Sustainability Indicators for Natural Resource Management & Policy

Working Paper 2

A Framework for Research on Sustainability Indicators for Agriculture and Rural Livelihoods

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The effects of policy and institutional environment on natural resource management and investment by farmers and rural households in east and southern Africa

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Background to Project and Working Paper Series

This paper is one in a series of working papers prepared under a research project on '*The Effects of Policy on Natural Resource Management and Investment by Farmers and Rural Households in East and Southern Africa'*.

This is a collaborative research project implemented by Agricultural and Rural Development Research Institute[1], the Development and Project Planning Centre[2], the Economic Policy Research Centre[3], the Institute for Development Policy and Management[4] and the Centre for Agricultural, Food and Resource Economics[4]. The project is supported by the UK Department for International Development (DFID) under their Natural Resources Policy Advisory Department (NRPAD) research programme. The project commenced on 1 July 1998 and is to run for a three year period.

The overall goal of the project is for it to assist in the development of more effective, equitable and sustainable participatory management of renewable natural resources in sub-Saharan Africa. The purpose of the research is to identify the links between the sustainability of different farming systems and agricultural policy in South Africa and Uganda.

This is to be achieved through a series of case studies in Uganda and South Africa which will examine "the success or sustainability" of small and large scale systems from a range of perspectives including: farmers, communities, scientists, planners and policy makers. This will include the identification of criteria used to assess the "success" of these systems, and the adoption or development of verifiable and measurable indicators of this "success". The impacts of different polices on the degree of success of these systems will be assessed in terms of their effect on farmers' management of, and investments in, their natural resources, and in the development of sustainable rural livelihoods.

This paper *'A Framework for Research on Sustainability Indicators for Agriculture and Rural Livelihoods'* is the second in the series of the project working papers. It sets out the 'sustainable rural livelihoods' (SRL) approach as a framework for analysing management and investment in natural resource use, and proposes an integration of this with the widely-used indicator frameworks reviewed in working paper 1 of this series. The paper then sets out a series of issues which need to be taken into account in order to operationalise and evaluate this indicator framework in Uganda and South Africa.

This research was funded by the Department for International Development of the United Kingdom. However, the findings, interpretations and conclusions expressed in this paper are entirely those of the author(s) and should not be attributed to the Department for International Development, which does not guarantee their accuracy and can accept no responsibility for any consequences of their use.

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Project Working Papers to date

1. A Review of Indicators of Agricultural and Rural Livelihood Sustainability

2. A Framework for Research on Sustainability Indicators for Agriculture and Rural Livelihoods

3. Natural Resource Management and Policy in Uganda: Overview Paper

4. Natural Resource Management and Policy in Eastern Cape Province, South Africa: Overview Paper

5. Stakeholder Analysis and Local Identification of Indicators of Success and Sustainability of Farming Based Livelihood Systems.

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1 Introduction: overview of project objectives and methodological approach

The purpose of the project is to contribute to planners' and policy makers' understanding of what policies and institutions are required for effective, equitable, and sustainable management of renewable natural resources. The project aims to achieve this purpose by evaluating a methodology for the application of sustainability indicators (SI) to renewable natural resource management.

In the first place, this requires identification of a restricted set of *indicators* which address productivity, equity, and sustainability in renewable natural resource use. These indicators need to be linked explicitly to an *analytical framework* linking natural resource use to rural livelihoods. They must also offer realistic prospects of being measurable in rural areas of South Africa and Uganda.

Secondly, evaluation of indicators requires the identification of *study areas* in both South Africa and Uganda. Each study area is understood to be a more or less homogeneous agroecological or climatic zone. Within each study area, *study sites* will be identified that provide contrasting farming systems. As far as possible, study sites will encompass contrasts in terms of the perceived 'success' and 'failure' of farming, and in terms of the scale of resource management (large-scale vs. small-scale).

It is important to note that these criteria for site selection are intended purely as a 'sampling' device to ensure the fieldwork covers a wide range of natural resource management contexts in which to evaluate the applicability or utility of sustainability indicators. Thus, while site selection is guided by contrasts in *farming system*, this does not imply that analysis will be restricted to agricultural resource use or users. For each study site, the analysis will include both 'farming' and 'non-farming' resource users and the interaction between them, and streams of income and investment generated outside as well as within the study site. Effectively, while the sample is constituted by 'farming systems', the analysis may be regarded as addressing 'livelihood systems'.

Similarly, criteria of 'success' or 'failure', which may be provided in the first instance by government agencies, imply no acceptance on the part of the project research team that such perceptions are accurate in relative or absolute terms, since such conclusions will be drawn only on the basis of the analysis of the case-study areas and the application of sustainability indicators and other criteria generated by stakeholders in the management of the natural resources in question.

The inclusion of large- and small-scale farming systems, although often identified with commercial and non-commercial production is not the same: small-scale production may be more or less commercial in orientation. We specify scale of production as a criterion because we are interested to see whether the same sustainability indicators are applicable at different levels of capital investment relative to labour input.

Key outputs of the research will be:

- Identification and clarification of criteria for the perceived success and failure of farming systems in target countries in terms of equity (including gender), production, and environmental sustainability
- Development and testing of a practical methodology for measuring sustainability of natural resource users' livelihood strategies and to link this to the development of natural resource management polices.

- To assess the extent to which policy initiatives and institutions have affected (both negatively and positively) the development of these successful and failing farming systems.

The following sections of this paper set out in more detail:

- The sustainable livelihoods analytical framework.
- The principal indicator frameworks, and an initial list of indicators which appear relevant to this research.
- A review of methodological issues which need to be considered in adopting indicators in the study areas for this research.

These elements of the methodology were discussed at a planning meeting held in East London from 8 to 13 April 1999. This document presents a framework for the studies which the project will undertake in South Africa and Uganda in 1999-2000. This document is now being circulated to the project advisors, mentors and all project researchers for final comment.

2 Sustainable Rural Livelihoods (SRL) framework

2.1 Introduction

The Sustainable Rural Livelihoods (SRL) framework is the most recent development of an approach to the analysis of links between livelihoods and natural resource use which has been widely discussed in recent years (Scoones, 1998; Carney, 1998; Ellis, forthcoming). Its central idea is that sustainability of livelihood *strategies* of individuals or households depends on access, use, and development of different types of *assets*. The framework further considers that the kinds of strategies which may be available, the choices made, and the outcomes achieved are influenced by two sets of factors which establish a *context*. The framework has been developed primarily to address the needs of policies and project interventions to reduce rural and urban poverty. In this research we shall be exploring its applicability to the analysis of both livelihood strategies of smallholder farmers and business strategies adopted by large-scale farming.

Figures 1 and 2 offer alternative versions of the SRL framework. Figure 1 emphasises the different elements of the framework, while Figure 2 emphasises the interactive ‘feedback’ linkages between elements of the framework.

An important feature of the framework, which makes it particularly appropriate to this project, is that it explicitly recognises the importance of urban-rural linkages and of the wider economic, institutional, and policy context as part of the analysis of strategies of natural resource management. From this it is clear that while analysis may be focused on the individual, household, or village level, natural resource management strategies and their outcomes can only be understood in relation to a context, the full extent of which may only be visible at the level of catchment, district, region, or agroecological zone. It is essential, therefore, that the analysis covers the necessary range of scale.

The elements of the SRL framework are now defined in more detail.

2.2 Assets

Assets are considered to be stocks of different types of ‘capital’ that can be used directly or indirectly to generate livelihoods. They can give rise to a flow of output, possibly becoming depleted as a consequence, or may be accumulated as a surplus to be invested in future productive activities. The SRL framework identifies five basic types of capital that comprise assets for livelihoods: natural, physical, financial, human, and social.

Natural capital consists of land, water, and biological resources such as trees, pasture, and wildlife. The productivity of these resources may be degraded or improved by human management.

Physical capital is that created by economic production. It includes infrastructure, such as roads, irrigation works, electricity supply, and reticulated water, and also producer goods such as machinery.

Human capital is constituted by the quantity and quality of labour available. At household level, therefore it is determined by household size, but also by the education, skills, and health of household members.

Financial capital consists of stocks of money or other savings in liquid form. In this sense it not only includes financial assets such as pension rights, but should also include easily-disposed assets such as livestock, which in other senses may be considered as natural capital.

Social capital includes any assets such as rights or claims which are derived from membership of a group. This includes the ability to call on friends or kin for help in times of need, support from trade or professional associations (e.g. farmers' associations), and political claims on chiefs or politicians to provide assistance. These latter are sometimes discriminated as 'vertical' claims on structures of authority, contrasted with 'horizontal' claims among group members of similar status. The ability to make such claims may be considered as a mark of social inclusion or exclusion of particular individuals or groups.

2.3 Context

The terminology for this element of the framework varies between authors, but generally identifies two distinct aspects of the context which conditions the options for livelihood strategies. The first of these covers a range of historical and current socio-economic trends, such as demography, terms of trade, technological change, and income distribution. Rapid changes in such factors, along with major disruptions such as drought, floods, war, may constitute 'shocks' to which livelihood strategies have to adapt quickly. The second aspect of the context for livelihoods is that of 'structures and processes' in the political realm (i.e. subject to policy). These include *institutions*, such as those of custom, legislation, property (e.g. land tenure), and market regulation. It also includes *organisations* of government and civil society through which institutions operate.

It is important to note that these elements of the context can be either macro or micro in operation: 'custom' and 'property' is established as much through practice at local level as it is through national political debate and legislation. Both macro and micro context will have an impact on livelihood strategies.

2.4 Strategies

Livelihoods have been defined as the assets, activities, and access determining the living gained by individuals or households (Ellis, forthcoming). Scoones (1998) has identified three broad livelihood strategies: intensification or extensification of existing productive activity; diversification by adopting additional productive activities; migration to develop productive activity elsewhere. It is important to note that these are not exclusive, and may be combined in practice. Further, the three broad strategies evidently include those not based on natural resource use as well as those which use natural resources, and allows an exploration of the interplay between them. Two important issues in the analysis of the role of particular assets in livelihood strategies are those of sequencing and substitution.

Sequencing refers to the fact that productive use of certain assets may require the prior access to and use of other assets. Financial and physical capital (cash and machinery) may be necessary to achieve productive use of land through cultivation, for example. In certain circumstances financial or social capital may be prior requirements for access to land.

Substitution refers to the liquidation or depletion of one asset to accumulate another. Financial capital may be liquidated to invest in physical capital such as equipment, or human capital, such as health or education. Natural capital in the form of trees or livestock may be converted into financial capital. The ability to convert one form of capital asset into another is likely to be an advantage where livelihood strategies must adapt to rapid change in contexts.

2.5 Outcomes

It must be recognised (Figure 2) that the outcomes of livelihood strategies will be of significance not only in terms of livelihoods and natural resources, but will possibly feedback upon the context and hence the further development of livelihood strategies. For the purposes of this research, it is livelihood outcomes which are the basis for assessing the sustainability of particular strategies of natural resource use. In considering what aspects of outcomes will provide useful indicators for such assessment, we can identify an initial list, based on the five types of capital identified by the SRL framework.

Natural capital:

Access to land, water, grazing.

Ownership of herds, trees

Productivity (per unit of land, per unit of water, per unit of inputs)

Soil, water, rangeland, quality

Biodiversity

Financial capital

Income levels, variability over time, distribution within society

Financial savings, access to credit

Debt levels

Physical capital

Access to roads, electricity, piped water

Ownership/access to productive equipment (oxen, tractor , irrigation pump etc)

Housing quality

Human capital

Total labour

Educational level, skills

Health levels

Social capital

Membership of organisations

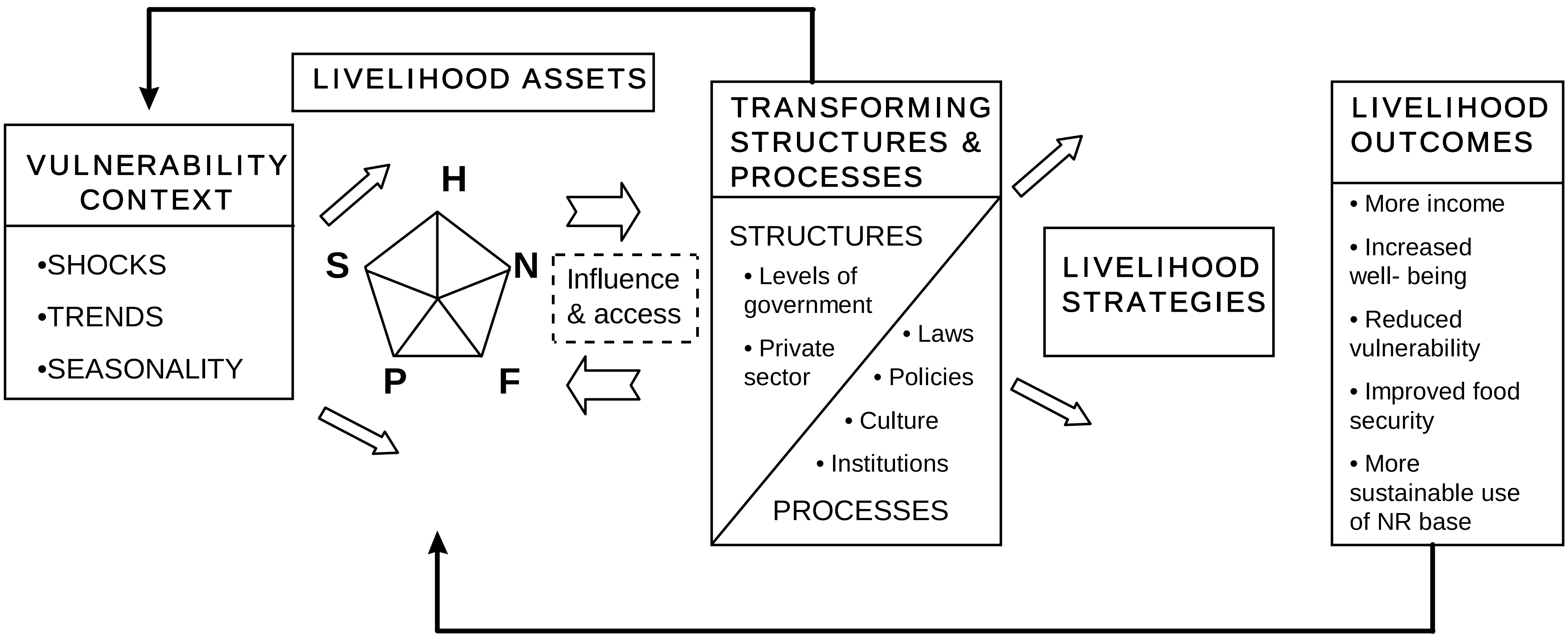
Support from kin, friends

Accountability of elected representation

Figure 1 Elements of a Sustainable Rural Livelihoods framework (Ellis, forthcoming)

A	***B***	***C***	***D***	***E***	***F***
Assets	***Structures and processes***	***Context***	***Strategies***	***Strategy elements***	***Outcomes***
Natural capital Physical capital Human capital Financial capital Social capital	**Social relations:** • Gender • Class • Age • Ethnicity **Institutions:** • Rules and custom • Land tenure • Markets in practice **Organisations:** • Associations • NGOs • Local administration • State agencies	**Trends:** • Population • Migration • Technological change • Relative prices • National and international economic trends **Shocks:** • Drought, floods • Pests • Diseases • War	**Livelihoods**	**NR-based activities** • Collection • Cultivation • Livestock • Nonfarm NR management **Non-NR-based** • Rural trade • Rural manufacture • Remittances and transfers (e.g. from migration)	**Livelihood security:** • Incomes level • Income stability • Seasonality • Risk **Environmental sustainability:** • Land quality • Water • Rangeland forests • Biodiversity

Figure 2 The Sustainable Rural Livelihoods Framework (Carney, 1998**)**



Key

H = Human Capital **S= Social Capital**

N = Natural Capital **P = Physical Capital**

F = Financial Capital

3 Indicator Frameworks for Sustainability Evaluation

3.1 Background to sustainability indicators

The main thrust for sustainability indicators for renewable natural resource management and in agriculture and rural development in particular has its origins in the sustainable development paradigm. The widespread "adoption" or pursuit of sustainable development, and indicators of sustainability, took off following the Earth Summit in Rio in 1992. Agenda 21 called for the development of, amongst many things, sustainable agriculture and land management as well as the systems necessary to monitor their achievement. This has led to a wide range of activities which have sought to define sustainability and, of particular relevance to this project, sustainable agriculture, land management and forestry (see Pretty, 1995 for comments on the number of different definitions since the Brundtland Commission (WCED, 1987)). FAO have developed 40 methodology sheets on how to calculate indicators in the areas of agriculture, biological diversity, desertification, fisheries, forestry, freshwater, land use, and mountain ecosystems. Basher (1996) states that currently there is no general agreement on appropriate indicators and many countries are in the process of establishing environmental monitoring networks and testing potential environmental indicators (e.g. Kerr, 1990; Messer *et al.*, 1991; Hamblin, 1992; Doran *et al.*, 1994).

Most, if not all, of these initiatives have been technically led, and have tended to focus on a natural science view of sustainability and associated issues. The Framework for the Evaluation of Sustainable Land Management (FESLM, Smyth and Dumanski, 1993) has, for example, been developed from a technical land management or soil science starting point. Alternative approaches have focussed on community indicators identified through participatory approaches. These have included the International Institute for Sustainable Development, IISD, programme on Community Adaptation and Sustainable Livelihoods, CASL, in sub-Saharan Africa, and an IIED project in Brazil on participatory monitoring and output assessment of sustainable agriculture (Sidersky and Guijt, 1997). In relation to desertification, a workshop was held on the grassroots identification of sustainability indicators as early as 1992 (Hambly and Onweng Angura, 1995).

This review now focuses on some of the most relevant issues with respect to this development of indicators of sustainable systems, and the lessons to be learnt for this research project. After a very brief explanation of indicators and thresholds, issues of time and scale are highlighted, different frameworks for organising indicator work are discussed and the different dimensions of agricultural sustainability commonly identified are outlined. Many of the issues discussed are presented in more detail elsewhere (Rigby *et al.*, 2000 forthcoming).

3.2 Indicators and Thresholds

Smyth and Dumanski (1993) define indicators as "environmental attributes that measure or reflect environmental status or condition of change", Glen and Pannell (1998) argue that "an indicator is a quantitative measure against which some aspect or aspects of policy performance or management strategy can be assessed". This criterion of quantification assigned by many authors is not universally accepted, since some authors regard qualitative indicators (e.g. visual assessment of soil erosion) as valid tools.

Definitions are numerous, and it is perhaps more useful to identify the uses and desirable properties of indicators. Following Tunstall (1992, 1994), Gallopín (1997) identifies major functions of indicators as:

- to assess conditions and changes;
- to compare across place and situations;
- to assess conditions and trends in relation to goals and targets;
- to provide early warning information; and,
- to anticipate future conditions and trends

A developing issue highlighted by several authors including Syers *et al.* (1995) and Coughlan (1996) is the importance of defining thresholds for indicators. A threshold is a boundary level of a variable which is regarded on the basis of expertise to represent the point at which significant changes occur. “Thresholds are particularly important in an agri-environmental context given the propensity of ecological systems to ‘flip’ from one state to another” (Moxey, 1998: 14).

When an indicator passes this level then the system is considered to be unsustainable or on the road to unsustainability. Issues arise as to the identification of a threshold level (be it qualitative or quantitative), whether passing a threshold level for one indicator is sufficient to signify unsustainability, or whether several indicators need to have passed their threshold levels before the system is unsustainable.

3.3 Issues of Scale

The type of indicators constructed in any study will be influenced by the level at which the system is analysed. Indicators in studies such as this may be constructed at the plot, farm, village or community, district, catchment, region, agro-ecological zone (AEZ), or national level. For instance, the individual farmer will often be seeking, or will already have identified, an indicator which forecasts the yield of this year’s crop based on a field or farm plot scale. Again at the farm level, the depth of soil may be a key indicator in assessing the sustainability, but at the national level it is impractical to measure the depth of all soils when it comes to assessing the agricultural systems at the national scale. Alternative or broader indicators are needed to achieve this. However, there has to be a link between the different levels. If we are using indicators to assess the relative sustainability of different farming systems we need to be able to relate this information and analysis to assessments at a “higher” level.

The decision about the level at which to collect information and apply indicators depends on both the issues being addressed and the data available. However as one moves up through the levels it may become more difficult to identify causal relationships, to identify desirable outcomes and to isolate choices that can be made with confidence. The level at which indicators are constructed has implications for the type of indicators that it is feasible to construct. Gomez *et al.* (1996) argue that working at the farm-level means that social issues cannot be incorporated, whilst Müller (1996,

1998) excludes social issues at the plot level but includes them at the farm household level.

There is no prescription here regarding what is the appropriate level of measurement of indicators for this study. The project's emphasis on the investment decisions of farm households of differing scales and success indicate that the farm/farm household are likely to be the focus of attention, but probably not to the exclusion of assessment at the plot as well as higher levels of scale (village, region). The different types of indicator are likely to occur at different levels of scale. However, we expect the measurement of certain types of indicator (see, for example, driving force or pressure indicators – section 3.6.2) to take place at levels above that of the farm household. So driving forces and pressures in the region (population change, increasing competition for land etc.) will shape the livelihood strategies of individual households.

This issue of scale should be borne in mind throughout the development of this study's indicator sets.

3.4 Internal and External Indicators

A central issue of the research is the identification of suitable indicators. A key question behind this is who identifies the indicators and on what basis. It is useful to identify two sets of indicators: those identified by "external" experts, such as the project researchers; and, those "internally" identified by the different stakeholders in the systems themselves. The latter group would include farmers, households, communities, and local agencies (e.g. District office of Dept of Agriculture, or NGOs). When considering this division between the role of "external" researchers and local "community" members, it is worth noting that there is also a separation here between issues and indicators. A key issue in the success or otherwise of a system (for example, the maintenance of soil fertility) may be agreed upon by both researchers and community members. However the indicator which each group uses to monitor the issue may differ. Alternatively, it may be the case that the key criteria on which the success or failure of the system is judged differs between researchers and community members, in this case the both the key issues identified (and the associated indicators) are likely to be different.

3.5 Cross-section or Time-Series Analysis (State or Rate)

A major issue to be decided upon here is whether indicators are to be constructed and monitored between sites at a single point in time, monitored over time, or both. Ideally indicators of both types will be measured.

Given the nature of this project, with its focus on the issue of farm size for example, the comparison between different sites is central.

A fundamental issue is time. We want to know what has and is changing. What has happened to the biophysical environment, how have people's perceptions and management and livelihood strategies changed, how have policies and institutions changed and how have these affected each other? However, monitoring over time is more problematic, as information from external sources is generally required.

If trends over time are to be determined then there are two relevant alternative sources of information:

1. Historical sources which may include:
   - *Secondary historical information* - past records; studies and surveys.
   - *Community and individual recollection*.

2. Biophysical information from sites which were previously of a similar type to other study sites, but have been cultivated or otherwise used in a different manner over a recent, known time-period. In this way measurements taken at the same moment in time can be treated as observations at differing time points. In this way, a *baseline* site can be paired with other sites.

3.6 Indicator Frameworks

Several sets of methodological frameworks or guidelines have been identified for the measurement of sustainability indicators at the farm or community to district levels. These have all tended to come from an approach focussed on sustainable agriculture and/or sustainable land management – often directly related to the FESLM. These have included: the guidelines for conducting case studies under the FESLM (Dumanski, 1995); Protocol for conducting case studies under the FESLM (Bechstedt and Renaud, 1996); and Guidelines for Impact Monitoring (CDE). Other relevant frameworks are those on sustainable livelihoods and poverty assessments. For example, UNDP is also developing a framework for poverty assessment and associated indicators (UNDP, 1999).

The United Nations, World Bank, OECD, European Environment Agency (EEA), IBSRAM and many other organisations and national governments are currently producing indicators or proposed indicators of sustainable development and sustainable agriculture. The frameworks within which these methodologies and indicators are being proposed differ. Some are developments of previous frameworks, but their frequent use is a recognition that a conceptual framework is required to organise indicators.

In addition to the various frameworks used, there are differing dimensions, aspects or properties of sustainable agricultural systems that are proposed as criteria for sustainability assessment.

Pressure-State-Response Framework

The PSR framework, illustrated in Figure 3 and Figure 4 was developed from the stress-response framework which was applied by Friend and Rapport (1979) to ecosystems. This framework is used by OECD, SCOPE (Scientific Committee on Problems of the Environment) and some other organisations working in the field. The PSR framework is the most widely accepted of the many frameworks advocated (Jesinghaus, 1998). Having been adopted by the OECD for its State of the Environment (SoE) group, the European Commission's indicator development also uses the PSR approach. The PSR framework is also used in the methodology of the

World Bank's Land Quality Indicator (LQI) programme which makes use of the 5 Pillars of Sustainable Land Management (discussed below).

Pressure refers to "human activities that exert a pressure on the environment and change its quality and the quality and quantity of natural resources (the 'state'). Society responds to the changes through environmental, general economic and sectoral policies (the 'response'). The latter forms a feedback loop to pressures." (Gallopín, 1997:22). These pressures are considered to be negative. An illustration of how the PSR framework might be applied to this study is given in Figure 4.

The OECD acknowledges that the PSR framework has an implicit notion of causality within it since it "tends to suggest linear relationships in the human activity-environment interaction" (OECD: 1993: 5). Unhappiness with this idea that (negative) pressure causes changes in the environment which prompts society's responses is one of the motivations for the development of the driving force-state-response (DSR) framework now discussed.

Figure 3 The PSR Framework

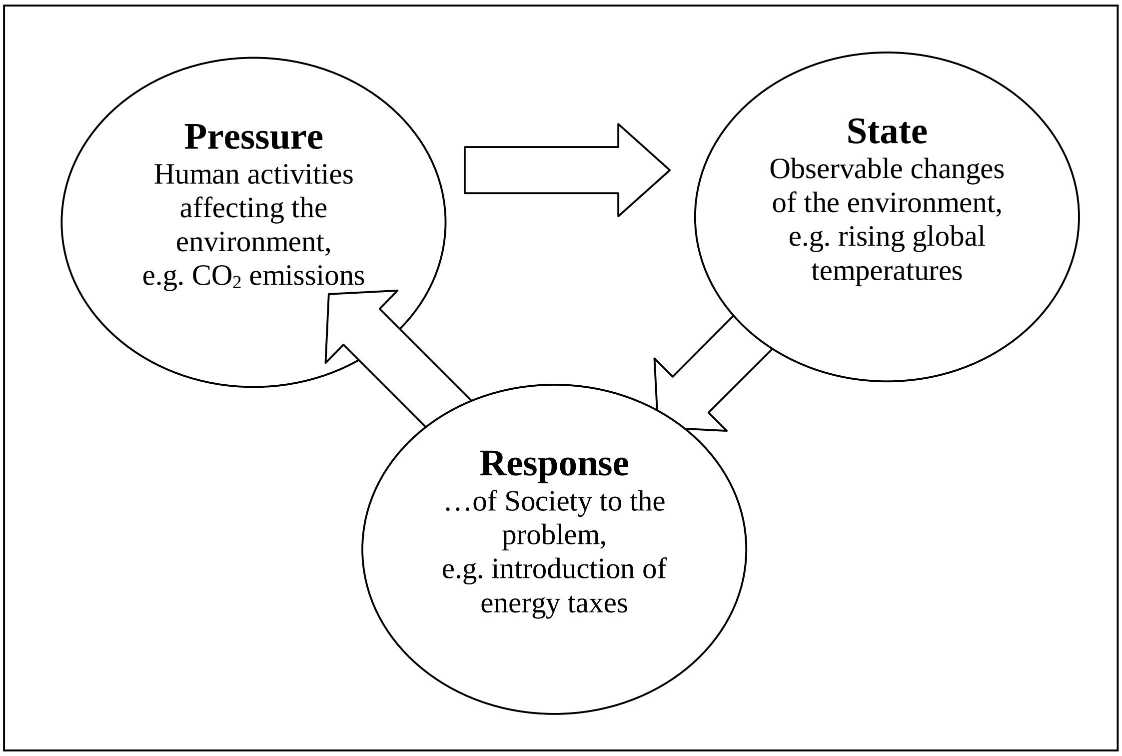
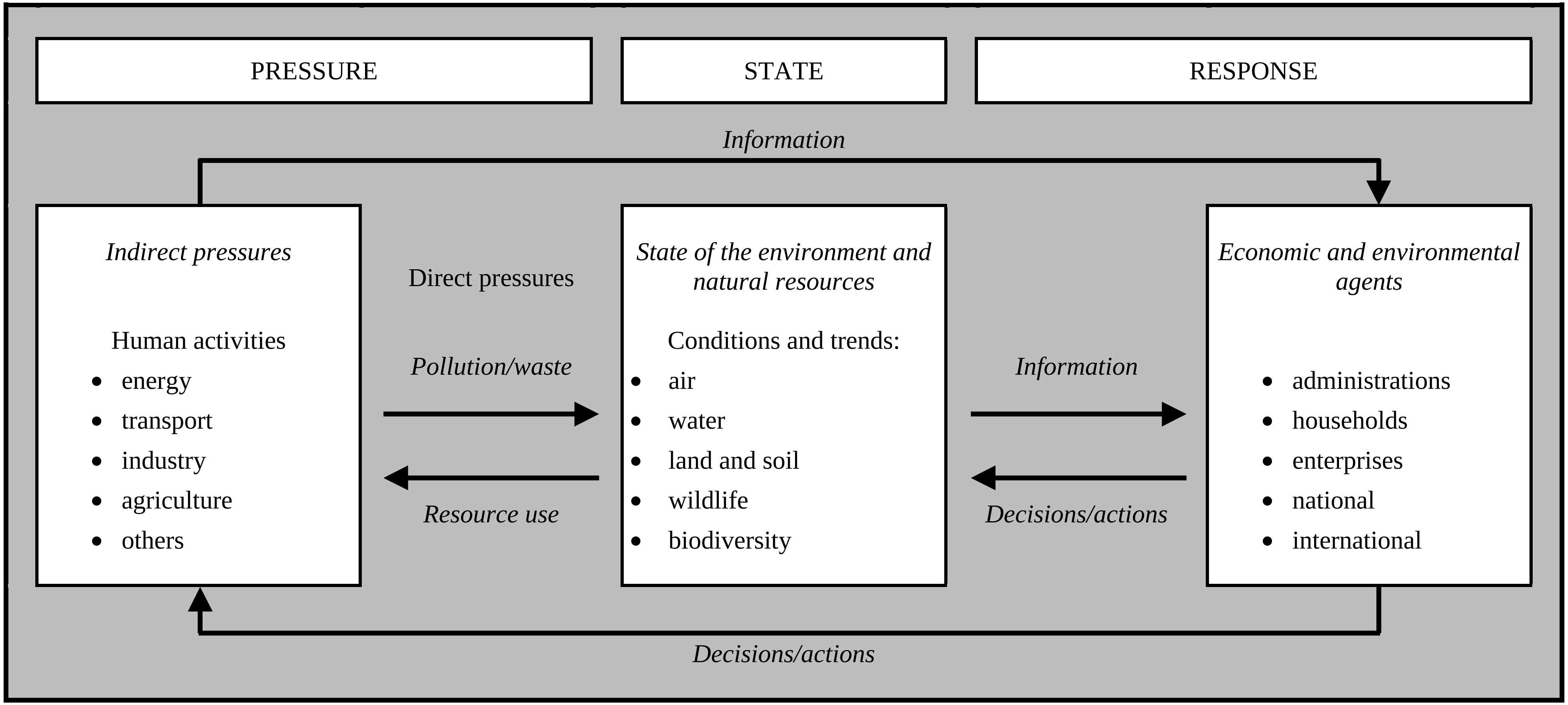


Figure 4 Pressure – State – Response (PSR) Model



Introducing Driving Forces and Impacts into the PSR Framework

Some organisations prefer variants of the PSR model; for example, the UN Commission for Sustainable Development (UNCSD) bases its indicator set on the Driving force-State-Response model (DSR) model, which allows for a better inclusion of non-environmental variables.

The replacement of the term “pressure” in the PSR framework by the term “driving force” was motivated by the desire to include economic, social and institutional aspects of sustainable development.

This adjustment was deemed necessary when one shifts from a consideration of environmental indicators to these indicators plus the state of the human subsystem. (Gallopín, 1997:22). The extension of the focus to all aspects of sustainable development (social, economic, environmental and institutional) is argued to be “particularly important for developing countries…for whom an equal balance between the developmental and environmental aspects of sustainable development is important in order to ensure future sustainable growth patterns” (1997: 49).

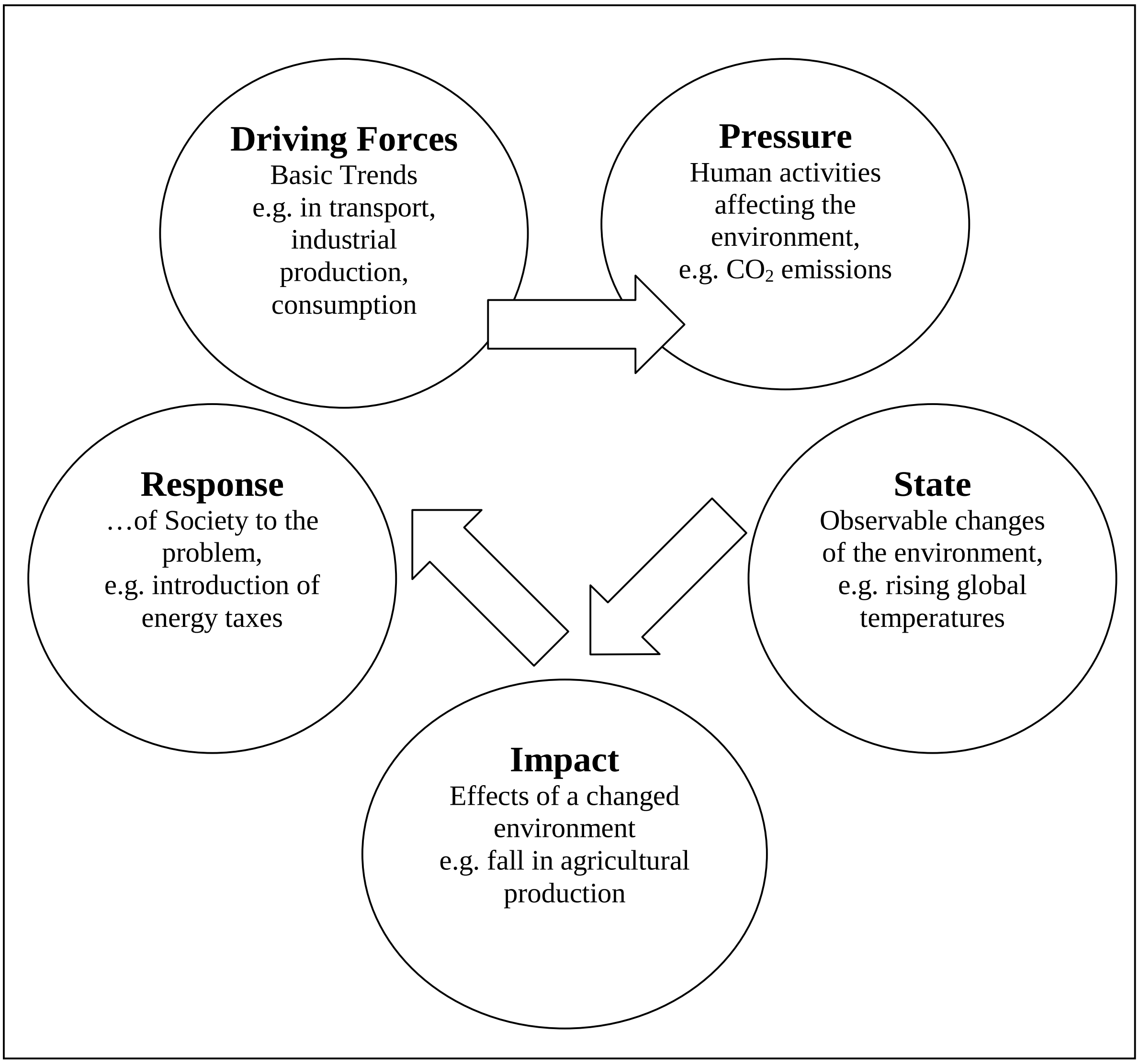
Another aspect of the DSR framework which separates it from its predecessor is that there is no assumption of causality between indicators in each of the categories.

“The term ‘driving force’ indicates…an impact on sustainable development. This impact can be both positive and negative, which is not the case for the pressure category used by the OECD”. (Mortensen, 1997: 48-49). “Driving force indicators represent human activities, processes and patterns that have an impact on sustainable development” (Mortensen, 1997: 47).

The World Bank has also adopted the DSR framework in its work on indicators of environmentally sustainable development (Pieri *et al*., 1995), and this has been repeated by other organisations and nations. For a better description of underlying economic trends, some authors have formulated the Driving force-Pressure-State-Impact-Response model, which includes PSR and DSR as special cases (Jesinghaus, 1998).

In the DPSIR framework State and Impact indicators are separated. State indicators show the current condition of the environment. Examples include the concentration of lead in urban areas; the noise levels near main roads; the global mean temperature. Impact indicators describe the ultimate effects of changes of state. Examples include the percentage of children suffering from lead-induced health problems; the mortality due to noise-induced heart attacks; the number of people starving due to climate-change induced crop losses.

Figure 5 The DPSIR Framework



The Sustainable Livelihoods framework presented in Section 2 may be envisaged as a DPSIR model:

Driving Force (basic trends in production and consumption):	Context
Pressure (human activities directly affecting environment):	Livelihood Strategies
State (observable change in the environment):	Biophysical outcomes
Impact:	Socio-economic outcomes
Response (of society to solve the problem):	Policy / structures and processes

It is important to note that (as indicated by Figure 2) the 'feedback' relationships between different elements of the SRL framework mean that 'structures and processes' constitute both 'response' and part of the 'context'. Similarly, while the DPSIR framework in Figure 5 implies a linear relationship between 'state' and 'impact', and therefore a dependency of socio-economic well-being on the state of the environment, the SRL framework allows a more disaggregated analysis of changes to both socio-economic and biophysical conditions in terms of the five types of capital: natural, physical, financial, human, and social.

3.7 Dimensions of Sustainability

Despite the contested nature of sustainability, there is agreement that it is multi-faceted, and therefore the (un)sustainability of systems must be assessed over several dimensions. At its simplest, this can be just considering economic, social and biophysical aspects of a system.

The Framework for the Evaluation of Sustainable Land Management (FESLM), being used in the LQI programme of the World Bank, identifies the 5 pillars of sustainable land management as:

- *Productivity* - maintain or enhance production services.
- *Security* - reduce the level of production risk
- *Protection* - protect the potential of natural resources and prevent degradation of soil and water quality
- *Viability* - be economically viable
- *Acceptability* - be socially acceptable

It can be seen that some of these pillars will be more related to either economic, social or biophysical issues.

Müller (1996, 1998) develops Conway's (1987) work on the properties of agroecosystems to produce criteria for the assessment of agricultural systems. Conway's properties of agroecosystems (productivity, resilience, stability and equity) are amended to become the following criteria or dimensions identified by Müller:

- Efficiency
- Resilience and biodiversity

- Rules for natural resource management
- Basic life support functions
- Satisfaction of basic needs

3.8 Examples of Indicators of Agricultural Sustainability

Despite the proliferation of literature on sustainability indicators, there are few examples of published applied work where indicators have been used at the farm or local level. Direct enquiries we have made with a wide range of organisations (e.g. World Bank, IISD, ACIAR, and CGIAR Secretariat) and individuals has confirmed this. Two examples where indicators have been used are discussed below.

Gomez *et al.*(1996) construct farm-level indicators using the FESLM approach. The indicators are applied to 10 farms in Geba, Cebu, Philippines. Six indicators are used, five are concerned with biophysical factors with profit as the final indicator:

The six indicators used are:

- Yield
- Profit
- Frequency of crop failure
- Soil depth
- Organic C
- Permanent ground cover

As noted above the five pillars of FESLM include ‘social acceptability’, but the authors note that this “has more relevance at the community level parameter and is not included at the farm level” (1996: 404).

This paper is also noteworthy since it employs sustainability polygons/webs to illustrate graphically the relative sustainability of systems. Simultaneously displaying a number of indicator “scores” in this way avoids having to aggregate across different scales (i.e. having to aggregate profitability and organic carbon levels). The threshold levels used for all the indicators are based on the average in the community.

Such sustainability webs also appear in Kelly (1996), shown below, and Bockstaller *et al.* (1997).

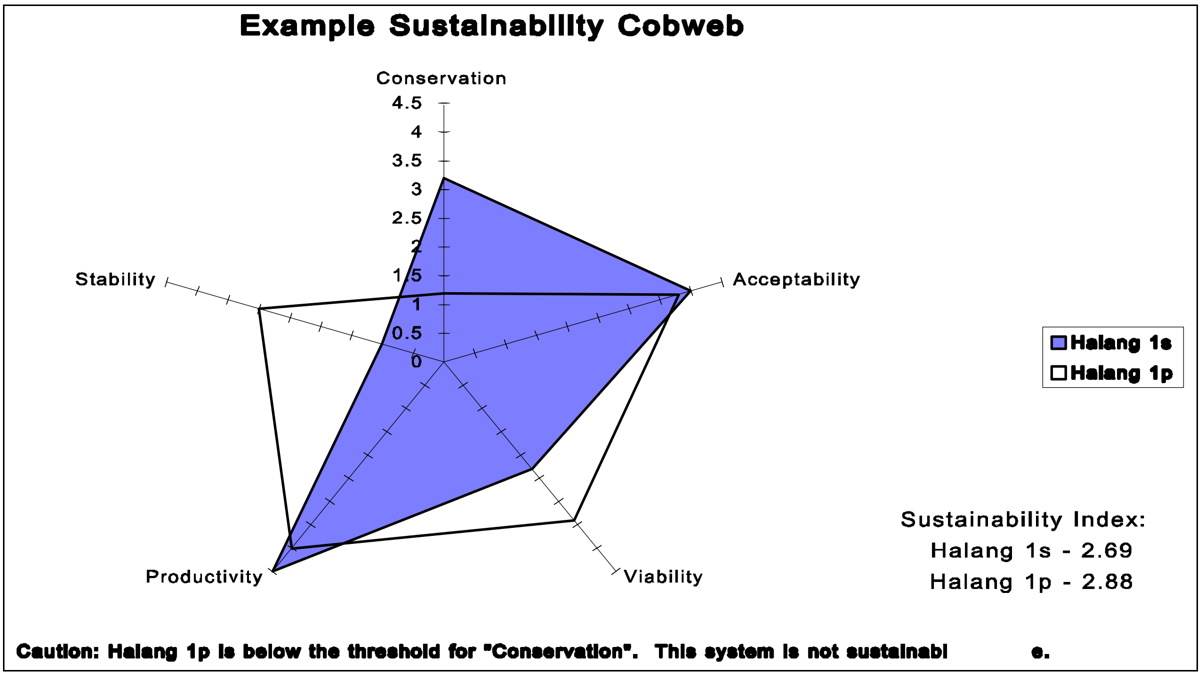


Figure 6

Müller (1996, 1998) reports the results of the development of indicators of sustainable agriculture in the Rivento River Watershed in Costa Rica. In doing so a detailed methodology is developed regarding issues of scale and the dimensions of sustainability that should be assessed.

The framework used comprises three levels of scale: plot, household, watershed. Indicators are categorised as being of three types: economic, social, environmental/biophysical. The five criteria or dimensions identified earlier are used to determine the sustainability of systems, with different sets of these dimensions for different scales. The matrices that appear in the resulting analysis are of the form:

PLOT LEVEL:

	Env/Biophys	Economic
Productivity		
Efficiency		
Resilience		
Rules for Resource Management		
Biodiversity		

FARM HOUSEHOLD LEVEL:

	Env/Biophys	Economic	Social
Productivity			
Efficiency			
Resilience			
Biodiversity			
Satisfaction of Basic Needs			

WATERSHED LEVEL:

	Env/Biophys	Economic	Social
Productivity			
Efficiency			
Resilience			
Biodiversity			
Satisfaction of Basic Needs			

3.9 Purpose and users of indicators

It is useful to look at the purpose of the measurement of indicators at the farm or community level. Why is a set of indicators to be measured, and how will the information they provide be used? Another important consideration often neglected is who is to be the user of these indicators? an example possible purposes of indicators identified by research staff in the Pacific are given in Box 1.

Examples of work linking indicators to policy and institutional development at the farm, community (village) or district levels are rare. Some exceptions are the work of Gomez *et al.* (1996), Gameda and Dumanski (199?), Müller (1996, 1998). Hardaker in his review for FAO of farm level information for policy making for sustainable agriculture and rural development discussed the issues surrounding this (FAO, 1996), but this has yet to be operationalised (Hardaker, pers comm).

Box 1 Purpose of the use of indicators at the farm level (Source: Howlett, 1996)

- To develop capacity and commitment of farmers towards more sustainable land use, and to allow farmers to evaluate their own practices.
- For the simple diagnosis of problems and improvements to farming practices, and development of appropriate research and extension activities.
- To enhance (or improve) the relationship between the researcher, farmer and extension agent, and through this to encourage farmer participation, the incorporation of indigenous knowledge, and ultimately to an increase in the adoption of improved technologies.
- To assess and monitor the spatial and temporal sustainability of different farming

systems, and to use this for the evaluation, prediction, planning and management of these systems by farmer, researcher, extension agent and planners.

Much of the measurement of indicators has, at the end of the day, largely resulted just in the measurement of indicators. The actual operationalisation of indicators to influence or change, for instance, policy is still in its infancy. This includes some of the actual examples discussed in this review. For instance, the work in the Philippines (Gomez et. al. 1996) focussed on identifying indicators of sustainable land management between adopters and non-adopters of conservation practices. A valid exercise in its own right, aimed at assessing the degree to which indicators could be rapid, reliable, practical and inexpensive enough so as to be useful to practitioners. However, the development of practitioner–orientated indicators is very much in its infancy, with different indicators and frameworks in the process of being developed and tested. The usefulness of such indicators to farmers, extensionists, researchers or policy makers in the development of more successful and sustainable farming systems and livelihoods has yet to be determined.

Other measures of sustainability or closely related issues have tended to focus on a single perspective or issue. For example, Stocking's (1995) recent work on the rapid appraisal of land degradation looked at a specific part of the sustainability equation – soil erosion. Similarly, the work of Müller looked at indicators of sustainable agriculture but with a specific focus on the use of agro-chemicals (their minimisation an apparent objective behind this project).

Views differ as to whether indicators should be identified "externally" by scientists, economists or "internally" by local communities themselves. One view sees sustainability defined from the "top" with the imperative to maintain and conserve the renewable natural resource base for future generations (e.g. FESLM). A second view focuses on the participatory and empowerment paradigm where local communities need to define what is sustainable to them and to then go on to determine the indicators for this sustainability (e.g. work of IIED and IISD). Both perhaps can be viewed as having some validity.

For society as whole it is essential that renewable natural resources are used sustainably. For the local community or farmer it is also essential for sustainable and profitable natural resource based livelihoods that natural resource use is both successful and sustainable. One challenge for this project is to identify a set of indicators which will yield useful information about the status and rates of change in the full range of assets managed by individuals, households, and businesses and that are relevant to both planners and resource users. An important aspect of the choice of our indicators will therefore be to identify at least a core set which will allow comparability across different study sites.

4 Pulling Together an Indicator Framework and Methodology

It is intended to use the Sustainable Rural Livelihoods (SRL) framework, discussed in section 2, as a basis from which to identify potentially useful indicators of sustainable use of natural resources in rural areas. This indicator development will also be related to the frameworks and dimensions identified above. The methodology proposed features elements of some of the above frameworks identified above, but it does not seek to apply any of them completely. An important factor is that the project's objective is not simply to develop a set of indicators which can be used to monitor any system but also to develop a methodology to guide the identification of meaningful and measurable "internal and external" indicators. To achieve this the following steps are proposed:

- Identification of an initial set of "external" indicators based on literature review and on Ugandan and South African experience.
- Identification of an initial set of "internal" (community) indicators through interviews and participatory methods with key stakeholders.
- Development of a combined set of indicators for field testing and monitoring.
- Analysis and selection of "final" set of indicators which are practical, meaningful and measurable – the number of these indicators to be kept to a minimum (target<10/15).

The first of these steps has been undertaken and Table 1 represents the outcome of the literature review and deliberations during the planning workshop. Table 1 presents a matrix of potential indicators chosen to reflect the various SRL asset types identified. It also allows these to be related to the FESLM five 'pillars' (dimensions) of sustainability. In Table 2 these indicators have been further explored in order to identify a core set of indicators that may be measurable in different study sites. As discussed above, measurement needs to take account of scale, and Table 2 groups measurements according to what scale appears appropriate. Some measurements are indicated at more than one scale, suggesting possible cross-checking from different data sources. It should also be noted that the set of indicators presented is fairly extensive, and it is almost certain that it will not be practical to measure or monitor all of them. Rather it is the intention that it will be used as a set from which a smaller number of indicators will be selected – along with the internal (community) indicators.

Table 1 Matrix for sustainability indicators

Dimensions (FESLM)	**Assets (SRL)**				
	Natural	*Physical*	*Financial*	*Human*	*Social*
Productivity	Levels and trends for: Productivity (per unit of land, per unit of water [irrigated systems])		Levels and trends for: Rates of return on investment [financial outlay]	Total earned income (on-farm and off-farm) per working household member	Active cooperative associations, organisations; Government extension services; Labour or asset sharing.
Economic viability		Return on fixed capital assets. Access to markets	Farm gross margins Farm profit Net household income	Affordability of health, education	Contributions to / claims on social welfare.
Production risk / security	Pest/ disease risks. Months with lack of water Flood and fire risk Cultivation of 'marginal' land	(Investment in) flood control and irrigation infrastructure.	Output and input price variability; Savings and debt levels Credit access Income diversity Insurance Welfare/pensions	Health status Educational attainment Unemployment	Security of crop, livestock from theft, damage; Security of land use rights Government food security measures; Gifts, loans in times of need
Protection from degradation	Soil 'quality', Soil erosion Pesticide use and toxicity levels Agro-biodiversity Ground cover (deforestation) Conservation technologies				Environmental; organisations, campaigns; Local natural resource management authorities, organisations
Social acceptability	Conflicts over access to, or tenure of, land, water etc	Distribution of access to infrastructure, equipment	Income distribution within society / 'community' / household	Inequality in access to health / education / training	Accountability of elected or customary representation or leadership Social exclusion.

Table 2 Sustainability Indicators: summary of measurement or data requirements

National level	*Economic statistics* on: • Output and input prices and price trends • Interest rates, inflation rates • Taxation rates (rural compared to urban, if different) • Social welfare benefits (if any)
'District' level S Africa: magisterial district Uganda: sub-county Secondary sources and key informant interviews	District (discriminate to sub-county in Uganda, if possible) *secondary data*: • Census: population, population growth rate • % population with access to electricity, piped water • Health statistics: child mortality, malnutrition rates, life expectancy (discriminated by sex), medical charges • Educational statistics: % enrolment and drop-out rates of school age girls and boys (primary and secondary) • School fees. • Agricultural production trends (total areas and yields per hectare), Output and input prices and price trends, *Estimates* (from reports, interviews) of: • Incidence of water shortage / drought (months) in recent years (excluding normal rainfall seasonality) • % loss of output due to pests and diseases in recent years • Incidence of flood damage in recent years • Incidence of fire damage in recent years • % agricultural land provided with irrigation • % agricultural land provided with flood protection *Estimates* (from comparison of old and recent Aerial photos / satellite image, or from research studies) of: Vegetation change: tree cover decline, or bush encroachment (on pasture)
Village or 'community' level Semi-structured interviews with stakeholder groups to provide information about the importance of, and semi-quantitative estimates of extent of:	• Population, population change • % of population with access to electricity, piped water. • Time or cost to reach markets • Rates of tax, or subsidy as % of costs, revenues. • Credit access, interest rates • Local or customary control over land • Conflicts over land, water • Production foregone or increased costs as a result of security problems (insecurity of land tenure, crop or livestock theft) • Months of water shortage in last five years • Incidence of fire, flood damage in the past five years • Labour or asset sharing by households • Gifts, loans from kin, friends, religious groups in times of need • Frequency of government emergency relief • Benefits from government technical services • Benefits from commercial technical services • Benefits from voluntary associations • Environmental associations: membership, campaigns. • Any regulatory authority influencing land use/conservation

Household or farm level A questionnaire survey conducted on a sample of farm households to include the primary stakeholder groups identified in the stakeholder analysis:	• Farm output and input prices and trends • Number of working and dependent household members (resident or contributing financially) • Amount of marketed production • Value of marketed production • Value of non-marketed production ? • Total earned income of working household members • Cash value of pensions • Household expenditure • % of household income earned and managed by women • Household savings, debt • Credit access, interest rates • Health, educational, and employment status of household members • Rates of tax or subsidy as % of costs or revenues • Production foregone or increased costs due to security problems (insecurity of land tenure, crop or livestock theft) • Gifts. Loans from kin, friends, religious groups in times of need • Benefits from voluntary associations, government services • Crop insurance • % loss over past three years due to pests, diseases • months of water shortage during past three years • Incidence of flood or fire damage in last three years • % land with irrigation • % land protected from flood • Pesticide applications: products, dosage and frequency • Agro-biodiversity: % of farm occupied by different crops, fallow • Conservation measures used (mulch, organic manure, tillage, terracing)
Plot level A survey of a sample of fields for each stakeholder group (does not have to be undertaken at the same time as farm interview). The survey will include an interview to ascertain cultivation history and productivity, and sampling for analysis.	• Number of years of cultivation (fallow, rotation history) • Fertiliser rates • Conservation measures used (organic manure, tillage, terracing) • Yield of crop or livestock per hectare • Soil sample analysis for Soil quality measurement (available (Bray 1) P ? organic carbon?) • Soil erosion assessment (erosion bridge measurements if possible) • Range quality assessment

5 Choosing and Using Sustainability Indicators

5.1 Introduction

The selection of the issues of concern and the indicators which should measure them is something which should take place as a result of dialogue between the project researchers, local communities and other key stakeholders of the study areas. The issues and indicators identified in the above matrix are only an initial draft of a core set of indicators seeking comparability across different study sites. In addition, the relevance of issues and the nature of the indicators need to be explored through discussions with stakeholders.

The identification and measurement of appropriate indicators for the case study areas will involve the researchers from both national project teams and stakeholders in the study areas. The involvement of stakeholders immediately becomes essential when identifying those farming systems perceived as "successful" or "failing".

Issues that will have to be addressed in developing and implementing the indicator methodology include:

- Identification of key issues and indicators.
- How, when and by whom will the indicators be measured (for example, will an indicator be measured by study area community members or by "external" researchers).
- How is the collected information to be analysed, integrated and displayed (this involves issues of aggregation and the identification of threshold values).

A series of steps in this process are:

- Initial Methodology: workshop discussions, and site selection (held in East London in April 1999)
- Identification of Stakeholders.
- Identification of Core Issues and Indicators.
- Measurement of Indicators
- Analysis, Presentation and Documentation

5.2 Initial Methodology

An indicator framework and a range of potential issues and indicators are identified above, based on the literature review, as a starting point for discussion. These are based on a series of workshop discussions at the East London planning meeting which sought to draw up shortlists of the issues and indicators most relevant to the specific circumstances of the sites selected in each research area in Uganda and South Africa, and to the goals of the research project.

The criteria for site selection are set out in Appendix 1. The study areas identified are:

In South Africa (Eastern Cape):

- Victoria East/Fort Beaufort: arable (rainfed maize, irrigated vegetables, and commercial citrus) and livestock (cattle, game) farming.

In Uganda:

- Coffee-Banana smallholder system, Mukono District
- Dairy farming, large-scale bananas, annual arable crops Mbarara district.

5.3 Identification of Stakeholders

These will include farmers and other land users, local groups, traders and merchants, representatives of local and district institutions and NGOs as well as other researchers and project planners in the area. The stakeholders are to be identified, interviewed (whether individually or in group meetings) and relationships of relative power and influence identified. The purpose of this is to involve these groups actively in the research, to see if indicators will meet the purpose we intend, develop partnerships/alliances, to throw out some indicators altogether or bring in new ones, or changes to ones proposed, to develop/identify community indicators. A key component of this stage is the identification of farming systems perceived as either "successful" or "failing". One obvious criterion which is anticipated to be strongly associated is that of wealth: wealthier farmers being viewed as more successful, and poorer as 'failing'. The identification of stakeholders will need to seek out a range of wealth categories at each study site, therefore.

5.4 Identification of Core Issues and Indicators.

A key issue is the different perceptions different stakeholders will have on the success or sustainability of different systems. It will therefore be necessary, following a stakeholder analysis at the case study sites, to determine the perceptions of these different groups on the success or failure of these systems. This should be framed in the wider context of livelihoods. The different perceptions will need to be analysed to determine the criteria different groups use to assess this success or sustainability, this would then feedback into the indicators we are proposing to measure.

- Identification of all stakeholder groups with an interest (positive or negative) in the case study areas and in the success of the chosen farming systems.
- Preliminary classification/identification of the different interests of the identified stakeholder groups.
- Selection of key stakeholder groups to interview and to work with.
- Semi-structured interviews of stakeholder groups to determine different perceptions of success/failure and criteria for determining these.
- Use of participatory methods to determine different perceptions of success/failure and criteria (such as 'worst' and 'best' case scenarios) for determining these.

The identification of issues should reflect both the interdisciplinary nature of the teams and the issues involved. That is, the issues may be identified in terms of societal issues (impoverishment, migration etc) or natural resource issues (overgrazing, monoculture etc). These issues will be related. Local stakeholders' involvement will also involve their views on what needs to be done, what should be monitored

Based upon 'core' indicators identified by researchers and community members and farmers, agree a set of indicators to test and measure. The indicators will have an individual significance and utility but will be chosen so as to comprise a suitably diverse and coherent set. The indicators will pertain initially to the status quo, but would ideally also highlight change. The use of historical information (see 5.5 below) is an important means of establishing this time perspective.

The indicator set will be embedded in a broader context (temporally, spatially and from a hierarchical sense). The indicators will also be of different types (CDE):

- *Generic Indicators* – internationally agreed.
  Example: Soil organic matter level.
- *Local Indicators* – i.e. local or site-specific.
  Example: Presence of particular species of plant.
- *Measurement Indicators* – often quantitative, precise and replicable.
  Example: Human height and weight measurements in human health studies
- *Proxy/Surrogate Indicators* – more indirectly related to the issues in question.
  Example: Consumption of beer bananas as a foodstuff rather than in brewing as an indicator of food shortage.

5.5 Measurement of Indicators

Where possible the work should continue with existing methods, which fits with our identification of secondary data sources as a highly important criteria for site selection.

Two sets of methods for gathering information are feasible. *Trans-sectoral* methods monitor a range of indicators using the same tool, i.e. the gathering of both biophysical and socio-economic information using PRA. *Sectoral* methods usually monitor single indicators, particularly the biophysical. These are the most often gathered by "professional" researchers, but exist alongside a range of "rougher" more practical methods used by many fieldworkers, although these tend to be sparsely documented.

In order to obtain indicators of trends and change, ideally we would like to go back in time as far as possible, say to the beginning of this century. However it may only be practical to obtain reliable information from historical sources from 1950s onwards. For community and individual recollections again a similar time frame is probably only possible.

An outline of the method(s) to follow is given below:

For historical data

This should build upon the outputs of the country literature reviews, collection of this type of information is likely to be difficult with some records having disappeared or literally gone up in smoke.

- Visits to National archives to search for relevant reports on the case study areas.
- Visits to present and past District/Provincial administrative sectors to ascertain the existence of old maps, reports, studies, census data and surveys – collection and copying of this information when found.
- Search of old colonial records held in UK (London) for Uganda for relevant information.
- Air photos (and satellite imagery) – Obtaining old air photographs and more recently satellite images will be an important source of information for determining changes in biophysical parameters and in land use and management.

Individual and community recollections and perceptions

- Using the outputs of the stakeholder analysis identification of key informants (individuals and groups) – to include local communities, government officials, scientists, NGOs etc.
- Semi-structure interviews of key individual informants.
- Use of participatory approaches (e.g. historical time charts) with groups (particularly local communities).
- Documentation of individual and group recollections and perceptions on biophysical and socio-economic change.

Baseline Information

- Identification of unchanged, or little changed, areas within or next to case study location - through local knowledge and/or old reports or air photographs.
- Measurement of indicators (as below) in unchanged or slightly "disturbed" areas.
- Interpretation of air photographs for baseline information.

5.6 Analysis, Presentation and Documentation

Documentation of indicators, measurement, and methodology used to develop this set of indicators.

The analysis of results should include the consideration of both (i) individual indicators with respect to any targets or thresholds specified, as well as (ii) the analysis of the indicators together, possibly involving aggregation, and the testing of impact hypotheses. The identification of thresholds values for indicators is something which should again involve local stakeholders rather than simply be determined by researchers. How far crop yields (or prices) would have to fall before switching crops or renting out land can only be determined through discussion with the relevant producers.

There are a number of issues here relating to aggregation:

- If individual indicators are to be aggregated this requires the combining of measures with different scales, for example combining crop yields with educational status.

Such aggregation reduces the amount of raw information one has to present to users, but may hamper interpretation of the resulting indicator.

- Also required is the weighting of the various components of the resulting indicator. Choosing the appropriate weights is subjective.
- Identifying threshold values is also more difficult with composite indicators.

These issues can only be resolved in practice. Who the indicators are being discussed with will often determine the form in which the information should be presented.

One method of presenting a number of indicators without aggregation is the use of Sustainability Polygons/Cobwebs which can display very accessibly the scores over a number of indicators for more than one farm/case. It can also incorporate threshold values for each indicator. This is an extremely accessible method of displaying a considerable amount of information concisely. However, without threshold values these types of diagrams may be of little use except for a rather qualitative presentation of different sets of data. An interesting possibility may be the use of stakeholders' definitions of 'worst' and 'best' cases for each indicator. This could be used to establish a scale on which each indicator is measured or scored in each study site. The resulting scores would have a common base (i.e. a proportion of the local best or worst case) which might offer useful comparative insights between sites with greatly different absolute values of, say, productivity and income. It would also offer the possibility of aggregating the score of different indicators to provide a single sustainability index.

A challenge for the research is to relate the indicators to policy impacts. While it is not considered feasible in this study to follow individual policy measures from implementation to impact in the study areas, it is intended that the examination of successful and failing farming systems will incorporate any discernible effects of policy and institutional change. This may concern changes that have had either positive or negative effects on the systems in question.

6 Concluding remarks

This paper has set out an analytical framework based on the Sustainable Rural Livelihoods approach, and used this to generate a matrix of potential indicators compatible with five ‘dimensions of sustainability’ from commonly-used indicator frameworks. In doing this we have sought to bring together disparate components of the ‘sustainability’ literature into a single methodological approach.

In setting out to test the applicability of this approach in assessing the sustainability of farming in East and Southern Africa, we recognise that exclusive reliance on a pre-determined set of indicators to be measured at each case study site would be a mistake. Firstly, indicators may vary in their relevance according to the local environment and the final purpose of their measurement and monitoring (and the practicality of this measurement). Secondly, it is important to test externally-defined indicators against local stakeholders’ criteria for valid indicators of the success and sustainability of their agricultural systems and livelihoods.

However, it would also be a mistake if no “external” framework or set of indicators were to be identified based on prior knowledge and technical expertise. This is important to ensure a basis of comparison between different study sites, to assess the robustness of the methodological approach proposed, and to permit valid policy conclusions. For this, success or sustainability of an agricultural system needs to be assessed from different perspectives: local or farmers’ perspectives as well as the scientific or technical. It is therefore useful to start off with a core set of indicators around which a final set will be built using stakeholders’ indicators. It follows logically from this that the methodology of identifying indicators will be important. This should deliver:

- locally relevant and easily measurable indicators;
- indicators which represent the potential diversity of perspectives of different users on success and sustainability– from farmers/local communities (both wealthy and poor), through scientists, to policy makers;
- indicators which encompass both agricultural systems and peoples’ livelihoods;
- indicators which can be “related” to policy; and,
- the smallest number of indicators possible, to make any assessment of success or sustainability of agricultural systems and livelihoods relevant.

The research steps set out above are, obviously, presented sequentially. The process in reality should be characterised by loops and feedback between the various people involved (most importantly, the various project teams and the inhabitants of the study areas).

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Appendix 1 Summary of case study/site selection criteria

1. Logistic feasibility and practicalities

Sites should be where research partners have already established or can easily establish a field research capability. In addition the following should be met:

- area should be familiar to the researchers and should be an area where their respective institutions have already worked.
- Local communities should have indicated their willingness to work with the researchers.
- Co-operation of relevant government and NGO agencies should have been obtained.
- area should be accessible to allow sufficient field work to be undertaken without excessive expense in terms of time and money.

2. Farming systems - "successful" or "failing"

An initial, possibly subjective, assessment should indicate that the area should have examples of "successful" or "failing" farming systems.

As far as possible, contrasts of more and less 'successful' farming systems should be identified within the same study area

3. Examples of large-scale and small-scale agriculture

The area should have examples of large and small sale agriculture to ensure an adequate sample of different levels of investment, productivity and managerial input in the farming systems being studied.

Large-scale and small-scale is preferred, rather than different degrees of 'commercial' orientation, as it ensures the issue of capital investment and economies of scale is included in the analysis.

4. Evidence of strong demand for resources (land, water etc)

This is a 'driving force' or 'pressure' on the farming systems.

Possible sources of this 'driving force' are population increase, rural poverty, or commercial expansion – these should be identified.

5. Availability of secondary data

There should be availability of findings of previous studies, research and surveys is important. Such information can be ranked in importance roughly as follows:

- Recent population and agricultural census
- Past production data (yields, incomes, costs etc) to compare with present data
- Historical records of resource use and population
- Biophysical studies (soil survey, agricultural field trials, vegetation assessments etc)

The literature reviews should specify what kind of secondary sources exist for each potential study site, to ensure that these sources are adequately used during fieldwork.