian land care.
- Santiago, A. **Urban gardening, landscaping and soil conservation using worn tyres and wastes**. Gives practical information on different uses of worn rubber tyres for urban gardening and landscaping.
- Subedi, KD. **In-situ manuring: a traditional system of maintaining soil fertility in the hills of Nepal.** Describes farmers' indigenous knowledge about the system of tethering animals in crop fields and about the role of migratory herds.

On-line

The ILEIA document database is now accessible on-line through AGRALIN, the agricultural information system of Wageningen Agricultural University. Over 6,000 published and unpublished documents (newsletters, reports, papers and monographs) are described. Nearly all have keywords and a rapidly increasing portion also has an abstract. We compiled these keywords from the FAO Agrovoc thesaurus. For specific LEISA ideas, we designed a special set of descriptors. With each entry, sources are given. We are pleased that by making our database available to a large academic audience, the University acknowledges the importance of Low-External-Input and Sustainable Agriculture. Please note that ILEIA's computerised library catalogue is also available on diskette. For Dfl. 75.- per year, it comes with "read-only" software and runs on any DOS computer. If you're interested, please write to Wietse Bruinsma at ILEIA.

LEISA in semi-arid regions

The December issue of the ILEIA Newsletter will be on "damming drains": Stopping the drain of natural, human and financial resources in *semi-arid agriculture* by optimising their use. Articles are requested which deal with subjects such as management of nutrient and organic matter flows (e.g. integrated plant nutrient supply, recycling of organic waste, green manuring, erosion control, nutrient harvesting, micro-nutrients, nutrient balance), water management (e.g. small-scale irrigation, water harvesting, improving waterholding capacity of the soil), soil tillage, micro-climate management, crop - livestock (- tree) integration, (organic) cultivation of resistant crops, fodder or fruit production, (indigenous knowledge on) animal health care or crop protection, genetic resource conservation, animal traction, improving tools or storage, landuse planning, management of the commons, sedentary farmers and pastoralists working together, added value by post-harvest processing, etc.

If you are interested to contribute in any form, please request a more detailed outline and a guide for authors from ILEIA. Proposals for articles should be in our office end of August. Articles should be in by 1 October.

Dear friends,

On the first of June 1995 Clive Lightfoot took over the responsibility of the general management of ILEIA. I am very happy that we have been able to find such a qualified professional to head our programme in a very essential phase of its existence and at the same time I am very grateful for the fact that I had the chance to work with ILEIA for the last eight years. I tremendously enjoyed working with our overseas partners and my colleagues of the ILEIA team.

Since I joined in 1986, the general perception about sustainable agriculture, the role of external inputs, farmers' knowledge and priorities for research and development have changed a lot. Sustainable Agriculture is now very much a focus for the mainstream institutions and the participatory approach in technology development is becoming widely accepted. ILEIA has played a stimulating role in this process and more than 8000 members of the global network have mobilised more than enough evidence that the LEISA approach is promising and worth more support.

I have experienced that the majority of the people who work towards this approach are motivated persons who, rather than repeating conventional concepts, follow their own logic and trust their own ideas of what is necessary in order to develop agriculture for smallscale farmers.

I will continue to be a supporter of ILEIA and remain member of the network. As one of the managers of ETC Netherlands I will stay involved with the programme. Further, in the context of COMPAS, a project to support bio-cultural diversity in agricultural development that my colleague Wim Hiemstra and I have recently started, I hope to stay in contact with many of my friends who are interested in indigenous farmers knowledge and endogenous development.

Bertus Haverkort

NETWORKING is open for (short) contributions from readers. If you wish to ask advice from other readers, or if you wish to announce a workshop or training course or if you just want to react on articles that appeared in the ILEIA newsletter or other hot news items related to sustainable agriculture, please write. We may have to shorten submitted contributions.

Urban agriculture: food is money

Your issue "Farming at close quarters" is a very interesting issue. However, these points may have been overlooked in your articles and they apply a different lens to urban agriculture:

- For the poor, food and money are almost the same thing. The urban poor in developing countries spend 60 to 90 percent of their income on food. If you or I, as a mother, spend 4 of our 5 guilders for food, how much difference does it make if my work produces food or guilders? Growing for "subsistence" and for "sale" are not so different. And we need to study that difference.
- Urban farmers provide "landscape maintenance" for the city and conserve the soil. Municipal costs are avoided and environmental degradation reversed.
- Fifty percent of all vehicle movements from the north into Port au Prince in 1990 were food shipments. In poor cities, where half they economy is food and fuel, a great deal of the traffic congestion is due to food moving from the countryside to the urban kitchen. Urban agriculture cuts congestion and reduces infrastructure costs.

Jac Smit, The Urban Agriculture Network, 1711 Lamont Street NW, Washington DC 20010, USA.

Bibliography on local crop development

The Centre for Genetic Resources, the International Plant Genetic Resources Institute and the Overseas Development Institute are working together to produce an annotated bibliography on local crop development. Most farmers continually modify the genetic characteristics of their crops. The term "local crop development" is preferred to "local crop improvement"since in many cases the objective is not to achieve specific improvements, but to gradually adapt and change their varieties. Information on local crop development is scattered throughout the literature of social sciences and plant sciences. This bibliography brings literature together and provides insight in the range of research activities on local crop development. It is organised in four thematic sections each listing key references: (i) descriptive studies on local crop development, local seed systems and related local knowledge systems; (ii) biological studies on local crop development; (iii) social, economic and policy aspects; (iv) research methodologies relevant to local crop development. All entries include an abstract and the bibliography is indexed by crop, country and subject. Would you like your organisation's library to receive the book by end 1995?

Send a request to: J. Dearing, Library & Information Services Officer, IPGRI, Via delle Sette Chiese 142, 00145 Rome, Italy. Please quote reference IL/LCDB.

Conference on Plant Genetic Resources

Preparations are made for the Fourth International Technical Conference on Plant Genetic Resources to be held in June 1996 in Germany. This conference should result in the adoption of a State of the World Report and a Global Plan of Action. NGOs concerned with the on-farm genetic resources management agenda, and farming and indigenous communities have a unique opportunity to influence the results of this conference and push for integrated farming approaches to agricultural genetic resources management. How? Contribute to the writing of national reports.

For contact addresses in your country, or for more information, get in touch with GRAIN, Girona, 25 - pral., 08010 Barcelona, Spain (fax: +34 3 3011627; e-mail: grain@gn.apc.org).

Participatory Methodologies Forum of Kenya launched

A network was launched in Kenya to enhance the use of participatory development approaches. Areas of collaboration may include exchange visits, training, funding of network activities, a database of resource persons, an information and documentation centre and dissemination/exchange of audiovisuals and written materials. Are you interested to join this network?

Write to: Margaret M. Kitonga, PO Box 58684, Nairobi, Kenya. Fax: + 254 2 442 136

Seminar in Tehran

The Biological Control Department of the Iranian Plant Pests and Diseases Research Institute organises a seminar on subjects like IPM, Biological control, bio-diversity and sustainable agriculture, 2-7 September 1995. "A new policy of Iran's Ministry of Agriculture is reduction of pesticide use and subsidy elimination", says Dr. H. Bayat Assadi, president of the institute. "We are looking for people who like to help us with presentations, videos, slides, posters and other training materials."

Please write to: PPDRI, Dr. H. Bayat Assadi, Biological Control Dept, PO Box 19395-1454, Tehran, Iran. Fax: +98 21 2043691.

Animal traction

ATNESA, the Animal Traction Network for Eastern and Southern Africa, organises a workshop "Meeting the challenges of animal traction in Kenya, 4-8 December 1995. Themes of this network meeting include gender issues in animal traction technology, improving animal-drawn transport, animal power for weed control and the challenges of donkey utilisation. Apart from exchanging experiences in research, development, training and extension, the workshop will also review the past five years of the network's activities and identify topics for future ATNESA workshops, publications and activities.

Contact: KENDAT, attn. Dr. Pascal Kaumbutho, Dept of Agricultural Engineering, University of Nairobi, PO Box 30197, Nairobi, Kenya. Fax: +254 2 593 465. e-mail: kendat@ken.healthnet.org.

Food, culture, trade and the environment

Under this title, the second IFOAM-Asia Assembly is organised in Seoul, Korea, 19-22 July 1995. The conference aims to bring together farmers, consumers and trade groups to assess constraints and new initiatives for sustainable agriculture and safe consumption. It further hopes to strengthen a citizens' "farm-to-table" platform for sustainable agriculture and consumption. A shift to sustainable agriculture and consumption implies shifts in the social and economic spheres of society. Citizen's participation is the cornerstone to re-establishing farmer-consumer partnerships.

For more information: PAN, PO Box 1170, 10850 Penang, Malaysia. Fax: +60 4 6577445. e-mail: panap@geo2.poptel.org.uk.

Forestry extension survey

The Forestry Department of the United Nations Food and Agriculture Organization (FAO) is attempting a global survey of forestry extension organisations, in order to facilitate exchange of information and experience related to forestry extension. Data would eventually be available in hard copy and electronic forms. Any organisation wishing to be part of the database should send information on their organisation and its extension approach to:

Jon Anderson, Extension Survey, FORC - Room B.362, FAO Forestry Department, Viale delle Terme di Caracalla, 00100 Rome, Italy. Fax: +39 6 5225 5137. e-mail: jon.anderson@fao.org.

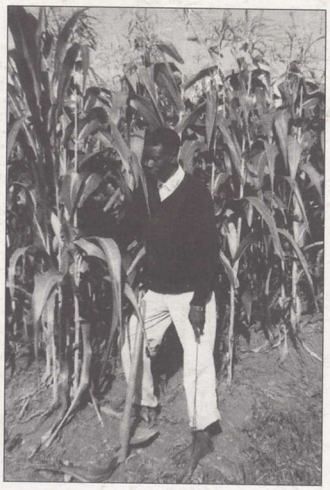
Aquaculture training

The Aquaculture Short Course Unit of the Asian Institute of Technology offers interesting courses and conducts 10-day study tour programmes on request. Special Programmes in Aquaculture are also offered for those who are interested in a 6 to 9 month study period.

For more details contact: ASCU, AIT, GPO Box 2754, Bangkok, Thailand. Fax: +662 5246200. e-mail: ascu@rccvax.ait.ac.th.

Fair Trade

Three hundred participants from about 40 countries participated in the 4th International IFOAM Conference "Trade in Organic Products" early March this year. The debates and discussions reconfirmed that society and environment can not tolerate "Free Trade" as it is understood by GATT unless it is based on Fair Trade principles. The conference also showed that an environmentally sound food production as outlined in the organic principles and Fair Trade are "natural" partners. Other topics centred around aspects of marketing, laws and regulations and quality assurance. Those who could not participate at this conference can order the conference book (130 pp, DM 20.- plus postage) from the following address:
IFOAM, c/o Ökozentrum Imsbach, D-66636 Tholey-Theley, Germany.
Fax: +49 6853 30110.

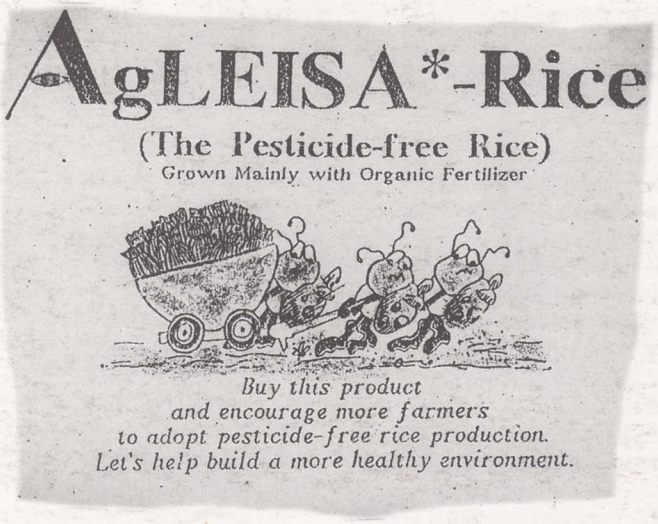


"Thanks a lot for your advice and for sending us the ILEIA Newsletter. Here in Malawi we have three main varieties of maize, MH18, MH16 and MH17. In the picture you see me with MH18. I am very much in favour of farmer experimentation and innovation. Thank you!"

O.O. Simwela, Postal Staff, Ifumbo, Chitipa, Malawi.

AgLEISA-Rice

Under this name, the LEISA-RICE Cooperators of Agtalon in the Philippines sell their pesticide free rice. This is what it says on the lable:



More information from: Agtalon, Nalsian, Manaoag, Pangasinan 2430, Philippines

PTD Circular No 3

The third issue is out now. Six pages of annotated bibliographies, training events, audio-visuals, networks, magazines and reading tips can be ordered free of charge from ILEIA. An extra bonus: this PTD Circular contains a one-page training module on using the right words when discussing participatory development with villagers. If you wish to subscribe to this six-monthly update, send a note to Marika van den Brom at ILEIA.

Next issue

Vol. 11 No.3 "Working with Weeds"is scheduled to appear mid-October.

Free book catalogue

The Natural History Book Service Ltd (NHBS) issues a free environment and ecology catalogue twice a year. The catalogue contains over ten thousand titles (partly new ones) on subjects like ecosystems, habitat and species conservation and uses and management of natural resources. Of course, ordering books this way is slightly more expensive. You can also search the NHBS BookNet for free on Internet. The address is: http://www.-nhbs.co.uk.

Contact: NHBS, 2-3 Wills Road, Totnes, Devon TQ9 5XN UK.
Fax: +44 1803 865280.
e-mail: nhbs@nhbs.co.uk

Farmers and Agenda 21

IFAP President Graham Blight, farmer by profession, was invited to give a presentation in a session on Agenda 21, which took place during the first week of the UN Commission for Sustainable Development in New York. Graham expressed his disappointment in noting that in the report, farmers are not mentioned. "When the Secretary General opened the Summit for Social Development in Copenhagen, he did not mention farmers or food once. Yet farmers are half the world's population and food is the first basic ingredient of social development," he said. He further stressed the importance of strengthening farmer organisations: "Farmers must have an effective channel to articulate needs, identify land-use problems, formulate their own solutions, have dialogue with, and collaborate with government and intergovernmental agencies in setting research, training and extension priorities in an equal partnership. There must be a consultative mechanism which helps set a policy environment which is supportive of farmers' initiatives, so that they are motivated and facilitated in the many tasks society expects of them.... The failure to treat farmers as the centre of policy making decisions will result not only in a continuation of environmental problems and the exacerbation of rural poverty but also bring into question the ability of the farming population to ensure food security for coming generations."

IFAP, 21 rue Chaptal, 75009 Paris, France. Fax: +33 1 48747212.

BACK COPIES of the ILEIA Newsletter are available: (US$ 5)

Vol.3/No.2:	Diversity
Vol.4/No.3:	Participatory technology devt
Vol.4/No.4:	Enhancing dryland agriculture
Vol.5/No.1:	Discussion on sustaining agriculture
Vol.5/No.2:	Intensifying agriculture in humid area
Vol.7/No.1/2:	Assessing farming techniques
Vol.7/No.3:	Learning for sustainable agriculture
Vol.7/No.4:	Searching for synergy
Vol.8/No.2:	(reprint) Let's work together
Vol.8/No.3:	Livestock sustaining livelihoods
Vol.9/No.1:	Keep rolling
Vol.9/No.2:	Cutting back on chemicals
Vol.10/No.2:	Caring for our land
Vol.10/No.3:	Wastes wanted
Vol.10/No.4:	Farming at close quarters
Vol.11/No.1:	Room for farmers

(issues not listed are out of print)

Also available: **Participatory Technology Development in sustainable agriculture: an introduction**. 1989. 40 pp. US$7.50. **Le développement participatif de technologies,** a translation into French of ILEIA Newsletter Vol.4/No.3 (US$). Third World readers may request a free copy.