

Locating a poverty focus in natural resource systems research

Experience and prognosis in the Natural Resources Systems Programme of DFID

Introduction

Most of the world's poor are found in rural areas of poor countries and projections indicate that this is unlikely to change in the next 20 years (IFPRI, 2000). The linked variables of low expectation of life at birth, high infant and child mortality, high exposure to disease and HIV/AIDS, high levels of food insecurity, exposure to shock from natural disasters, economic downturns, or conflict, limited opportunities for salaried employment, and inadequate public sector service provision will continue to be associated with poverty, as traditionally defined in terms of weak assets and low incomes. This paper addresses a major challenge for the natural resource (NR) science community, namely: given the obduracy of poverty and the complexity and vulnerability of poor peoples' livelihood systems, how can systems research create potential benefits for partly or wholly NR-based livelihoods? This objective links NR systems research firmly with the debate about rural development strategy (for recent statements in this debate, see Ellis, 2000; IFAD, 2001, World Bank, 2001).

A dominant approach to research on agriculture and natural resource (NR) management in poor countries used to be to proceed by identifying output constraints affecting particular crop, livestock, forest or other resources, and applying science to developing solutions to those constraints. In recent years, sustainability has been added to productivity as an expected outcome of such research. Much activity that was supported by the CGIAR and NAR institutions, international donors and UNEP exemplified such an approach. Because of the perceived importance of the constraints, and the expected impact of the solutions on poverty and on NR conservation, such research proceeded outside a cost-benefit framework in any restrictive sense. Its aim was to use public investment to change the behaviour of resource managers along predetermined lines. Such an approach still has many advocates (Young, 1998).

Solutions which were deemed to be technically proven and practicable were later passed to the agriculturalist, economist, sociologist and extension specialist who had to wrestle with their compatibility with existing

production systems, economic feasibility in a context of resource and income poverty, social acceptability, and susceptibility to promotion/extension methods. As everyone knows, not all solutions were taken up on the scale envisaged, for reasons apt to be complex and case-specific. The benefits, moreover, often failed to flow to the poor.

Hunger is commonly seen as a 'subset of poverty'. Approaches to poverty which focus on food availability accept a supply-side view of 'the global food problem'. But an 'entitlement approach' to hunger (Sen, 1981) challenges this assumption. Enhanced productivity, and *even enhanced sustainability*, will not necessarily or always benefit the food-poor, whose predicament is the result of distributional as well as production failures. The livelihoods of poor people therefore depend on production relations in both NR-based and non-NR-based activities. NR-linked systems are multisectoral, and research on them finds itself at an interface between, on the one hand, the simple equation 'More Food = Less Poverty', and on the other, economic empowerment of under-privileged people. This is a daunting task, not least because it challenges long-accepted disciplinary specialisms in the research community.

A 'technology transfer' paradigm became so powerful that it soon influenced rural development and NR management in general. There is now a vigorous debate about replacing it with approaches that are more sensitive to the circumstances and goals of poor people. New approaches focus on participatory methods, empowering institutions, and a broader sustainable livelihoods (SL) framework. (see Annex) The urgency of specifically targeting poor people, rather than leaving them to struggle for 'trickle down' benefits from development interventions which may unintentionally reinforce privilege, is gaining recognition, as new and better data emerge.

The aim of this paper, therefore, is to assess the systems approach as a resource for characterising,

DFID-Natural Resources Systems Programme (DFID-NRSP), 2001
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understanding/analysing and evaluating NR-linked production and income systems, with a view to identifying entry points for development interventions which can make a difference in the lives of poor people.

Systems, livelihoods and poverty focus

The *White Paper on International Development* (1997) redirected and sharpened the UK Department for International Development (DFID)'s focus on poverty elimination. There are 10 NR research programmes operating under the auspices of DFID, including the Natural Resources Systems Programme.¹ Moving from an early focus on technical projects, the Programme Management of NRSP seeks to improve the poverty focus of its research activities. These are carried out by research scientists located in UK and overseas institutions. Their experiences feed back into the policy and strategic debate.² Analysis of practice therefore plays an important role in the search for methodologies in research that will identify better entry points for interventions (whether 'enabling', 'inclusive' or 'focused') that can make a difference in the lives of poor people.

In some situations, an entire system or community may be designated 'poor'. Candidates are, for example, the impoverished livestock breeders of the western Sahel, the nearly-landless labouring communities of South Asia, some fishers, displaced refugees, and very many primary producers after droughts or floods have temporarily destroyed their capacity to produce. More generally, communities are differentiated internally. In order to target their poorer members, the system must be understood in depth, and the methods used for identifying researchable constraints must be subtle and discriminating. This implies a correspondingly greater use of applied social analysis, as well as other relevant interdisciplinary experience.

A *systems* approach, by definition, begins with an existing system (of production, livelihood generation, NR management, etc.). In a precursor of this paper (DFID-NRSP, 1999), a 'systems approach' to NR research is defined essentially as holistic or integrative. It accepted enhanced output and sustainability as the justification for NR research (or that part of it supported by DFID), which 'aims to contribute to poverty elimination in target countries by generating research outputs which sustainably enhance the production and productivity' of renewable NR systems.

*'The NRSP was designed to investigate the new systems perspective, and . . . was required to place emphasis on the identification of the major systems constraints, analysis of problems and their resolution by integrated approaches.'*³

The document went on to justify the systems approach, to characterise some systems research outputs, and to discuss monitoring and evaluating those outputs. Examples of systems research at production system, project and household levels were described. It did not, however, define the theoretical or methodological content of an integrated systems approach, or offer guidance (other than by example) of how such an approach is to be constructed in specific times and places. The objective of this paper is to move forward from this starting position, conceptually and methodologically, in the specific context of meeting international targets for eliminating poverty.

Poverty analysis is not integral to a systems approach. Indeed, many production systems have improved their productivity at the price of further marginalising the poor, as documented in some studies of the Green Revolution. What is the linkage between systems research and poverty elimination?

'The programme's overall purpose is to deliver new knowledge that can enable poor people that are largely dependent on the NR base to improve their livelihoods. The new knowledge centres on changes in the management of the NR base that can enhance the livelihood assets of the poor over a relatively long timeframe, thus providing greater livelihood security and opportunities for advancement of poor individuals, households or communities. Integrated management of natural resources is central to the research. The term 'integrated management' defines not only the adoption of a holistic view of the physical NR-base (landforms, soil, water, vegetation and organic residues) but also appreciates the integrated and dynamic nature of peoples' livelihood strategies and how these affect their decision-making and capacity to use and manage the NR-base.' (NRSP, Annual Report, 2000-2001. I-1).

Influential in recent debates, both within and outside DFID, has been the sustainable livelihoods (SL) approach. This is directed towards strengthening the beneficial outcomes of development interventions, and of supporting research. Advocates of the SL approach lay emphasis on capabilities and assets:

'A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base' (Carney et al., 1998).

Five kinds of capital assets are recognised: natural resource stocks, social resources (networks, groups, etc.), human knowledge, skills, abilities and health, physical infrastructure and equipment, and financial resources (savings, credit, remittances, etc.). Subject to the 'vulnerability context' of particular groups, which can be analysed in detail, these assets are transformed by means of various structures and processes into livelihood outcomes. The SL approach recognises the multisectoral diversity of rural peoples' livelihoods and the linkages between micro- and macro-scale processes. Following this line of argument, a typology of 'poverty aim markers' has been proposed for

screening development interventions according to their expected impact on poverty (Box 1).

Box 1: DFID's Poverty Aim Markers (PAM)

Poverty Aim Markers are a threefold typology of development actions that are designed to promote poverty reduction (Cox, Farrington and Gilling, 1998:30).

- (1) An 'enabling action' focuses on policy and institutional issues which reduce poverty and lead to social, environmental or economic benefits for the poor.
- (2) An 'inclusive action' aims to improve poor peoples' access to services, infrastructure, etc. on the basis of public sector programmes.
- (3) A 'focused action' targets the rights, interests and needs of specific poor people through a specific agency.

Examples of (1) are fiscal reform, land tenure legislation; of (2) education, extension services; and of (3) urban slum improvements, poor peoples' advocacy. It follows, presumably, that research on poverty elimination should identify one type of action as its central focus.

The definition of 'capabilities' and of 'assets' is not, however, straightforward. Much remains to be done in translating these principles into research agendas and methods. In the context of linkages between natural resources and poverty, 'stocks' is too crude a conceptualisation for practical purposes. Access is probably more important and immediately exposes the complex and often fragile linkages that exist between natural and social systems. Time-related processes such as changes in access (altered rights, subdivision, fragmentation, scarcity), environmental changes (soil degradation or amelioration, deforestation or tree planting, water table decline or increase), or inter-generational changes (in human fertility, age and sex structure, out- or in-migration) introduce a dynamic that must form a part of every research perspective. It is in relation to such processes that the use of a systems approach can be justified.

In addition to taking forward the debate from these baselines, this paper raises a fundamental question about the justification for development research. The broadening of the agenda from technology development and transfer to economic, institutional and social objectives is now accepted. What is less clear is the nature of the entry points being sought in place of technology promotion channels (from adaptive research to local piloting, extension, monitoring and evaluation, and national development programmes). It must be asked whether intervening directly in peoples' livelihoods is an appropriate or practicable objective for development. The alternative strategy is to enable or empower poor people to build their own livelihoods, secure their benefits and dispose of them at will.

Such an agenda calls for a reversal of some traditional attitudes. It also exposes the presence of social and economic barriers within and between communities.

Development research, in being more sharply focussed, may also be socially discriminatory. With public sector investments and service provision increasingly at risk, in many countries, from structural adjustment programmes, economic stagnation, and penury in state finances, a new realism is growing with regard to the limits of intervention as a development tool, and the urgency of creating enabling knowledge, economic and policy environments for poor people.

These environments are increasingly global in scale and in power to change poor peoples' lives, for better or for worse. The *White Paper on Globalisation* (2000) uses the expression 'making markets work for the poor', which captures the challenge of managing these forces successfully, though the solutions are at best opaque and the subject of much debate. NR management by small farmers, herders and collectors is directly affected by trans-national price and policy factors. Systems research therefore addresses such questions as soil conservation, water harvesting or agroforestry in more than a local context.

Causes and dynamics of poverty

Poverty is a sub-set within a livelihoods system, which, in any community, includes those of the rich as well as those of the poor. Its boundaries are moreover changeable. It should not be assumed that the category 'poverty' is free from ambiguity, and the literature seeking its deeper understanding in specific contexts continues to grow. The concept used inevitably influences a research agenda.

Poverty has usually been considered as an economic or social condition without direct reference to environmental or natural resource parameters, except in a generalised way. It is important to conceive of poverty not as a static condition but as a dynamic process. Large numbers of people move into and out of poverty during given time periods. For example, in Pakistan from 1986 to 1991, 55 percent of the population fell below the poverty line at some point in time but only 3 percent were consistently below that indicator. Distinctions therefore can usefully be drawn between the 'always poor', the 'sometimes poor' ('tomorrow's poor'), and the 'never poor'. In most countries the 'sometimes poor' exceed in numbers the 'always poor'.

The causes which may plunge individuals, or whole groups, into poverty include:

- Demographic - age, illness, disability or widowhood
- Social - social exclusion, marginalisation, lack of social capital
- Structural - a lack or loss of assets or of access to land, work or employment

- Ecological - natural disasters, resource degradation

The definition of poverty is inextricably bound up with its causes (Box 2). A 'physiological deprivation' approach focuses on the non-fulfilment of basic material or biological needs, such as shelter, nutrition, or health. A 'social deprivation' approach focuses on a lack of the resources required to participate in activities and enjoy living standards that are customary.

Box 2: Defining poverty and its immediate causes

Physiological deprivation

- (1) Income/consumption approach. A person is considered to be poor if, in a given period, her or his access to economic resources is insufficient to acquire enough commodities to meet material needs. The poverty line may be calculated in a variety of ways, usually emphasising income and/or consumption, or dietary energy supply, and those who fall below this line are at risk of a shortened lifespan, ill health, working impairment or discomfort.
- (2) Basic needs approach. Basic needs are the minimal specified quantities of such things as food, clothing, shelter, water and sanitation that are necessary to prevent ill health, malnourishment, early mortality, etc. This approach usually specifies a basket of goods and services that meet these needs and sets adequacy levels for each, rather than relying on indirect measures of non-food needs such as income.

Social deprivation

- (3) Entitlement approach. Poverty can involve not only the lack of necessities for material well-being but also the denial of opportunities for living a tolerable life. This draws on the theoretical work of Amartya Sen who conceptualises it in terms of the absence of certain capabilities to function. Analysis should include both what people can or cannot do (capabilities) and what people are or are not doing (functions). The UNDP characterises such capabilities as those leading to a long, healthy, creative life and to a decent standard of living, freedom, dignity, self-respect and respect for others (Human development report, 1997, p 15). Non-physiological well-being is important to the poor themselves.
- (4) Social exclusion approach. This refers to the relative lack of resources experienced by a specific social group that are required to participate fully in activities and enjoy living standards that are accepted widely in the society in question. It may result from social discrimination rather than being an artefact of poverty itself.

A lack of assets (or capital) is fundamental to poverty, whether of natural, physical, human, financial or social assets (World Bank, 2001: 34). Many writers emphasise the importance of social capital in the asset portfolio of the poor (more so than the rich) but in fact social capital is not a well defined concept. It is used to describe density of associational life at the individual, community or even national level. Different types of social capital are also identified, for example:

- bonding - strong ties connecting family, neighbours and friends
- bridging - weaker ties with people of similar social status
- linking - vertical links with people in positions of influence (patron-client relations)

Poor people tend to have weak bridging and linking social capital.

'... weak bridging and linking social capital leave the poor very vulnerable to natural disasters and economic shocks, because a geographically confined social network will be able to mobilise few external avenues of support or sources of information. Misfortune... may wipe out an entire village... for lack of bridging social capital that might provide longer-term support in the form of shelter, jobs or credit. Where bridging social capital exists, it can be a powerful means by which poor communities address problems requiring collective action... linking social capital can play a critical role in mitigating the effects of disasters. (World Bank, 2001: 128).

Social capital may well play a more important role in poor people's portfolio of assets than that of the rich: it may be said that social capital is the capital of the poor. One aspect of vulnerability which is stressed by poor people themselves is their voicelessness and powerlessness (World Bank, 2000). To provide the conditions necessary to give poor people greater voice and power would require building up social capital so as to enable poor people to participate in collective actions or to engage in dialogue with power holders.⁴

Poverty and natural resources

If raising productivity per hectare is not itself the solution - or only a part of the solution - to rural poverty, what are the linkages between NR management and poverty?

Poverty forms a sub-system within human resources, and production systems a sub-system within natural resources. The area of overlap between these two sub-systems describes a focus for natural resources systems research that is targeted on poverty elimination. Encircling the whole is the global environment (i.e., forces external to the system under investigation). Table 1 suggests some of the key NR-linked parameters of poverty, on which research may lead to potentially beneficial new knowledge.

Risk

Risk can have impact, and generate responses, at different levels: for example, the household (micro), community or regional (meso), and country or global (macro) levels. Poor people have developed adaptive strategies for coping with their vulnerability to risk, including diversifying out of natural resource dependency. These 'coping strategies' are now relatively well known from the literature and current projects.⁵ But they may fall short when the event is

Table 1: Some parameters of poverty linked to the NR-base

Parameter	Variables	Poverty defined	NR-linked strategies
Access to NR – private – CPR	Land, water, grazing, woodland, livestock	Inadequate assured access to meet production and income needs, displacement from NR, inequitable access	Enhanced capacity to compete for access, ending involuntary movements, equitable access
NR management capability	Labour, knowledge, tools	Inadequate access, incompetence (e.g., through sickness) degradation of NR-base	Enhanced access to knowledge, tools, health, capacity to sustain productivity
Capital for purchasing	Technological investment, inputs, breeding stock	Incapacity to save, risk, lack of access to credit, smallness	Enhanced capacity to prevent or mitigate risk, protect investments
Access to NR product/ input markets	Transport cost, information, institutional channels	Unprofitability of NR-based market options; inefficient, unfair, ill-regulated or remote markets	Improved physical or financial access, more options, efficient markets
Off-farm incomes	Employment, trade, services, 'free goods', etc	Inability to travel or migrate, lack of starting capital or knowledge, lack of education	Enhanced capacity to diversify from NR-base, easier travel, better options via more NR-based income, education
Access to social capital	Bonding, bridging, linking	Exclusion, widowhood, low status/claims	Enhanced access to NR-based incomes, association
Access to outside help	Local government, agencies, national government, migrant relatives	Bad governance, no agencies, or end of queue for benefits, no migrant relatives	Equal rights, targeted interventions

The third and fourth columns of this table move towards defining a role for NR systems research within a broader poverty reduction framework.

severe, unanticipated, or occurs with high spatial co-variance (for example, drought). The poorest people have fewer or weaker alternative livelihood strategies, and in some circumstances can fall on a downward spiral into destitution.

Linkages between poverty and risk related to people's dependency on natural resources should include the dynamic elements just identified. There is a need to assess the elements of risk emanating from the natural resource sector as a proportion of the total risk exposure of poorer households. A major focus should be the reduction of risk and vulnerability which are attributable to natural causes or changes in natural resource endowments. A starting point should be a search for enhanced NR management by poor people themselves as a strategy for achieving an impact on poverty. Such management includes both adapting consumption to fluctuations (seasonal and inter-annual) and asset protection, the key to capital accumulation.

However, does this go far enough? Risk management is also clearly dependent on social capital (as well as economic and environmental externalities), and this linkage needs more research and may be susceptible to change through institutional or other interventions.

Solutions to risk exposure tend to be economic rather than technical, yet the technical inventories of people living under high exposure to risk from natural causes (droughts, flooding) are rich in coping capacity. NR management research tends to ignore extreme events, however. A better understanding of risk, not only as a source of poverty, but as a property of natural and economic systems, requiring management, is needed urgently.

How systems research can contribute to poverty elimination

The research emphases proposed earlier should lead to focused development actions with respect to specific groups of the poor (refer box 1, PAM 3), or to enabling actions that benefit such groups (PAM 1).⁶ Techniques for identifying such groups have improved significantly, in particular in relation to the food insecure (a sub-set of the poor). For example, methodological work in India (Chung et al., 1997) has built on foundations laid by village studies in which the dimensions of the human and natural resources systems are known from long-term studies (Walker and Ryan, 1990). Such methodologies may be adaptable to NR-based objectives.

'The systems approach is central to the design and implementation of NRSP's research projects. This applies to the context of the research (the rationale); the features or elements that the research prioritises (the justification); the methodology (how the research will be undertaken); the process (the ways by which the research will be transacted and conducted) and the products (the form of the results)' (NRSP Annual Report, 2000-2001, I-22,23)

According to this interpretation, systems research

- Emphasises inter-relationships
- Accommodates complexity
- Has boundaries appropriate to the question under investigation
- Is distinct from a production system
- May work at a detailed scale (ibid.)

The first avenue we shall discuss for using a systems approach to contribute to poverty elimination is the modelling of systems.

MODELLING SYSTEMS

The justification for researching systems is that a system is more than the sum of its parts. In addition to its parts (*components*), a NR-based system has:

- *Organisation*, or is non-chaotic and susceptible to analysis,
- *Linkages*, or relationships between its *components* that can be described in a model. Such linkages are legion in any NR-based system;
- *Flows*, which quantify the *linkages* in terms of such variables as energy, nutrients, finance; and
- *An internal dynamic*, which represents the system's capacity to change in response to external variables.

From a developmental perspective, it is essential that a system is also:

- *Manipulable* through policy or intervention.

The larger and more complex systems may display some additional properties, as suggested by the new science of complexity (Waldrop, 1992); they are:

- *Aggregative* (as the outcome of large numbers of individual decisions),
- *Multidimensional* in space and time,
- *Emergent*, or subject to transformation as well as growth, and
- *Adaptive*, or capable of responding to external challenge.

This last characteristic results from the fact that a system can evolve in a way that cannot necessarily be predicted from the behaviour of its parts. Agricultural

models of transformation through the interaction of two or more independent variables, such as the 'Boserupian' models of intensification under population growth, provide illustrations of this principle which are highly relevant to both the scientific agenda and the developmental objectives of research such as that supported by the NRSP.⁷

A systems approach may be criticised on the ground that while producing illuminating case studies, which are highly place- and time-specific, its exposure of complexity, diversity and dynamics impedes simplicity and generalisation. Policy-makers want solutions that have broad applicability. Therefore, in a developmental context, we cannot justify holism for its own sake, nor the collection of indiscriminately large data sets. Interconnections among real-world systems are in any case infinite. For analytical purposes, and as a tool for development, the system under investigation must be bounded. Here a distinction should probably be made between a focussed *systemic* approach that searches for linkages between specified elements of a system and the modelling of whole *systems*.

Modelling approaches offer the possibility of both advancing and simplifying understanding of systems. Most modelling so far has been confined to biophysical systems however. Diversity has discouraged social modelling. However, it is time to take a new look at the capability of modelling approaches to provide a route to generalisation. An NRSP programme development assignment reviewed biophysical modelling approaches used in a number of research projects. A major finding was that some of the models, from an interdisciplinary perspective, have only a limited application. However, the challenge lies in developing the potential of modelling techniques from quantitative (or biophysical) models to non-quantitative (or interdisciplinary) ones which may offer greater flexibility in the field, less demanding data requirements, and stronger relevance to the adaptive behaviour of poor households and stakeholders seeking NR-based livelihoods (Box 3).

Whether or not a given research project includes formal modelling, it is doubtful if a systems approach can be used effectively in the absence of a conceptual model, accurately specified.

EXPOSING THE LINK BETWEEN SOCIAL SYSTEMS AND NATURAL RESOURCES

Traditional disciplinary specialisation is not helpful to systems research, and does not reflect the multi-sectoral reality of poor peoples' livelihoods. Attention to the linkages, flows, and dynamics which are basic properties of systems provides a method for understanding, measuring and if necessary, intervening in the social and production relations of NR management. An interdisciplinary approach needs to begin with the recognition of a livelihood system,

Box 3: Interdisciplinary models of systems

The quantitative or non-quantitative development of simple descriptive models may merit attention, for example, to:

- Sequential decision making models which expose the relations between decisions made over time by households or individuals in the disposal of assets or the allocation of resources
- Monetary circulation models which expose the movements of wealth within and between communities, perhaps focussing on wealth derived from natural resources
- Models of multisectoral livelihood systems
- Models of risk and vulnerability
- Energy/nutrient cycling models, applied to soil fertility management, labour circulation, or human nutrition
- Ecological models of system sustainability under different management scenarios
- Models of institutional relations and decision making
- Impact models showing the expected outcomes of change
- Models of processes at system level, such as agricultural intensification
- Migration models

understood holistically, rather than as an assemblage of different crop or livestock enterprises. Because the livelihood system is multisectoral, farm and non-farm sectors must be understood and, of course, the linkages between them.

Natural resources (a) provide income for very large numbers of poor families; while (b) poor families who control natural resources are their custodians on behalf of future generations. Therefore (a) productivity and (b) sustainability should be priorities in a responsible development-oriented research agenda⁸. Notwithstanding the numbers of landless people among the rural poor (especially in Asia), and global urbanization, markets for primary products and factors of production (employment, formal or informal, farmland, capital, knowledge) maintain direct or indirect linkages between poor people and NR management. Indirect linkages offer a valid area for research, as the livelihoods of people who have lost the capacity to produce directly from NR are sometimes the most vulnerable to risk.

These linkages may not be the same for poor people as those between larger commercial producers and NR management. The benefits of much NR research in the past have been captured by such producers. Far from invalidating NR research, such inequity (which, in spite of some income gains from employment, can lead ultimately to the dispossession of increasing numbers of poor stakeholders from direct access to NR) serves to accentuate a need for research which can deliver benefits for poor people, whether those having NR assets or those only indirectly dependent on NR. However, the complexity of the linkages between poor families and NR shows that technological research alone is not enough. The income and energy flows

which link the poor with the NR base, whether through direct rights of access or indirectly through rights controlled by others (such as employment, petty trading, waste recycling, etc.), require an interdisciplinary analytical approach.

Using both participatory methods and relevant measurement and assessment techniques, researchable constraints are identified largely by means of participatory methods, which allow the expected costs and benefits of solutions to be evaluated in financial, economic, social or bio-sustainability terms. This shared knowledge then sets bounds to a search for technical, management or institutional solutions. Candidate lines of research must be 'screened'. The upshot is not the replacement of technical by social research⁹, but an identification of researchable constraints according to criteria that have reality for poor individuals or households, whose impact can be expected to be real.

FINDING 'ENTRY POINTS' IN A MULTI-SECTORAL SYSTEM

Stakeholder (including gender) interests cut across or disaggregate the household structure of any community. A traditional approach to development based on the provision of basic needs through public sector investments and service provision cannot fully take account of such complexity. Economic differentiation is often rooted in unequal access to natural resources and to the knowledge or technology necessary for their equitable, sustainable and profitable use. A key question is the locus of control. Therefore, neither social nor technical research alone is sufficiently robust for diagnosis and prescription. Research needs to situate natural resources - given the peculiar constraints of a given environmental system - within a social framework - again, specific to time and place - both to determine ways to introduce change and leading on from this, to achieve demonstrable change at a scale that shows the developmental potential of the topic of the research.

Ways to introduce change require 'points of entry' - opportunities in any given system by which a particular beneficial change might be achieved. These opportunities may be of varying kinds - perhaps a particular target group that is slightly more innovative and could 'lead by example' and enable wider uptake and impact of a piece of research, or the opportunity can be in improving a part of the system that is not the immediate area of concern but does provide an acceptable lead in (with clients) to the part of the system where change is sought. An example is tackling a pest, which farmers definitely identify as a problem (like *Striga*), in order to introduce better rotation practices that will help to sustain the capacity of farmland to support crop production over the longer term. Interdisciplinary research, arguably, is essential for the keen perception of system-based entry points.

What implications has a systems approach for the ways developmental research is carried out?

Sharpening a poverty focus in systems research means extending the foregoing argument from rationale and justification to methodology, process and product, which we shall do in terms of four areas of practice where choices must be made: partner and target institutions; methodologies; scaling up; communicating findings; and impact assessment.

PARTNER AND TARGET INSTITUTIONS

In common with any other developmental research, systems research should involve partner institutions, local and national government, development agencies, professions, communities and participating individuals as stakeholders, and not bystanders. It is likely that the more effectively government agencies participate in research, the stronger the possibility is that findings will be taken up afterwards. In some countries, NGOs are prominent players in development programmes. Public sector development projects are sometimes partners in NRSP's research. *Partner institutions* may be expected to retain an interest in uptake, promotion and further development after foreign (UK) researchers have left. *Target institutions*, however, are those that are expected to make use of the results in development policy and practice.

As it is clear that continuity is a condition of achieving an impact on poverty, the role of target institutions is critical. However, systems research has (necessarily) a long timeframe (as emphasised in the quotations above from the *NRSP Annual Report*). It does not lead to a technical promotion, as a rule, but provides new knowledge of the system for the use of policy makers and development practitioners. Effective penetration of the structures and processes of development in target countries cannot realistically be expected in a short timeframe, even assuming that a project's findings *deserve* to change opinion and practice after a due time for announcement and critique. Several possibilities of action suggest themselves:

- Initiating a debate on the role of partnerships between UK-based and in-country research groups, institutions, and governments
- Initiating debates in-country which are supported by the findings of systems research
- Strengthening links between researchers, community leaders, stakeholders and householders in research locations
- Achieving equality of ownership of both the research and its findings
- Adapting budgetary planning and management if necessary to leadership by in-country institutions
- Placing more emphasis on uptake in initial project planning

- Scoping studies before main proposals are prepared, to take better account of partner and target institutions' perspectives and priorities
- Involving DFID country offices more directly in NRSP research¹⁰

This is an operational area that is still developing, a situation that results directly from the nature of systems research.

CHOICE OF METHODOLOGIES

Setting technical or biophysical studies in a systems framework involves raising the profile of social and economic analysis. It is clear that this cannot be achieved merely by 'adding on' social science to a study that is intended primarily to address a technical agenda. But a convergence of social science, biophysical science and technical methodologies in development research is by no means a completed process. A need for interdisciplinary research teams is widely acknowledged – to the point of being 'politically correct'. But experience has shown that more is needed than parallel inputs from different disciplines having their own scientific agendas (multidisciplinarity). Integrated research design and methodologies (interdisciplinarity) are necessary to engender disciplinary coherence.

The social analysis, which is essential for understanding systems holistically, is not obtained cheaply. Sometimes well-known acronyms such as PRA (participatory rural appraisal) are thought incorrectly to guarantee interdisciplinarity. Nor are rapid field survey methods appropriate where in-depth understanding of social process is needed. The adoption of a SL approach does not in itself carry methodological implications. Many specific questions arise from the objectives of individual projects, which may include such diverse themes as policy interactions, conflict management, and the design of new institutions for NR management, as well as data gathering exercises susceptible to standard methodologies. The search for appropriate methodologies for systems research should not be under-estimated.¹¹

Given a partnership structure, research teams include members from several institutions, disciplines, and countries. Distance, as well as specialised institutional interests, can impede effective collaboration at this intellectual level. Asymmetric relations (where one discipline dominates the research design) are more common than equitable ones. For example, technically biased groups may search for a social scientist to take a subsidiary role or cover a perceived gap in the design, rather than accepting the harder challenge of hammering out conjointly a shared intellectual platform. Yet it is from such a platform that truly innovative research questions are most likely to emerge.

The choice of analytical unit has obvious implications for interdisciplinarity (Box 4). These suggest that NR management research needs to take a critical approach to the selection of analytical units, as social and NR management units may be linked in complex ways (Table 1, above).

Box 4: Analytical units

Natural and social scientists have their own conventions but for interdisciplinary questions, data sets need to achieve a degree of convergence. The options include the choice between individuals, households, stakeholder groups and institutions as a framework for social data collection. Much social analysis used the household as a frame of reference. However, there is a vigorous debate about the household as a unit of analysis. Production units, which in some places differ from households, may be more appropriate for investigating natural resource management. Institutions at the local level are currently in fashion, especially for studying CPR management. Stakeholder groups however permit analysis to take account of gender, age, caste or other groupings that may cut across households.

Natural resource quantification is based traditionally on sampling frames that reflect ecological differentiation such as soil or vegetation classes, groundwater availability, slope and erosion hazard classes. It is rare for such classifications to be linked directly with resource access (such as farmland tenure, grazing rights, fuel collecting rights) and even rarer for such linkages to be carried further into the social distribution of natural resource benefits.

SCALING UP

Scaling up has specific methodological implications to do with cost-effective methods of assessing the potential for wider adoption of research findings, covering such things as their applicability and replicability, and the modalities of the promotion of new knowledge generated by research. Some researchers feel that this is beyond their competence or interest, but it is an essential component of NR management research where a landscape element forms an integral part. An example of such a 'landscape element' is where improved NR management is sought beyond the limits of the fields or holdings where the micro-scale research commenced. The reclamation of a tract of land on a hillside, the improvement of water management on irrigated land, or better waste management (pollution reduction) in a peri-urban setting provide other illustrations. Even without a 'landscape element', the provision of improved services to enable better NR management by smallholders also needs to be supported by research that links these different scales.¹²

A wider dimension of scaling up research findings from case level to system, from local to national, or from national to regional cannot always be planned within the lifetime of a research project unless it is

following up an earlier study. Nevertheless, proposers of *development-oriented* research should consider this issue. As much systems research is conducted at micro- or meso-scales, sampling strategy is an important question in order to manage the problem of 'representivity', which is universally recognised. This problem may have different implications for scientific than for developmental objectives. Certainly there are studies which, although they advanced scientific understanding, have not had their recommendations taken up. Yet without scaling up, any benefits for the poor will, at best, remain restricted to a few, may not be sustainable and may be insufficiently noticeable to register with policy-makers and donors.

What is clear is that scaling up should be an integral part of development research design, and not be left until the primary scientific objectives have been satisfied. Within NRSP, part of the responsibility for this lies with the Programme Management, which carries the mandate for continuity and coherence in its six production system sub-programmes.¹³ It is consolidating the work of previous studies with a view to strengthening continuity and identifying those technologies and methodologies with strong potential for taking forward, both within a target country and internationally.

COMMUNICATING FINDINGS

Research sponsors (including DFID) are expressing increasing interest in the 'uptake pathways' of projects, including communication strategy (considered here) and impact assessment (below). The communication of new knowledge, perspectives, critique or prescriptive policies and technologies is a multifaceted operation. It may be considered at five levels: the village or research site, local government, development agencies, central government, and international research and policy debates (Box 5). At every level, there are a number of issues that are likely to affect communication strategies, which (given the nature of systems research findings) need to be tailored to the specific situations of research projects. The target institution may be located at any of these levels.

There is more to communication, therefore, than the production of inputs to the scientific literature. Some research groups produce an 'alternative literature' of broadsheets, manuals, and extension pamphlets, or audio-video outputs. On the other hand, students (the policy makers of the future) need user-friendly scientific texts. Such activity is becoming a necessary concern in development research. However, some researchers doubt their competence in such areas and, furthermore, project budgets cannot realistically provide - unless in a second phase - for the long term efforts which are necessary in writing, translation, promotion and in-country meetings. Research findings have to be targeted with respect to mode, language and style as well as effectively disseminated.

Box 5: Dissemination, promotion, uptake: levels and issues

<i>Village (research site)</i>	social and economic differentiation, exclusion selective appropriation of benefits community institutions commercial or land-owning interests distortions caused by research intervention 'action' versus 'pure' research
<i>Local government</i>	vested interests democratic institutions accountability capacity participation and ownership of findings
<i>Development agencies</i>	constituency agendas, mandates inter-agency co-ordination relations with government time-frames
<i>Central government</i>	prioritisation of research versus action political agendas access to democratic institutions prioritisation of needs addressed by the research openness to critique, flexibility capacity and continuity in professional departments
<i>Research & development debates</i>	integration of in-country with international debates national versus international development priorities local versus international scientific literatures local research applications versus wider debates

What is clear is that effective in-country partnerships and target institutions are necessary for communicating the findings of systems research, which does not always generate simple technical messages and may need to be inserted into ongoing policy or professional debates, calling for a relatively long time-frame. It is important, therefore, to recognise both the constraints and the opportunities of communicating research products, in order to deliver expected benefits to poor people within acceptable time-frames. It may (on occasion) be appropriate for additional dissemination activities to be funded.

IMPACT

Major donors are concerned to assess the impact of their projects on poverty. Whereas a development intervention is normally expected to benefit poor people in specified ways within a defined time-frame, research (even 'action research') aims to provide new knowledge and its impact on poverty is necessarily removed by one step. Developmental impact assessment of NR systems research is neither practicable nor appropriate.

Nevertheless, impact assessment is both necessary and valid within appropriate terms of reference. A major difficulty facing 'impact accounting' is, once again, the time-frame: it is not reasonable to expect impact on livelihoods within the lifetime of a project unless it is a follow-up to an earlier one. The new knowledge generated by systems research has to engage with debate and critique before it is likely to achieve acceptance. More work is needed on defining realistic indicators of impact that can be written into project proposals.

It is still relevant for NR systems research to ask why technical research may have little impact on poverty reduction. Some answers to this question are suggested in Box 6. The adoption of a systems approach targeted on poverty is not in itself a guarantor of greater success.

Box 6: Some reasons why research may not have an immediate impact on poverty

- (1) *Accepted findings are not taken up by development agencies.* Many factors intervene between research and development, most notably, policy priorities and resource constraints.
- (2) *It lacks focus.* It is likely that an assumption still exists in some research communities that new knowledge should eventually benefit the poor, if only via the agency of government. A 'poverty focus' attempts to force the pace of a transition to better targeting. There are signs of unevenness or asymmetry in this transition, among NRSP groups both in the UK and overseas.
- (3) *Research findings are unrepresentative, inconclusive, or controversial.* Is research only worthwhile if conclusive? Unrealistic expectations can overestimate the usefulness of research findings for immediate application, yet inconclusive findings may further the search for outcomes which will have a direct impact on poverty.
- (4) *New knowledge is strategic, 'upstream' or fundamental rather than applied or 'downstream'.* This issue is recognised in discussions on natural resource research. Recognition of the legitimacy of longer term or policy-oriented research is given in the 'Poverty Aim Marker' (Box 1).
- (5) *Communication is targeted at educational and professional groups rather than governments or agencies.* Impatience is often expressed with a strategy to influence the course of development through educating students and providing professionals with better scientific inputs, rather than policy makers directly. However, it should be noted that such a view underestimates the impact that paradigms have on development practitioners.
- (6) *Communication is blocked or interrupted.* Major barriers block the north-south transmission of published research (high costs or poor distribution of books, high costs of participation by southern scientists in international debates, inadequate arrangements by foreign scientists to share research data and outputs with southern institutions, high costs of access to computers and the internet, etc.). Discontinuities both in donor policies and in personnel or policies of key government institutions in southern countries can disrupt uptake.

Therefore, systems research must be evaluated not in terms of its immediate developmental impact but in terms of its impact on the thinking, policy and practice of development agencies at all levels. To include, for example, measures of uptake of new NR management practices at community level among the verifiable indicators in a project logframe is not likely to be meaningful.

Furthermore, to evaluate the impact of research on poverty, an agreed definition of poverty is required, with indicators whose incidence can provide an objective assessment of progress. It will be apparent from the discussion on poverty earlier in this paper that given the diversity, dynamics and complexity of poverty, any definition, and the indicators to go with it, must be functional in nature - applicable to the need

in question. The tension between globally compatible indicators (which are insensitive to local context and process) and culturally grounded indicators (on which participatory evaluations are possible) is reflected in current debates on poverty and food insecurity among major donors (HTS, 2001). A consensus is emerging that a pluralistic approach to assessment indicators can reflect the different requirements of the various stakeholders.

Conclusion

The present context of NR systems research calls for more debate on research objectives and methods in relation to a strengthened poverty focus. Research funded by agencies whose policies embrace such a focus must engage as effectively as possible both with the uncomfortable truth that much NR management research in the past has failed to improve poor peoples' livelihoods (for reasons which may not always have been within the researchers' control), and with a rapid contemporary shift in perceived ethical and institutional responsibilities towards the poor and marginalised among the global community.

A systems approach distinguishes the DFID's NRSP from other NR programmes, and also offers an unique perspective on poverty. Poverty is multi-dimensional, dynamic, and capable of more than one interpretation. In relation to natural resources, there is an important subset of linkages that are susceptible to investigation using a systems approach. Some specific implications have been identified with regard to interdisciplinarity and practice. The experience of NRSP in bringing about a convergence between NR systems research and poverty reduction - a process which continues - has a wider relevance in today's debates on rural development, food security and poverty strategies.

Annex: NR Systems research and some alternative approaches

It may be helpful to clarify the relations between the systems approach supported by NRSP and other approaches in current use.

Farming systems research (FSR) was developed in the 1970s and 1980s in response to a need to

'escape the single commodity focus [of station research] and concentrate specifically on farmers' actual circumstances, integrating farmers into the research process. An important development is that agriculture came to be seen as an holistic system in which all important interactions (ecological, biological, social, economic and political) should be considered' (Dorward et al., 1997)

but in practice, FSR work was primarily concerned with the development and promotion of specific farm technologies.

With regard to farmer participatory research (FPR), Okali et al. (1994: 135) write

'the current interest in farmer participatory research has developed at the confluence of several major development

themes: farming systems research, participation, empowerment, the importance of local knowledge systems, the role of NGOs, etc. Farmer participatory research has rightly generated considerable excitement, as it has attempted to move beyond the formal interactions that characterised much farmer participation in the early years of farming systems research'.

Whether FPR represents a conceptual or merely a methodological advance on FSR, it remains focused on farmers and on the development of farm technologies.

The SL approach, however, is founded on the fact that rural households are multi-sectoral and complex, agriculture being but a part (if, often, the major part) of the structure for earning real incomes.

The impulse for the SL approach was social and economic. Renewable natural resources may be regarded as income streams from a livelihoods perspective, but as they are, in reality, managed ecosystems, the technologies and management modes used in their exploitation are as important as the social distribution of access to (or denial of) them and their benefits. The level of management may range from minimal (e.g., in forest reserves or game parks) through intrusive (e.g., bush fallowing systems) to transformational (e.g., irrigated systems). Natural resource systems research focuses on these management regimes, the technologies used, their impact on ecosystems over time, their productivity and sustainability (in environmental, economic, and social terms). Through the livelihood system, NR management is linked with other sectors of the local economy, the social system, and (very important) the regional, national and global system whence markets, employment, policy stimuli and other forces emanate. According to the document cited above (DFID-NRSP, 1999),

'A systems approach to research means identifying researchable issues in their developmental context, by undertaking analysis of all the technical, economic, social and institutional inter-relationships that are involved in a given situation'.

This need not imply that a system must be analysed in its entirety before any of its components can be understood, or researchable constraints identified. The systemic inter-relationships of a focal component are explicitly sought out rather than allowing them to fall between specialisms. Nor should it imply that systems research stops with the identification of researchable constraints. The challenge for researchers is to carry a systems perspective forward through design, methodology and execution to identify, test and validate points of entry for poverty-reducing interventions.

Notes

- ¹ The Natural Resources Systems Programme began in 1995 as a part of the Renewable Natural Resources Research Strategy of the Overseas Development Administration (now the Department for International Development). In April 1999, after four years of the planned ten-year Programme, management was placed under contract to HTS Consultants Ltd (now HTS Development Ltd). During the ensuing one and a half years, 23 projects, which had commenced in earlier years, were completed, and 28 new projects were commissioned. The NRSP is now (February, 2001) more than half way through its guaranteed lifetime. Programme Management includes the Programme Manager, Steering Group and Programme Advisory Committee.
- ² The Workshop, 'Improving the poverty focus of NRSP's research on management of natural resources' (IACR, Rothamsted, 29-30 November 2000) aimed to facilitate such a debate. A draft of this paper was prepared as a background to those discussions, and we acknowledge many valuable

insights gained therein, which we have tried to incorporate into this version.

- ³ The six NRSP production systems [Forest-Agriculture Interface, High Potential, Hillside, Land and Water Interface, Peri-Urban Interface, and Semi-Arid Production Systems] were seen as the mechanisms for introducing a systems perspective into the Renewable Natural Resources Research Strategy (RNRRS) of DFID.
- ⁴ Questions which arise for a research programme such as the NRSP include: how can research contribute to the strengthening of social capital in the specific context of natural resource management? In what ways can enhanced management strengthen the bargaining position of the poor and thereby mitigate poverty? Or (vice-versa), how can better social capital improve the sustainability of natural resource management by poor people?
- ⁵ See NRSP Annual Report, 2000-2001, vol. III.
- ⁶ At this stage of the NRSP's programme term (year 6 of 10), research that would lead to 'inclusive' development actions (PAM 2) arguably offers insufficient application to its demanding objectives and time deadlines.
- ⁷ The NRSP is alone among the renewable natural resources research programmes of DFID is being specifically targeted on multisectoral systems.
- ⁸ It can be argued that, in general terms, AID-related research adds to the knowledge base for development. However, current AID priorities, including IDTs, require us to sharpen our focus on our clients (the poor) and, in relation to this, to give much greater attention to the identification of the priority topics/issues for NR research and the improvement of research design. Both initiatives are needed in order that relatively near term delivery of relevant research findings is achieved. This is the basis for the argument that NRSP conducts development-oriented research.
- ⁹ The term 'social research' in this text is used in a restrictive way to encompass only social research. An additional and distinct reference to 'economic research' is made when needed. The hybrid term 'socio-economic' purposely is avoided because it weakens each of the disciplinary research fields to which it refers.
- ¹⁰ Country offices have not, in the past, been directly involved in planning NRSP's research, although recent developments in Eastern Africa (setting up of a joint RNRRS-bilateral regional coordination office) can point to a way forward. It must be remembered that DFID offices may be linked with many different research programmes; that they have their own agendas; and that their primary responsibilities are likely to remain with DFID-supported bilateral projects (which may have their own research budgets).
- ¹¹ The Socio-Economic Methodologies Programme (SEM/NRSP) produced a number of 'best practice' guidelines on Participation, Stakeholder Analysis, Gender Analysis, Economic Planning, Farmer Participatory Research, and Dissemination.
- ¹² As NRSP progresses towards the latter part of its programme term, scaling up research may need to claim a higher priority than research at micro-scale.
- ¹³ More discussion may be needed on how to take this issue into consideration in preparing proposals, incorporating contextual work in relation to previous research and development in the country concerned, and including methodological questions, implementation and evaluation.

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Acronyms, abbreviations

AID	Aid for international development
CGIAR	Consultative Group on International Agricultural Research
CPR	Common pool resources
DFID	Department for International Development, Government of the United Kingdom
FPR	Farmer participatory research
FSR	Farming systems research
IACR	Institute for Agricultural Crop Research
IDT	International Development Target
NAR	National agricultural research
NGO	Non-governmental organisation
NR	Natural resources
NRSP	Natural Resources Systems Programme, Department for International Development
PAM	Poverty aim marker
PRA	Participatory rural appraisal
SL	Sustainable livelihoods
UNEP	United Nations Environment Programme