

Working Paper 112

**REACHING THE POOR? DEVELOPING A
POVERTY SCREEN FOR AGRICULTURAL
RESEARCH PROPOSALS**

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Acronyms

CGIAR	Consultative Group on International Agricultural Research
DFID	Department for International Development (UK)
GMT	genetically modified Tilapia
HYVs	high yielding varieties
IDS	Institute of Development Studies
IFAD	International Fund for Agricultural Development
IPR	intellectual property rights
NARS	National Agricultural Research System
NGO	non government organisation
NR	natural resources
NRPAD	Natural Resources Policy and Advisory Department (DFID)
NRRD	Natural Resources Research Department (DFID)
PAM	Poverty Aim Marker
PAs	poverty assessments
PRA	Participatory Rural Appraisal
RNR	renewable natural resources
RNRRS	Renewable Natural Resource Research Strategy
SRL	sustainable rural livelihoods
SSA	sub-Saharan Africa
UNDP	United Nations Development Programme

Summary

1. The central argument of this study is that natural resources (NR) research is a potentially powerful, but also comparatively blunt, instrument for addressing poverty. Much of the study is concerned with ways of sharpening its focus.
2. NR research can help to create benefit streams from the capital assets of the poor through one or more of three principal mechanisms: production, employment, and consumption. Although not a ‘mechanism’ in the definition used here, empowerment is also potentially important.
3. How, and how far, NR research impacts on poverty is strongly dependent on national institutional and policy conditions. Conceptually, these help to shape the ‘conditioning factors’ which in turn determine how research helps to convert capital assets into benefit streams.
4. The capital assets framework for analysis presented here, is closely coherent with generic Poverty Aim Markers developed by the Department for International Development (DFID). These indicate that poverty reduction may be promoted through enabling, inclusive or focused actions. When applied to NR research, *enabling* actions can improve the poverty impact of either existing or new research through changes in general conditioning factors such as the regulatory or incentive frameworks; *inclusive* actions, such as improving extension services or markets, address equity concerns as well as benefiting the broad population; and *focused* actions through sector or sub-sector specific research, seek to target most of their benefits at poor groups.
5. There are three major implications for NR research arising from this analysis:
 - first, a ‘screen’ is needed at project proposal stage to help proposers specify how they anticipate their work will impact positively on poverty, and to screen out those proposals having little or no prospect of poverty impact. It is recognised that impact can only be imperfectly predicted at this stage. Nevertheless, it should be possible to identify and screen out proposals clearly unrelated to any mechanism of poverty impact;
 - second, the dominant mode of prioritising what research is to be done and where, should be sustainable livelihood strategy reviews at country level. They will have to be prepared and applied more rigorously than previous country or regional Renewable Natural Resources (RNR) Strategies. Only through these can the opportunities and constraints for poverty impact determined by policy and institutional factors (and thence ‘conditioning factors’) be understood and worked into research prioritisation.
 - third, research into a number of major areas of relevance to the poor transcends national boundaries and so, although necessarily informed by relevant country livelihood strategies, need not be limited by them. They include certain livestock diseases, aspects of fish genetics, major commodities such as rice and irrigated rice/rice or rice/wheat rotations as a production system. Once it is agreed that research should be undertaken on these, then its form, level and resourcing need to be determined through consideration of how it can best complement existing national and international efforts.

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The interpretations presented here, and any remaining errors, are the responsibility of the authors alone.

1. Towards a new understanding of poverty

Poverty in sub-Saharan Africa and South Asia remains predominantly a rural phenomenon, and many of the poor rely in one way or another on agriculture or the exploitation of natural resources for at least part of their livelihoods. Changes in the distribution of benefits from these activities can accrue through long-term change in relative productivities, terms of trade and access rights. They can also result from specific interventions at project or strategy levels, including those supported by international funding organisations. The focus of this paper is on distributional change brought about by the latter.

There is wide recognition that livelihoods may be particularly at risk since the distributional impact of technological change in agriculture or NR management is rarely neutral (see Annex 1). This has helped to generate a literature on procedures for prioritising research so that the distribution of impacts will be directed preferentially to one or more ‘target’ groups with the aim of furthering the poverty reduction objective embraced by most European donors.

This paper draws on both of these sets of writing, but with the publication in 1997 of the White Paper on International Development, the UK has swept away any ambiguity concerning its commitment to poverty reduction. This paper is intended to serve as a resource in the pursuit of poverty reduction, and it shares definitions of poverty found in the White Paper and elsewhere which go beyond income, food security and basic needs to embrace wider concepts of livelihood such as social inclusion. Specifically, this paper is intended to inform decisions on the allocation of DFID resources to NR research, through bilateral projects and programmes, but also through international agencies such as the Consultative Group on International Agricultural Research (CGIAR).

The purposes of this paper then are twofold:

- on the basis of these wider interpretations of poverty, to propose a model of how technical change in agriculture and natural resource management can be expected to impact on livelihoods; and
- to suggest specific procedures for screening proposals for biophysical research in order to enhance the prospects of positive impact on the poor.

In the remainder of this section, the paper reviews different concepts of poverty, examining in detail the capital asset definition of poverty and relating this to DFID’s Poverty Aim Marker. Section 2 develops a profile of the poor, emphasising the need for assessments of poverty which are sensitive to local context, and gender. Section 3 examines the scope for enabling, inclusive and focused actions in support of the poor. Annex 1 reviews recent literature on NR research and poverty reduction.

1.1 What is poverty?

Poverty has most commonly been assessed against *income* or *consumption* criteria. According to this perspective, a person is poor only if his/her income level is below the defined poverty line, or if his/her consumption falls below a stipulated minimum. The ability to consume is clearly a fundamental dimension of wellbeing, particularly when it is considered that some 500 to 700 million of the world’s poor are unable to satisfy their most fundamental need of all, i.e. food.

Meeting basic food needs is the first priority of the poor, who will tend to place this before their need for improved shelter, sanitation, or education. This suggests that raising overall production and productivity, and the ability to import food, should be early on in a sequential treatment of poverty.

However, although income and consumption are clearly vital, poverty cannot be fully understood through this optic alone. When the poor themselves are asked what poverty means to them, income¹ is only one of a range of aspects which they highlight, and sometimes not the most important one (Chambers, 1997). These other aspects include rather intangible assets, such as a sense of voice vis-à-vis other members of their household, community or government, as well as their state of health, literacy, education, and access to assets. Many of these other dimensions of well-being may depend less on income—although the poor will tend to send children to school only once a certain level of consumption has been achieved—than on political resource allocation by local and national governments. This is, in turn, usually a function of the social or political capital of individuals or groups.²

Dissatisfaction with the income/consumption model gave rise to the *basic needs perspective* which views poverty as ‘deprivation of material requirements for minimally acceptable fulfilment of human needs, including food’. It goes far beyond income to include the need for basic health and education, clean water and other services which are required to prevent people falling into poverty. More recently, poverty has been defined in terms of the absence of *basic capabilities* to function. This takes the multidimensionality of the basic needs approach as its starting point, but places the emphasis on the factors enabling or constraining individuals in their attempts to achieve the minimum level of these functionings. The functionings, as defined by United Nations Development Programme (UNDP), ‘include physical ones such as being malnourished, being adequately clothed and sheltered, avoiding preventable morbidity’, but the concept also embraces social exclusion by including capabilities to partake in the life of the community and to influence decision-making (UNDP, 1997: 16).

The basic capabilities perspective has formed the basis for a fairly new approach to analysing poverty, or its absence—well-being—which has gained ground in recent years. This centres on the concept of *sustainable livelihoods* or sustainable rural livelihoods (SRL), and informs the review process currently underway within Natural Resources Policy and Advisory Department³ (NRPAD). NRPAD have commissioned an approach paper which seeks to ‘make the concept of sustainable rural livelihoods useful and practical’ (Carney, 1998b: 1). The concept of livelihood is defined thus: “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”.

The concept of SRL would appear to have greater practical implications than the basic capabilities approach, since it places the emphasis on the maintenance of livelihoods rather than on the rather intangible concept of capabilities to function. However the NRPAD paper acknowledges that, as currently defined, it remains rather conceptual, providing limited information as to what the factors are which may enhance or diminish a livelihood’s sustainability. The Institute of Development Studies (IDS) Sustainable Livelihoods Programme indicates that sustainability may be analysed in terms of its economic, social, institutional and ecological aspects, but this remains work in progress.

1 A definition of poverty based on income or consumption is usually termed ‘income poverty’, though it is recognised that consumption provides a better basis for measurement. Here income and consumption poverty are used interchangeably.

2 The narrow income definition of poverty is nonetheless the one which has prevailed at the World Bank and forms the basis of its Operational Directive (4.15) on poverty (Hanmer *et al.*, 1997: 2.4). More recent Poverty Assessments have recognised the multidimensionality of poverty, though the Bank’s estimates of trends in levels of poverty remain centred on income poverty.

3 The concept’s champions include R Chambers and C Johnson at the Institute of Development Studies.

IDS have developed a draft framework that presents some initial ideas on how the concept might be made operationally relevant. It starts with the initial broad context and the ‘livelihood building blocks’ of individuals/households, then describes how institutional processes and strategies condition the precise relationship between the context/building blocks and a range of outcomes (see Figure 1.1).

Although the draft framework helps illuminate the concept of sustainable livelihoods, there are several difficulties with it as an approach to defining poverty and understanding the causal processes. The intention behind the DFID promotion of sustainable livelihoods is to eliminate poverty. However, it remains unclear what constitutes poverty in terms of the draft SRL framework in Figure 1.1. It could either be seen in terms of a lack of livelihood building blocks, or in terms of the outcomes. The range of outcomes posited include the extent to which additional livelihoods (for an individual or household) have been created, the degree to which poverty (presumably income poverty) has been reduced, capabilities enhanced, vulnerability reduced, or the natural resource base protected. This appears to mix up ‘umbrella’ concepts (poverty and livelihoods) with their components (capabilities and vulnerability). There is also some ambiguity as to whether these outcomes are at the individual/household level or at the community-wide level. Finally, there is, in the current early draft, only a limited sense of how these outcomes themselves determine the ‘second round’ set of livelihood building blocks and the second round outcomes, and so on (all arrows point from left to right). It might be assumed that outcomes might contribute directly to changed (improved) livelihood building blocks at the household level, but this is not clear in the diagram as it stands.

It may be more helpful at this stage to consider poverty in terms of a *capital asset framework*. This is consistent with the sustainable livelihoods concept, which is itself defined in terms of the set of capabilities and assets (and activities) required for a means of living. Poverty may be understood in terms of the set of capital assets which an individual (or household) possesses. The livelihood building blocks referred to above are in fact the set of capital assets which an individual or household possesses. This set of capital assets in turn determines the capabilities and the range of escape strategies from poverty available to the individual or household, along with other ‘conditioning factors’. This is broadly the model developed by Vosti and Reardon and used in Malik, 1998 (see Figure 1.2 overleaf).⁴

Vosti and Reardon seek to clarify the many complex linkages between poverty and land degradation, and develop a tool which can be adapted to analyse poverty linkages more generally (see below). Their model views poverty as the product of various ‘assets’, made of the following components:

- natural resources (private and commonly held);
- human resources;
- on- and off-farm resources;
- community-owned resources;
- social and political capital.

4 Vosti, S. and Reardon T. (1997) *Sustainability, growth and poverty alleviation: A policy and agro-ecological perspective*. Baltimore: The John Hopkins University Press, cited in Malik (1998). Sohail Malik’s report was prepared for the Technical Advisory Committee of the CGIAR.

Figure 1.1 Draft framework—rural sustainable livelihoods

CONTEXT →	LIVELIHOOD BUILDING BLOCKS →	INSTITUTIONAL PROCESSES →	STRATEGIES →	OUTCOMES →
National Policies	Natural capital	Institutions and Organisations	Agricultural intensification	1. Livelihood creation
History	Economic/ financial capital		Livelihood diversification	2. Poverty reduction
Agro-ecology (gradients)	Human capital		Migration	3. Capabilities
Differentiated social actors	Social capital		(Other)	4. Vulnerability and resilience
Commentary				
Choice of field sites, sampling	Analysis of availability of building blocks and tradeoffs	Analysis of institutional determinants of access to building blocks and strategy availability	Analysis of strategies adopted and trade-offs	Analysis of outcomes

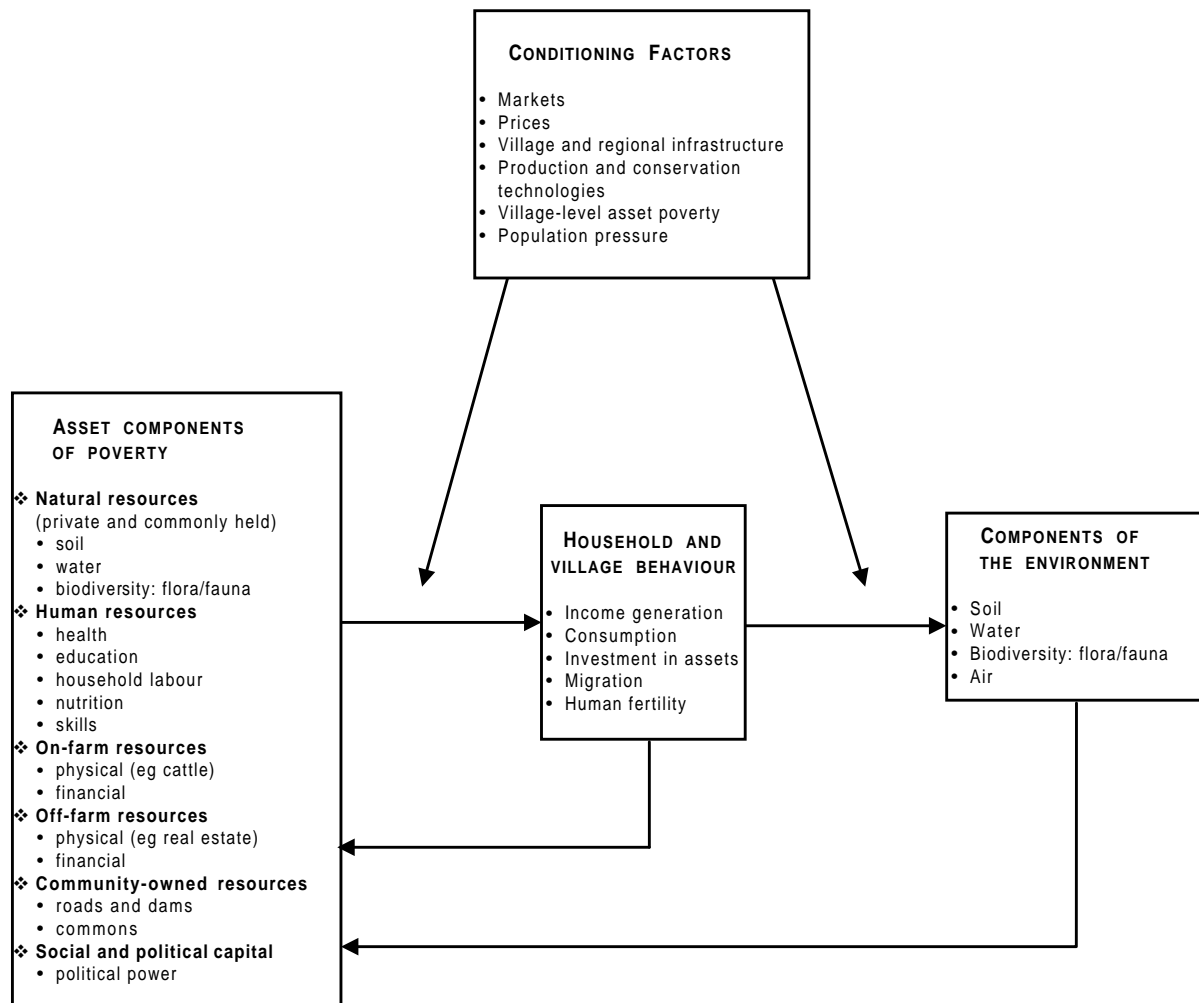
Source: IDS Mimeo, cited in Carney (1998b)

The level and quality of these assets determines household or village behaviour—in terms of income generation, consumption, investment in assets, migration—which in turn has implications for the use of natural resources which feeds back as a determinant of the various asset components of poverty. The precise relationship between assets, household/village behaviour and natural resources is governed by a set of conditioning factors which include:

- access to markets;
- pricing, marketing and exchange rate policies;
- village and regional infrastructure;
- technologies of production and conservation; and
- population pressure.

Malik finds that defining poverty in this way has innovative policy implications. Sizable resources are required over and above those required to meet subsistence needs if issues of resource degradation are to be addressed. Malik's approach can be adapted to analyse the linkages between the set of assets of the poor and outcomes in terms of a change in those assets. This is described diagrammatically in Figure 1.3, which draws both on Vosti and Reardon (1997) and on the IDS sustainable rural livelihood framework. This begins by identifying the type of poor household or households, such as smallholder, landless or artisanal fisherman/woman. There are likely to be linkages between the household type, (e.g. landless) and the level of assets (e.g. land), which the

Figure 1.2 Poverty and environment links



Source: Vosti and Reardon, (1997)

household possesses. The level of assets, including human capital (such as skills and labour) and social capital (such as claims on friend/family networks), are a key determinant of 'escape strategies'. The level of skills or knowledge will determine the range of employment opportunities available, just as access to land and water may limit the scope to increase production or productivity.

The set of capital assets possessed at the household level are not the sole determinants of the range and impact of escape strategies. Choices and their impact also vary according to a set of conditioning factors, including those already identify by Reardon and Vosti, and which can be extended to embrace:

- public and private sector natural resource extension systems;
- access to, and price of inputs;
- access to micro-finance;
- access to, and influence on the local political system;
- NGO/grassroots capacity;
- access to social services;
- developed country protectionism.

Some of these conditioning factors are sometimes referred to as produced assets and political capital. Booth *et al* (1997) describes access to credit and to extension services as important components of produced capital. In the same report, political capital is described as a non-material asset and a measure of power relations. The report adds that “it may be best to see political capital as a gatekeeper-asset, permitting or preventing the accumulation of the other assets upon which successful poverty-reducing growth depends” (Booth *et al*, 1997: Annex 4, p.14). It is argued here that both produced capital and political capital, as illustrated above, are best seen as factors which condition the choices of the poor and the impact of these choices on poverty.

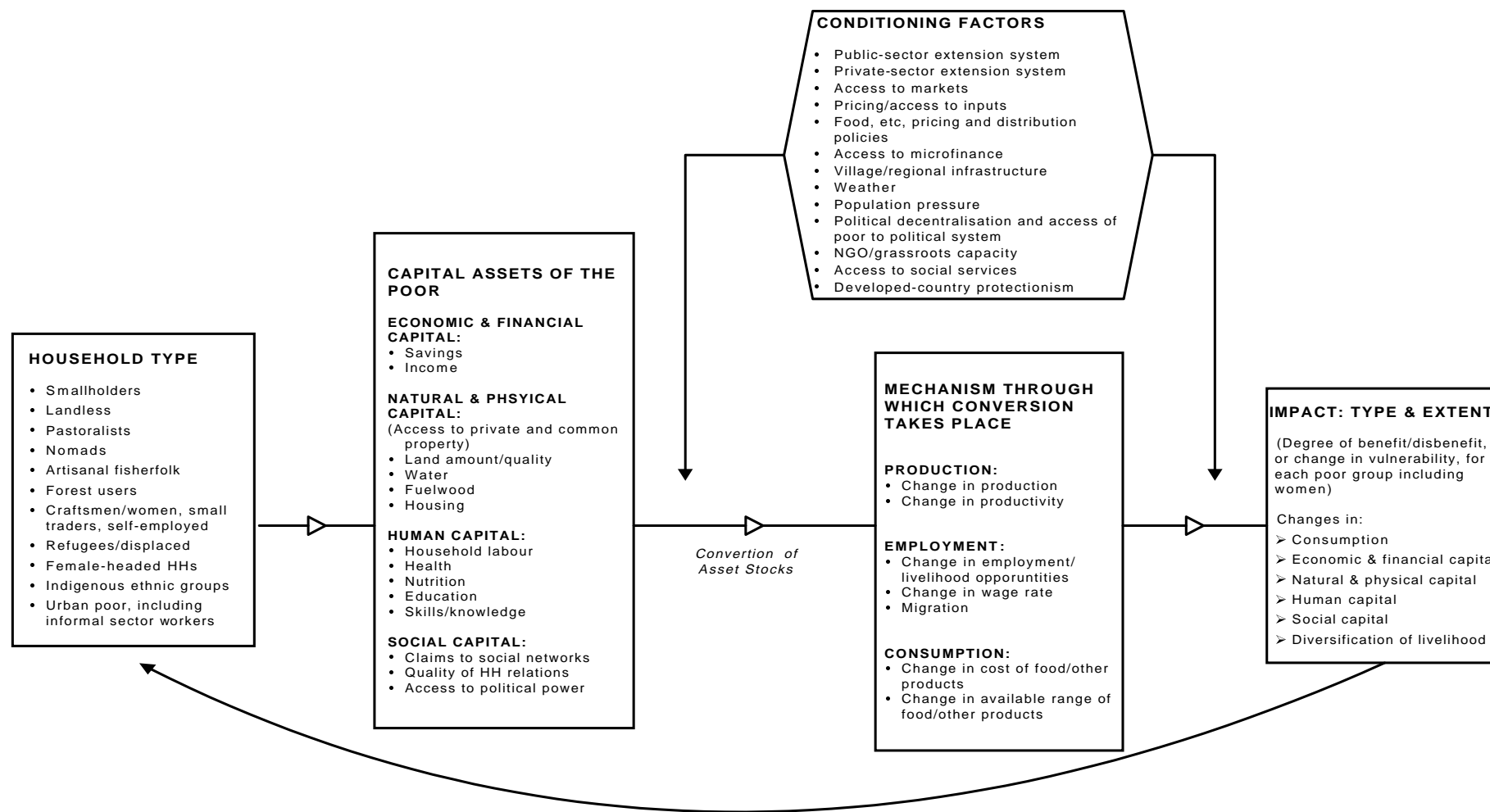
1.2 The dynamics of poverty analysed from a capital asset perspective

Figure 1.3 illustrates the mechanisms through which the poor may seek to escape from poverty. The leftmost box lists the household types characteristic of the poor, which possess a particular set of capital assets, representing their economic, natural and physical, human and social endowments. It is immediately clear that certain household types, without individual analysis, are associated with particular endowments. Thus, the landless have very limited or no access to private natural capital such as land or water and will tend to be highly reliant on access to and quality of common property resources (or their physical capital as a labourer). Female-headed households and indigenous ethnic groups are often associated with lower social capital endowments, as well as lower levels of many of the other forms of capital. This analysis of assets should also be considered at the intra-household level to take account of intra-household inequities in the level of or access to assets.

The particular capital asset endowment of the household is the major determinant of the ‘escape strategies’ available, or the ways in which asset stocks may be used to impact on poverty. The three principal mechanisms are changes in production, employment and consumption. An example of how both the production and the employment mechanisms may improve livelihoods could be success by smallholders in diversifying their livelihood through increasing crop production and productivity. If, as well as increasing production, this reduced the number of days required until harvest, it would provide labouring opportunities with the time thus freed up. A further example for those with household labour as their principal asset would be improvements to their capital asset stock if improved technology generates increased employment opportunities or higher wages. Another way in which employment may provide the mechanism to improve wellbeing is through migration—either within the country from villages to cities, or abroad.

Affecting consumption, in terms of the range, cost, quantity and quality of food and other products also provides an important mechanism for poverty reduction. The majority of the poor are net buyers of food and stand to benefit as consumers should technical change lead to reduced prices (see Annex 1). Whatever the asset conversion mechanism, there may be an improvement in levels of consumption as well as an enhancement of the asset base, or there may be a trade off between the two. Finally, it should also be noted that the poor may not necessarily draw upon all their assets, even in cases of hunger. Assets that are a status symbol or insurance against vulnerability, such as a bicycle or jewellery, will not easily be relinquished (World Bank: Mali, 1993).

Figure 1.3 Poverty linkages analysed from a capital asset perspective



While the stock of assets is a determinant of asset enhancement, the precise scope is strongly influenced by the conditioning factors. They have a two-fold effect, signalled by the two arrows in Figure 1.3. Firstly, they determine the threshold level of endowments required before assets may be successfully converted and enhanced. A familiar example is access to microfinance, which may permit households with modest asset stocks to increase productivity and generate increased capital assets. Secondly, conditioning factors determine the rate of return from the conversion process. Pastoralists who succeed in raising livestock levels will reap greater benefits from enhanced production in the context of well-functioning markets and adequate access to such markets. In an urban context, levels of human capital or marketable skills are an essential determinant of available escape strategies.

The rightmost box summarises the type and extent of impact generated, whereby changes through production, employment or consumption mechanisms generate changed streams of benefits in terms of consumption, income (economic capital), access to resources and human and social capital. Examples of these effects are discussed in the following chapter. Account is also taken of changes in vulnerability, since a reduction in uncertainty or in vulnerability to shocks may raise wellbeing without materially altering economic and financial asset stocks.

The arrow linking impact with household type serves to emphasise that the process is a dynamic one. Enhanced levels of capital assets generate second (and subsequent) effects, which may mean that the threshold levels which permit the conversion of other assets or which allow a higher rate of return from those assets can now be attained. They may also have implications for household type itself, since enhanced assets may permit a diversification of livelihood. In addition, the conditioning factors are in a constant state of flux, thus continually altering the array of options available from a given set of capital assets and the rate of return from the conversion of those assets.

1.3 Poverty analysed from a capital asset perspective: some examples from World Bank poverty assessments

A survey of World Bank poverty assessments (PAs) illustrates the practical application of the capital asset framework. There are a range of examples showing how the nature of poverty can usefully be understood at a country or local level from a capital asset perspective—indicating how the gap between the theoretical and the practical may be bridged.

1.3.1 Natural and physical capital

Virtually all the Bank assessments point to the importance of land, cattle and other natural and physical assets as determinants and indicators of poverty status. A clear relationship can be shown between the level of such assets and the incidence and severity of income/consumption poverty. The 1996 World Bank poverty assessment of Niger shows rural poverty to be highly concentrated among farmers and pastoralists, but goes on to disaggregate this group according to the amount and type of livestock they possess (World Bank: Niger, 1996). Almost 80 per cent of all farmers without any livestock were below the poverty line, compared to 69 per cent of farmer/pastoralists who owned sheep and goats, falling to 61 per cent of farmer/pastoralists with camels and cattle. However, farmers without livestock assets experienced poverty over twice the depth and three times the severity of those with the most assets. This finding reveals that assets are highly significant as a determinant of the depth and severity of poverty, of the vulnerability of a household to destitution, and of the availability of a range of escape strategies.

The PAs also underline the importance of access to complementary non-land inputs such as irrigation and animal power. In the surveyed region of Eritrea distribution of land was relatively equitable, yet the non-poor earned three times the income from crop cultivation than the poor, pointing to the importance of non-land inputs (World Bank: Eritrea, 1996: 8).⁵

A number of participatory PAs emphasise that natural and physical capital endowments are not simply causes of income poverty, but are perceived by the poor themselves as important *components* of poverty. Thus ownership of cattle or quality of housing is very often seen as an indicator of poverty status (e.g. Norton *et al*, 1995).

1.3.2 Social capital

One dimension of social capital is the extent to which individuals or households have access to a solidarity network. The very poor tend not to have relatives who can help in finding them a job or providing credit or gifts—they are obliged to beg for help. Needing to ask for help is seen by the poor as lowering their social status and an important element of being very poor (World Bank: Niger, 1996). This same dimension was highlighted in a participatory component of the Eritrean poverty assessment, whereby people identified poor households as those where “one has no husband or wife, or when one is old and handicapped”, or “somebody without a son or daughter to help you”, etc. (World Bank: Eritrea, 1996: 14). The Zambia participatory poverty assessment underlines that the level of social capital may itself determine access to other asset components. It found that migrant groups, for instance, “may lack access to high value land, not so much because they lack money, but because they lack entitlements in respect of the local social institutions which determine land ownership” (World Bank: Zambia, 1994: 15). Similarly in Ghana it was found that access to land often came through community ties rather than the market (Norton *et al*, 1995).

1.3.3 Human capital

The level of skills and knowledge of a household is both a component of poverty and a determinant of poverty status. The former is illustrated in a number of the participatory PAs, while the latter is demonstrated in several of the more traditional PAs. Several PAs highlight the strong correlation between the incidence and severity of poverty and levels of education, and a few indicate the particular importance of educating females. The Bank’s poverty assessment for Niger shows that 70 per cent of households whose head is illiterate are poor. This falls to 58 per cent when the head has attended Koranic school, 56 per cent where the head has attended primary school and 29 per cent when the head has attended secondary school (World Bank: Niger, 1996: 40). This finding is reinforced by the Bank’s poverty assessment in Eritrea. This showed that the rural non-poor obtained about eight times the income from trade and self-employment as do the poor.

⁵ The poverty assessment for Chad, which found that those farmers who lacked animal traction tended to be significantly poorer in cash income terms, provides a further example of the link between natural capital and income poverty (World Bank: Chad, 1997 p.11).

1.4 Poverty Aim Marker and a capital asset definition of poverty

DFID have recently developed a new Poverty Aim Marker (PAM), which recognises that poverty reduction may be promoted through different levels and mechanisms. Three categories are indicated:

- *enabling actions*: actions which underpin policies for poverty reduction and lead to social, environmental or economic benefits for poor people;
- *inclusive action*: such as sector programmes which aim to benefit population groups (including poor people) and address issues of equity, barriers to participation or access of poor people; and
- actions *focused* predominantly on the rights, interests and needs of poor people.

Box 1.1 Examples of types of actions scoring against the Poverty Aim Marker

Enabling actions include:

- economic and fiscal reform programmes;
- public sector reform and capacity building;
- anti-corruption, criminal justice, and electoral reform measures;
- encouragement of private sector investment and reform;
- reforms to regulatory and incentive frameworks;
- promotion of small and medium enterprises;
- social policy and poverty action planning;
- improvements to labour standards and terms of trade;
- restructuring of power supply services;
- action to safeguard the environment;
- integration into the international community.

Inclusive, broad-based actions include improvements in:

- basic education, health, and family planning services;
- extension services;
- basic infrastructure, including water and roads;
- energy services.

Focused actions include:

- social, economic and physical improvements to urban slums and areas of acute rural poverty;
- improved social protection for the poorest;
- financial services for the poor;
- support to poor people's advocacy groups and community-based organisations;
- provision of clean, reliable and affordable energy services;
- strengthening poor people's human rights.

Examples of the kinds of activities are provided in Box 1.1. The new approach will allow a more credible profile of DFID's contribution to poverty reduction to be obtained since inclusive and enabling actions are now recognised and so the temptation to score projects as *focused* when they are not is reduced. This is realistic since it is often impractical to attempt to improve, say, basic education or health services for only the poor, and an inclusive approach is required. Similarly, project interventions focused at the poorest may not be effective or sustainable when the underlying incentive system within a sector is inappropriate, when radical policy overhaul is required or a redesign of the delivery system is needed.⁶ A further upside is that the PAMs, together with the emphasis placed on poverty reduction by the Minister, will lead country programme managers to look harder at how links to poverty reduction can be strengthened in *all* DFID-supported interventions, not just in the 'traditional' poverty ones.

The new PAM is consistent with the multi-dimensional capital assets approach to poverty. The examples of *enabling*, and to some extent *inclusive* actions, detailed in Box 1.1 are very close to the 'conditioning factors' depicted in Figure 1.3, showing poverty linkages analysed from a capital asset perspective. The *focused* and some *inclusive* actions imply attempts to alter the stock of economic, natural, physical, human and social capital assets possessed by poor groups.

⁶ An example would be the UK's support to the health sector in Orissa, India. The first two phases concentrated on providing physical infrastructure and met with limited success, in part because of unsupportive policy, political and institutional frameworks within the health sector. A proposed third phase will concentrate on sectoral reform rather than project level outputs.

2. Who are the poor and where are they located?

2.1 A profile of the poor

The previous section sought to develop a framework for the analysis and definition of poverty, and to illustrate it with a number of practical examples drawn from poverty assessments. This chapter will attempt to describe who the poor are, concentrating on their socio-economic and livelihood characteristics and their location.

Much of the data on trends in, and levels of, poverty concentrate on the number and proportion of the poor beneath a given income/consumption poverty line and how this varies from region to region (see Table 2.1 below):

Table 2.1 Trends in income poverty in developing countries

(poverty line at \$1 a day per person, 1985 \$)	People below the poverty line (%)		Share of all poor people (%)		Number of poor people (millions)
	1987	1993	1987	1993	1993
Region or country group					
Arab States	5	4	1	1	11
East Asia, South-east Asia and the Pacific	30	26	38	34	446
East Asia, South-east Asia and the Pacific (excl. China)	23	14	10	7	94
Latin America and the Caribbean ^a	22	24	7	9	110
South Asia	45	43	39	39	515
Sub-Saharan Africa	38	39	15	17	219
Developing countries	34	32	100	100	1,301

^a Poverty line of \$2 a day.

Source: UNDP (1998)

Such statistics reveal that the majority—nearly three-quarters—of the world’s poor live in South and East Asia. In addition, the table shows that poverty is particularly severe in South Asia, where 43 per cent of the population is poor, and in sub-Saharan Africa where the figure is 39 per cent. Such data have their place, but without disaggregating the poor—by their activity, gender, age or other characteristics such as disability—it is difficult to formulate policy prescriptions for reducing the incidence and severity of poverty. There is no single basket of policies which can serve as a panacea for ‘the poor’. The poor—like everyone else—engage in differentiated economic activities and have particular sets of assets and skills. Policy prescriptions, (and NR research for that matter) must clearly take these activities, assets and skills into account if they are to contribute to effective poverty reduction.

The 1992 International Fund for Agricultural Development (IFAD) study makes a useful contribution by identifying what it terms ‘functionally vulnerable groups’, defined as those groups which are “economically insecure and thus particularly sensitive to the slightest change in external factors”. They may or may not be included in the core of the rural population which is below the poverty line but, the report argues, “functionally vulnerable populations subsist on the borderline and can easily fall below it, temporarily or persistently, as a result of any deterioration in their conditions” (Jazairy *et al*, 1992: 468).

Box 2.1 Definition of functionally vulnerable groups

Smallholder farmers: households with up to three hectares of crop land;

Landless: households without any crop land;

Nomadic pastoralists: households not settled in any specific area and which derive most of their income and consumption from pastoral livestock;

Ethnic indigenous populations: households described as such according to the law and customs of the countries concerned, and/or recognised as such by the communities themselves;

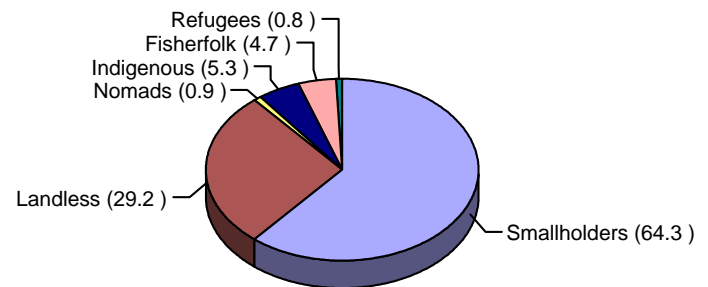
Small and artisanal fisherfolk: households carrying out fishing activities using small, often non-mechanised boats;

Displaced/refugee populations: as defined under the UN 1951 Convention and refugee-like populations 'temporarily' displaced;

Households headed de facto or de jure by women: account for about 20 per cent of the functionally vulnerable. They are not included in the chart because of overlap with other categories. (NB: there is already some five per cent overlap among the other categories)

Source: Jazairy *et al* (1992)

Figure 2.1 Functionally vulnerable groups



Note: there is some overlap among the above categories.

Source: Jazairy *et al* (1992)

The breakdown in Figure 2.1 represents an average across 64 developing countries. The report reveals a substantial variation across countries and between regions in the actual incidence of these functionally vulnerable groups. The most striking differences are between Asia and sub-Saharan Africa (SSA). In the case of SSA the largest functionally vulnerable group

by far are smallholder farmers, who account for 73 per cent of the total, with the landless accounting for only 11 per cent. In Asia, however, smallholders represent some 49 per cent of the functionally poor, and the landless 26 per cent (rising to 31 per cent in Latin America and the Caribbean).

Although the IFAD data are valuable, they are necessarily very broad and offer only a partial insight into who the rural poor are, since they do not distinguish within the broad category of smallholder, for example, the poor from the less poor. Thus, for India the data indicate that functionally vulnerable smallholder farmers amounted to 280m people in 1988, the landless accounting for a further 180m making a total functionally vulnerable rural population, (with other groups) of some 470m. However, India's total rural poor is identified in an earlier table as 250m, indicating that the 'functionally vulnerable' includes some 220m people who live above India's poverty line.

The functionally vulnerable categories used by IFAD provide a useful indication of the types of people who are likely to constitute the bulk of the poor and vulnerable, but do not provide an accurate picture at a country level of which groups are deepest in poverty and why. For this, it is necessary to turn to detailed PAs and participatory PAs—usually prepared under World Bank auspices. Unfortunately, many of these are at their weakest when it comes to differentiating between poor groups, except on the basis of income, and provide little information on the correlation between livelihoods or geographical/production systems and levels of poverty.⁷ Nonetheless, they do provide important insights into who the poor are, and the nature of their poverty.

⁷ See for example Hanmer *et al* (1997) and Booth *et al* (1997). The other criticism made is that the findings of both poverty and participatory PAs are poorly integrated into World Bank programming.

Different Bank surveys differentiate between poor groups in different ways. The Kenya study reveals that over 40 per cent of subsistence farmers, food crop farmers, pastoralists and informal sector workers fall below the poverty line, and are, on average, the poorest groups. The Chad survey of rural poverty used a slightly different breakdown, however, and found the poorest to be informal sector traders, the unemployed/economically inactive, and farmers/herders/small producers (see Table 2.2 below).

Table 2.2 Socio-economic breakdown of poor in Kenya and Chad

Kenya 1992		
Socio-economic group	Incidence of poverty (% of HHs)	Share of total number of HHs (%)
Subsistence farmers	47	17.7
Food crop farmers	46	24.2
Pastoralists	42	2.0
Informal sector	41	24.4
Cash crop farmers	26	4.6
Private sector employees	31	4.6
Public sector employees	16	8.4

Chad (N'Djamena) 1991		
Socio-economic group	Incidence of poverty (%)	Share that poor HHs in group represent as % of total poor HHs
Informal sector traders	81.9	20.4
Unemployed/economically inactive	80.6	31.9
Farmers, herders, small producers	80.5	15.7
Private sector employees	75.5	12.5
Public sector employees	72.5	14
Industrial/commercial senior managers (modern sector)	53.2	2.4
Independent professionals	52.2	3.1

Source: World Bank-Kenya (1995); World Bank-Chad (1997).

The tables underline the importance of considering both the incidence of poverty within a particular socio-economic group, how numerically large they are and what 'contribution' they make to the overall number of poor. Both tables also point to a gap in the IFAD categorisation, namely those working in the informal sector.

The importance of considering the overall numbers of poor, as well as how concentrated they are, applies at the geographical as well as socio-economic level. It is widely recognised that the poor tend to be concentrated in marginal areas of low agricultural potential, such as semi-arid areas. This information is useful in that it allows crude targeting of the poor to take place by supporting interventions in low potential areas. However in some cases, very substantial numbers of poor live in areas of medium and high potential, lacking access to sufficient natural capital such as land or water, as a result of inequitable landholding patterns and population pressures. This is the case in Kenya, where a quarter of the poor are found in districts containing mainly high agricultural potential land with humid conditions. Indeed, two-thirds of all poor live in areas of high and medium potential together (World Bank: Kenya, 1995: 18-19). It should be recognised that this in part reflects the fact that far more people live in the less marginal areas, and that even in this Kenyan example, the incidence of poverty is higher and the severity of poverty is greater in arid areas.

Box 2.2 Severity and incidence of poverty among farmers/pastoralists

The World Bank poverty assessment for Niger provides an econometric analysis of the poverty level of the rural population, broken down by the socio-economic group of the household head (World Bank: Niger, 1996: 41-42). Indicators of incidence, depth and severity of poverty are provided, showing that nearly 70 per cent of farmer/pastoralist households were in poverty, similar to that for the craftsmen/self-employed /builder/transport worker category. However, the depth and severity of poverty among the farmer/pastoralist category was about twice that of the self-employed. Less than a third of rural small traders and hawkers were categorised as poor, and their depth of poverty was a quarter of that of the farmer/pastoralists.

The importance of the severity of poverty must also be acknowledged and can be measured as the distance from the poverty line, with the very poor falling far short of a given income/consumption poverty line. The severity of poverty raises important questions for those trying to reduce poverty: should programmes be aimed at those just below the poverty line for immediate 'impact'; or at the very poorest, who may be the most difficult to reach. The latter may imply targeting particular socio-economic groups if they can be shown consistently to fall the farthest below the poverty line (see Box 2.2)

2.2 Contextual assessments of poverty

Box 2.3 Contextual versus consumption-based measures of poverty

Chambers cites the Jodha study of two villages in Rajasthan, who defined their own criteria for judging changed economic status. Comparing data from fieldwork in 1964-66 with 1982-84 he found that the 36 households which were more than five per cent worse off in per capital real incomes were on average better off according to 37 out of 38 of their own criteria. These criteria included not having to migrate for work, not having to skip a third meal and other indicators of social and economic independence.

Source: Jodha (1988)

There has been an increasing emphasis on 'contextual' poverty assessments, which may be defined as whose methods 'attempt to capture a social phenomenon within its social, economic and cultural context' and which includes Participatory Rural Appraisals (PRAs) and ethnographies, but also survey-based longitudinal studies of individual villages (Booth *et al.*, 1997: 11). Part of the reason for this is that contextual methods may generate a different narrative from conventional survey-based analysis, or may enrich the latter. In particular, survey-based analysis concentrating on income or consumption shed little light on non-economic and non-financial capital assets, such as education,

health, nutrition or social standing. Such factors have long been emphasised as being fundamental components of poverty, or basic capabilities, as indicated in Section 1.⁸

Robert Chambers has long championed contextual approaches to assessing wellbeing, believing them to be the best way of capturing a 'local, complex, diverse and dynamic reality'. He cites a number of occasions when contextual methods yield diametrically opposed conclusions on wellbeing (see Box 2.3). Nonetheless, it must also be recognised that there is often a close correlation between consumption shortfalls and other dimensions of poverty. The two approaches to measurement are complementary. Contextual methods of data collection help to validate and explain results obtained through survey methods. This explanatory function is essential to policy formulation and it is therefore essential that contextual methods meet a very high standard, and avoid becoming a 'quick and unreliable amateurish manner of misgathering social information'.⁹ Booth *et al.*'s study suggests that a method for ensuring quality is to use different tools and cross-

⁸ Dreze and Sen (1989) expressed this in their influential analysis of wellbeing in terms of 'capabilities'.

⁹ This warning was given by the chief sociologist at the World Bank, Michael Cernea, quoted in Booth *et al.*, 1997: Annex 2, p. 5.

check or ‘triangulate’ them, providing they are measuring the same phenomenon and are subject to different errors. An example would be the use of focus-group discussions, open-ended individual conversations, and direct observation of health status (for example).

2.3 The gendered nature of poverty

Box 2.4 Specific constraints facing women

Land rights: limits on women’s right to inherit land may constrain women’s productivity by discouraging women’s investment in land improvement, agricultural equipment and livestock.

Limited access to credit: limiting investment

Lack of access to extension.

Health status: may be a reduced capacity for production labour due to recurrent intestinal disease, poor nutrition, tightly spaced childbirths and female genital mutilation (little known about precise link with productivity in agriculture).

Education: female disadvantage in education, measured by school enrolment and literacy, has been clearly shown to constrain women’s productivity.

It is widely recognised that women are disproportionately and increasingly represented among the poor and that their needs should be given particular attention when designing poverty reduction strategies. The 1997 Human Development Index adjusted for gender inequality reveals, in general, the poorer a country (in human development terms) the greater the degree of inequality between women and men (UNDP, 1997: 39). However, not only do women suffer lower levels of human development, holding all else equal (education, age, economic sector, employment category), working females also “have a 34 per cent [probability] of belonging to the bottom [20 per cent], versus 14 per cent for males”.¹⁰ There is some evidence of a feminisation of poverty, though not across all countries. Data from 41 countries indicates that women accounted for 60 per cent of the rural poor by 1988, up from 57 per cent in 1965-70, representing a rise in the absolute number of poor women of 47 per cent, compared with 30 per cent for men.¹¹

Individual country PAs provide a valuable supplement to this macro-level picture. The 1992 World Bank study of the agricultural sector in Zambia includes a useful analysis of the particular role of women and constraints facing them in the rural context. Women account for 65 per cent of the rural population and half to three-quarters of subsistence labour in the agricultural sector. They have primary responsibility for subsistence and food crops, and increasingly for cash crop production. Changes in technology—notably the greater use of oxen and tractors for clearing land and tilling the soil—has reduced men’s workload and women now spend more time on average working in the fields compared to men, and over ten times (4.1 hours) the time spent by men on other household activities. Specific constraints facing women are detailed in Box 2.4.

A large proportion of rural households are headed by women as a result of male migration to urban areas and the copper belt. Female-headed households tend to be more heavily dependent on cash income, and poorer due to fewer resident workers, more dependants and smaller landholdings. Female-headed households are also far less likely to have access to agricultural extension services or credit. As a result of these differences, female-headed households often have the highest levels of food insecurity and malnutrition in rural Zambia.

10 Lustig, N. ‘Coping with austerity: Poverty and inequality in Latin America’, in G. Rodgers and R. van der Hoeven (eds) (1995) *New approaches to poverty analysis and policy III—The poverty agenda, trends and policy options*. Geneva: ILO. Cited in ILO (1998), *Gender, Poverty and employment* (draft), Module 1, pp. 71-2, Geneva.

11 Jazairy *et al*, 1992; Buvinic, M. ‘The feminisation of poverty? Research and policy needs’, in J.B. Figueiredo and Z. Shaheed (eds) (1995), *New approaches to poverty analysis and policy II—Reducing poverty through labour market policies*, Geneva: ILO. Cited in ILO (1998), *Gender, poverty and employment* (draft), Module 1, pp. 72-3, Geneva.

2.4 Migration and rural and urban poverty compared

Migration is a widely practiced coping strategy, allowing the conversion of physical labour assets or of natural assets through the employment or production mechanisms. Most migration is seasonal, with people leaving in the dry season when there is little to be done in the fields and returning in the rainy season. The World Bank poverty assessment of Mali describes how, after harvesting their own fields (October), villagers go to the wetlands to work as wage labourers during the rice harvest (December), then go to towns to work as unskilled workers or as servants and return to the village for the next planting season (May-June). The impact of migration on local economies is often very significant, going well beyond securing food for immediate survival, as remittances may permit the purchase of assets to be used for production, or lead to the formation of community development associations. However, migration is not appropriate for all, and as a mechanism for converting assets it is far more available to young men than to women, children or the elderly. The removal of young men can have a negative effect on the livelihood of those left behind, depending on the level of the remittances received (Norton *et al*, 1995).

Box 2.5 Characteristics of poorest slum dwellers

- low level of ownership of personal assets by women;
- low level of ownership of household consumer goods;
- high percentage of income spent on food;
- narrow dietary diversity (percentage of food expenditure on staples);
- households headed by women;
- households with men incapacitated from work due to sickness;
- low levels of male labour participation;
- high levels of female labour participation;
- high levels of child labour participation;
- high levels of indebtedness for food/rent and other household needs as percentage of income;
- occupational status (casual unskilled and dependent labour);
- low earner:dependancy ratio (more dependants than earners);
- low/no related kin in locality.

Several of the poverty assessments show that levels of poverty were often closely linked to whether or not the household had members working in towns and were able to send remittances back. Family networks similarly influence the welfare of the migrant, who tend to seek work through family and village connections. Thus, the extent and strength of the social network, which may be thought of as a component of social capital, is an important determinant of wellbeing. These mutual social obligations may come at a cost however, and it is conceivable that strong families with high or increasing social capital may, paradoxically, see some mechanisms for escaping poverty narrowed. While the benefits of strong family ties are real, “sharing with one’s needy relatives makes it very difficult for a single family to accumulate enough assets for productive investments” (Hanmer *et al*, 1997: 5.8).

The difficulties and needs of the urban and rural poor differ in important respects. The rural poor, for example, consistently face particular constraints stemming from urban bias in the allocation of resources to physical infrastructure and social services and in fiscal incidence. There tends to be more differentiation between individuals in terms of asset levels in urban areas. Vulnerability is often associated with the level of human assets, or marketable skills within the informal sector. Unskilled wage work can leave workers vulnerable to abuses of contract, while unskilled self-employed labouring (e.g. market truck-pushing) leaves individuals vulnerable to sickness and disability (see Norton *et al*, 1995:13-14).

Despite the differing contexts, there are significant parallels in the characteristics of poverty experienced by both rural and urban poor. The list of ‘key characteristics’ in Box 2.5 refers to the poorest group of slum dwellers in a DFID-funded slum improvement project. A high degree of overlap is apparent between the characteristics of poverty identified here for the urban poor with those known to be relevant to the rural poor.

3. Focusing NR research: towards a new framework

In Section 1 we discussed DFID's generic Poverty Aim Marker and its relationship with the modified capital assets approach to poverty reduction adopted as the conceptual basis for the present study. We argued that our capital assets analysis, highlighting the stream of benefits that could be derived from capital assets and what factors would condition the ways in which benefits were achieved, was consistent with the Marker. We also argue in Annex 1 that agricultural and NR research, although a potentially powerful instrument for poverty alleviation, is a fairly blunt one. In some cases, poverty reduction can be achieved by focusing on the types of commodity that are produced or consumed specifically by the poor and/or provide employment for them. But in many cases, crops, as well as livestock, fish and trees, are common to both the poor and less poor, so that the question of who gains from the research depends heavily on whether wider policy and institutional conditions favour the poor or less poor. In this section, we examine in more detail the steps that can be taken under each of the three categories of action under the DFID Poverty Aim Marker (Box 1.1)—viz enabling, inclusive and focused actions—in order to improve the poverty focus of NR research. Given the breadth of this area—the NR response to each of the opportunities for action in Box 1.1 merits a report in its own right—the discussion below is necessarily illustrative rather than comprehensive.

3.1 Enabling actions: NR research, policy and institutional conditions—a two-way interaction

In Box 1.1 we presented a number of *actions* relevant to the removal of constraints in *enabling*, *inclusive*, and *focused* contexts. Where projects or programmes address one or more of these constraints, they are deemed compatible with the overall Department goal of poverty eradication and so are scored against the DFID Poverty Aim Marker. In Section 1.4 we suggested that *enabling* and *inclusive* actions were similar to the conditioning factors set out in our capital assets perspective (Figure 1.3) in two respects: i) both influence how effective the production, employment and consumption mechanisms would be in generating benefit streams from the capital assets, (including the threshold level of assets necessary before they can be converted and enhanced); and ii) what the type and extent of impact of these streams would be on the livelihoods of different categories of the poor.

Although they are broadly consistent with the capital assets framework, some enabling actions are relevant to higher orders of conditioning factors than those indicated in Figure 1.3. In some cases they have to be accepted as parameters within which NR research is designed, and in others, as variables which (often over lengthy time periods) can be changed so as to enhance the prospects of successful impact of research on the poor. Public sector reform and capacity building—especially where it involves changes in performance criteria and incentive structures—provides an example of the latter. Responsibility for investing in enabling actions will generally lie with developing country governments, but donors supporting NR research may wish to contribute to this for its intrinsic merit, for its complementarity with NR research investments, or both.

Examples are given below of the ways in which enabling conditions impinge on NR research, and of the changes in these conditions which may be brought about to facilitate the uptake of research results. First, however, it is important to distinguish how and how far particular kinds of research are influenced by these enabling conditions:

- i) Much long-term strategic research focuses on genetic improvement in crops, trees, fish or livestock, or on the strengthening of techniques, such as genetic markers, intended to facilitate such improvements. This research will often be conducted in a regional or international context. Since it is intended to benefit more than one country, the particular policy or institutional conditions prevailing in any one country are unlikely to act as a binding constraint. In any event, the nature of these constraints are likely to vary over time, and given the long-term nature of this research, there are arguments against constraining it by the mix of policy conditions prevailing at any one time.
- ii) At the opposite extreme, some NR research is specifically focused on commodities that are only produced and consumed by the rural poor. Black pigs in Nepal (Box 3.3 below) are a case in point. The number of commodities falling into this category is small, and is strongly determined by cultural conditions. To focus NR research largely or exclusively on these cannot therefore be a panacea for poverty eradication. However, such commodities tend to be somewhat isolated from mainstream policy or institutional conditions, and where research on them is capable of generating benefits these are likely to help in poverty eradication, especially through production and consumption mechanisms (Figure 1.3).
- iii) Some research—especially that focusing on improved management practices for common resources (grazing land, forest, minor forest products)—starts on the same premises as (ii), namely that these areas contain products gathered and used predominantly by the poor. Whilst these areas remain poorly managed and often degraded this is valid enough. However, a difficulty here is that improvement in the condition of these areas often attracts the attention of elites. These then typically try to control access to the resource, undermining the intended poverty focus of the research. Reviews of a number of common pool areas (Richards, 1997 on forest in Latin America; Turton *et al*, 1998 on microwatersheds in India) suggest that it is extremely difficult to take enabling actions to allow the results of this type of NR management research on common land to be captured predominantly by the poor.
- iv) In much NR research, however—and certainly that on most of the staple food crops and common livestock types—‘enabling’ policy and institutional conditions have a strong influence on whether the better off or the poor are the predominant beneficiaries. This research has potentially the largest impact on the poor via consumption, production and employment mechanisms and so care is needed so that research is designed and located where policies are pro-poor, or where the prospects of changing policies in this direction are good. As Annex 1 argues, for major changes in technology such as the Green Revolution, the picture is made more complex by the length of period over which benefits of different types accrue. Here, it is clear that enabling factors—especially types and levels of subsidy—have had a major influence on the extent to which the poor have benefited, especially through employment mechanisms.

Examples of how enabling environments impinge on the benefits between the poor and better off are given in Boxes 3.1 and 3.2.

Box 3.1 Enabling actions: reforming seed regulations

First, for those inputs incorporating new technologies (such as seed) the range of new materials coming on to the market, and the length of interval between completion of successful research and wide-scale uptake of outputs, is in some countries strongly determined by regulatory provisions. Evidence from India, (Witcombe *et al*, 1998) suggests that plant breeders' choice of parental materials, the criteria against which the success or otherwise of newly bred materials is assessed, and the environments for which they breed all have a potentially 'anti-poor' bias because of the provisions of formal varietal registration and 'release' regulations. Grain yield is the principal criterion for selection (though other properties such as stover are important especially to low-income farmers) so that trials tend to be grown under 'safe' conditions where, for example, the availability of irrigation reduces the risk of crop failure and allows higher returns to be obtained from purchased inputs such as agro-chemicals. This is likely to produce varieties—and levels of recommendations for purchased inputs—unsuited to the conditions of low and erratic rainfall, poor soils, hilly topography etc. under which the poor operate. These findings are echoed (though at times to a lesser degree) in other countries reviewed by Tripp (1997). Witcombe *et al* (1998) have urged reform of these regulations in India; such reform would be simple to introduce and could have major positive implications, for development in general and for the poor in particular.

Box 3.2 Enabling actions: performance criteria and incentives

A far more intractable 'enabling' problem is posed by the performance criteria and incentive frameworks for NR scientists which, in many developing countries are incompatible with strong poverty orientation. This is a chronic problem long recognised by some observers (Chambers and Jiggins, 1986). An illustration can be provided by extending the above example of varietal selection and plant breeding: incentives for conducting fieldwork are poor in many developing countries—transport is rarely available, accommodation poor, overnight allowances insufficient, and so on. There is therefore little incentive to leave the comparative security of the research station in order to produce something potentially more appropriate to farmers' needs. This is doubly so if the types of variety produced under relatively favourable on-station conditions are more likely (because of their higher yield potential) to be accepted for formal 'release', and so enhance the status of the breeder.

Plant breeding aside, the more general condition is that scientists' promotion in most developing countries is linked to the wider criterion of number and quality of peer-reviewed publications. Many of the same arguments apply: scientists will tend to work on issues that can be resolved within predictable time periods (such as developing fertiliser recommendations), and will generally avoid working under the risk-prone, low fertility conditions faced by low-resource farmers, preferring instead the stability of research station conditions.

Some of the work described above may, of course, benefit the poor through consumption or employment mechanisms. However, major changes in performance criteria and incentive structures are needed if research scientists from developing countries are to be persuaded to work on issues potentially more relevant to the poor as producers. Such change has proven difficult to introduce in the past. Some progress is being made with the introduction of competed research grant funds, (Carney, forthcoming), but these are unlikely to influence the behaviour of scientists in settings where they are protected by permanent civil servant status.

3.2 Inclusive actions: the examples of input supply and advisory services

The presence or absence of a wide range of inclusive actions can potentially influence the extent to which NR research is able to achieve poverty impact. These include the provision of basic infrastructure, transport, health and education, support for the functioning of markets, provision of advisory services and so on. We provide illustrations in Boxes 3.3 and 3.4 from agricultural extension and seed supply.

Box 3.3 Inclusive actions: agricultural extension

It is now recognised that conventional approaches to agricultural extension have largely failed to reach poor producers adequately.

From our discussions earlier in this paper, it is evident that poor producers have specific characteristics which, in turn, demand particular kinds of agricultural extension. These include the facts that:

- they draw on production of several commodities for their livelihoods; there is rarely any degree of specialisation in one particular commodity.
- interactions among the systems in which commodities are based are often strong. This is particularly so with crop: livestock interactions.
- they need technologies which are low cost, low risk and accessible, despite (often) poor transport infrastructure.
- they often draw on common pool resources for important contributions to their livelihoods, and a capacity to act jointly in managing these resources—including the taking of joint decisions—is essential.
- the production systems of the poor are often more complex than those of better-off farmers, and less easy for outsiders to comprehend.

It is now recognised that conventional approaches to agricultural extension have widely failed to respond adequately to these needs. The training and visit approach promoted by the World Bank has, been criticised (Purcell, 1993) for delivering calendar-driven messages unresponsive to local needs, for its focus on (usually better-off) contact farmers, and for its high costs of institutional support (vehicles, subject matter specialists, etc.).

In response to these difficulties, there is growing recognition that extension services need to be pluralistic and more demand-driven than hitherto. This recognition is penetrating even the higher echelons of the World Bank (Zijp, 1996), and both among donors and, albeit slowly, within developing country public sectors themselves. There is growing emphasis on multi-agency partnerships (Farrington *et al.*, 1998), on farmer-led approaches (Scarborough *et al.* (eds), 1997), and on the innovative use of media such as video, whose potential to empower local people is increasingly being recognised (Rural Extension Bulletin, June 1998).

Box 3.4 Inclusive actions: seed supply

A number of inputs embody new technology, so that improvements in the provision of these to people disadvantaged through remote location or poor infrastructure, for instance, can have potentially important 'inclusive' effects.

Tripp (1997) notes that a wide range of organisations, from commercial seed companies to community-level endeavours, can be involved in seed supply and that numerous constraints inhibit the emergence of appropriate seed supply systems, including continuing government subsidy for parastatal seed companies and laws and regulations discouraging private competition. However, he argues that institutional factors are key to an adequate understanding of the potentials and limitations.

In particular, Tripp argues that due attention has not been given to the importance of information, its attendant transaction costs and the supporting role of norms and trust, often viewed as 'social capital'. The complex process of seed provision makes information particularly important: "It can be seen as a chain that begins with plant breeding and extends through source seed production and multiplication; quality control; seed conditioning and storage; and distribution and marketing. Except in the case of large-scale commercial seed companies, most seed provision entails the coordination of several different organisations to accomplish these tasks. There is often a mix of public and private (commercial or voluntary) entities in the process, adding to the importance of coordinating the flow of information. The expansion of seed markets also requires attention to the development of trust and information exchange between farmers and seed providers" (Tripp, 1997: 7).

Much can be done through more focused policy action than achieved hitherto: a government seed policy unit can assess seed demand and direct resources and capacity building to appropriate areas; parastatal seed companies can be placed on a more competitive footing; the incentives and focus for public plant breeding require modification and seed regulations need to be reformed to support seed system diversification. Particular attention should be given to supporting the types of organisations (associations, producer groups, firms) and institutions (markets, norms, legal systems) that contribute to information exchange.

3.3 Focused actions: examples from livestock and fisheries

Products can occasionally be identified which are produced and/or consumed uniquely by the poor. Technical improvement focused on these will therefore very largely (in some cases, uniquely) be of benefit to the poor. Such commodities include roots and tubers in many parts of sub-Saharan Africa, and minor forest products in Amazonia and South Asia. Our focus here is on the improvement of pigs in the mid-hills of Nepal (see Box 3.5). Examples such as these provide a direct, demonstrable link with the poor; their (generally) applied nature often also makes them highly photogenic. For both of these reasons they therefore tend to feature strongly in public relations material—and some would argue that they receive publicity out of proportion to their overall impact on poverty. It should be emphasised that the number of products exhibiting this direct link with the poor is in fact quite small, as is their overall scale. The scope for improving them technically may also be limited. Despite their obvious attractions, therefore, the overall opportunity they offer for poverty alleviation is not large, and is certainly less than improvement in the major food staples.

A second example is provided by the genetic improvement of the freshwater fish species *Tilapia* which are widely harvested by low income rural people. This provides an example of focused, strategic research, but it must be stressed that this product is not uniquely accessed by the poor—some better off rural people also culture *Tilapia* in ponds, and in the absence of appropriate policy measures may attempt to increase their production share at the expense of the poor, once the technology is improved.

Box 3.5 Focussed actions: Pakhribas pigs

Forty-five per cent of hill farmers in Nepal keep pigs. The most popular are small local black breeds with an average weight of just 25kgs. A breeding programme at the Pakhribas Agricultural Centre crossed this local breed with high yielding foreign animals. The new Pakhribas pigs grow a third faster than the local breed, have lower mortality rates and higher weanings per sow. As a result, adoption rates for the crossbreeds are high.

Since the wealthier farmers in Nepal come from the higher castes that neither keep nor consume pigs, the benefits of this research are largely confined to the poorer members of the farming community.

Source: Gatenby and Shrestha (1989)

Box 3.6 Focussed actions: genetic improvement of *Tilapia* fish

Fish aquaculture production in the Philippines in 1997 amounted to 13 million tonnes, of which the *Tilapia* share amounted to 1.1 million tonnes. The industry is growing at around 10 per cent per year (Rana, 1997). Some species of *Tilapia* can breed when still very small (under 40g) and up to twelve times per year. Harvesting a pond some 5-6 months after stocking with *Tilapia* may therefore mean that 30-40 per cent of the harvest comprises very small, unmarketable and nutritionally low grade fish. Males generally grow more rapidly than females, and clearly, ponds stocked only with males will not suffer the problems of overcrowding and immaturity at harvest characteristic of mixed sex stocks. The difficulty has been that of finding a low-cost, large-scale method of producing male-only juveniles for stocking ponds. The factors determining sex are mainly genetic but environmental variables such as temperature may also be involved. The major genetic factor is the possession of chromosomes similar to the XX (♀) and XY (♂) sets in humans. YY *Tilapia* (supermales) are viable and fertile and can be generated by crossing normal (XY) ♂♂ with males sex-reversed to female by oestrogen treatment and subsequent progeny testing. Careful (but time-consuming) selection means that stable lines of supermales can be achieved to generate over 98 per cent males (genetically modified *Tilapia* or GMT) in their offspring. This is sufficient to eliminate production of fry. Recent advances in genetic techniques mean that YY males can be feminised (Mair *et al*, 1997). Matings between these and YY males produce large numbers of YY male offspring. These form the basis for large-scale production of GMT for male-only stocking of ponds. A network of accredited hatcheries has been established in the Philippines which produces at present some 65 million fingerlings per year, largely bought by small farmers. The additional benefit to livelihoods of these families from the use of GMT is at least £1 million per year.

Source: Beardmore, pers. comm.

3.4 Conclusion

The preceding discussion has identified examples of the type of NR technology-related action that can be undertaken under enabling, inclusive and focused aspects of the DFID Poverty Aim Marker. To a large extent, the priorities will depend on individual country circumstances. However, the different types of research have differing characteristics which may help to determine whether/when they are taken up. These are summarised in Table 3.1.

Briefly, enabling and inclusive research has a high policy, organisational and/or institutional component, and by implication, relies heavily on changes in these environments within developing countries for its success. However, it is low-cost and stands to benefit large numbers of people. One implication is that it is likely to bear fruit in those countries where DFID relations with host governments are particularly good. Another is that this type of research is likely to be best conducted through collaboration between NRRD and NRPAD.

Focused actions fall into two broad types: strategic research on, for instance, the breeding of new rice genotypes is likely to be long-term, costly and risky, but with potentially high payoff in terms of the number of poor people affected by the research. Applied or adaptive research is likely to be less costly, more predictable and shorter term, but affecting limited numbers of people. Clearly, it would be risky for a donor such as DFID to put all its resources into the former. On the other hand, to put it all into the latter would generate a large number of potentially quite small projects, each with limited scope in terms of the numbers of poor people likely to be affected.

Table 3.1 DFID Poverty Aim Markers and agricultural research

	Typical characteristics of NR research	Extent of policy/institutional content of research	Numbers of poor people covered¹	Typical riskiness	Typical cost of research
Enabling actions	Main focus on policy and institutional issues	High	High	High	Low
Inclusive actions	Main focus on organisational and institutional issues	High	Moderate/High	Moderate/High	Low
Focused actions					
1. Strategic	Long-term, somewhat speculative research on, for instance, genetic manipulation.	Low	High	High	Moderate/High
2. Applied/adaptive	Short-term research building on known technologies	Low	Low	Low	Low

1 Per individual project or initiative. The *proportion* of project beneficiaries which are poor is likely to be the highest for applied/adaptive focused actions.

Annex 1 NR research and poverty reduction

A1.1 Introduction

In Section 2, the issue of how poor rural households escape from poverty was analysed. Households were shown to have access—in varying degrees—to a range of growth factors, defined as ‘assets’, which included social, economic, natural and human factors. In the simple model shown in Figure 1.3, these assets interact with a set of conditioning factors, including government policies, to produce a poverty impact through income generation. NR research can influence this process in two ways. First, technological innovations resulting from research can lead to efficiency improvements which will support broad-based growth in the rural sector. Such efficiency gains in the rural sector act as an engine of broader economic growth—lower food prices and higher rural incomes lead to an expansion of the non-farm sector, providing employment opportunities for rural labourers and supplying a market for further agricultural growth (see for example, Schuh *et al.*, 1997). Second, research could be harnessed to generate a range of specific distributional effects of relevance to poor households, for example by increasing productivity, providing employment opportunities or lowering the price of their food.

The types of NR research activity discussed include work on managerial (agronomic) issues, such as crop and livestock management techniques; biological issues, including the generation of improved plant varieties and breeds, hormones and vaccines; chemical issues, involving the development of new fungicides, fertilisers pesticides and herbicides; and mechanical issues, including machinery and agricultural implements. Another area of research may also be considered—that involving policy or institutional issues, such as national research and extension policy and organisational issues surrounding the main institutions involved in knowledge generation, its implementation and its impact.

NR research may be conducted by the private and the public sector. The focus of this annex, however, is on public sector activity and the manner in which poverty reduction objectives may be achieved through public spending on research, although it must be acknowledged that private sector research can and does have an impact on poverty—especially through generating efficiency improvements and enhancing broad-based growth^{12,13}. As will be demonstrated in A1.2, the private sector will not generate an adequate investment in research and will lead to an inefficient level of productivity growth if left to its own devices. Moreover, the private sector has a limited interest in the pro-poor distributional consequences of research activities. Governments can act to address the market failures inherent in private research, and some of the key options are outlined in A1.2. But they can, of course, do little to force the private sector to address distributional issues.

It is clear from reviews of publicly financed NR research that it can have an impact on the poor (see Box A1.1 on the impact of the green revolution; Beynon (1998) also considers the evidence on the returns to publicly-financed research and concludes that they are high—despite the methodological problems—implying an impact on growth and on food prices). The questions which this section seeks to answer are how does publicly financed NR research impact on poor people and to what extent and under what conditions is such research an appropriate vehicle for poverty reduction.

12 Although the very poor often do not have the capacity to undertake research (Sutherland *et al.*, 1998).

13 Such informal research was responsible for all the key technical innovations up to the end of the 19th century and beyond, including the adoption of introduced species such as cassava.

In order to answer these questions, A1.2 will look at the rationale for public intervention in NR research. It will be argued that NR research is faced with a series of market failures that deter the private sector from producing sufficient research investment to generate efficient levels of production. Based on this type of analysis, the principal objective of public involvement in research is to correct market failures and generate improved productivity levels.

A1.3 goes on to argue that public investment in NR research also has distributional consequences—it may be a cost-effective way of benefiting the poor in some socio-economic, policy and institutional settings, and for some commodities. Impacts will depend on the context and on the prioritisation, design and implementation of the research. For instance, owners of certain factors of production will sometimes benefit at the expense of others; consumers may benefit at the expense of producers; and those living in areas suited to commodities targeted by successful technical innovation may benefit more than those who produce other products. However, while NR research can be highly effective in promoting broad-based rural growth, with some exceptions it does not readily lend itself to fine-tuned targeting of the poor.

Finally, A1.4 will develop some basic conclusions on the poverty impact of NR research, specifying the types of conditions under which a significant impact may be expected to occur.

A1.2 Market failures in research

The standard rationale for public sector funding of research activity is based on perceived market failures which prevent the private sector from supplying the amount and type of economically efficient research activity. The supply of privately funded research is influenced by at least four types of market failure:

- i. Some research possesses the characteristic of a public good, consumption of which is non-excludable (i.e. the problem of free-riders may be intractable) and/or non-subtractable (where the consumption of one unit does not reduce its availability to others). Private suppliers cannot appropriate profits from supplying these goods because of weak intellectual property rights (IPR) and/or some specific natural characteristics of the new technology (for example, non-hybrid seeds). Clearly, the importance of institutional factors (particularly the strength of IPR legislation) means that what may be a public good in some countries (for example, where IPR is weak) may not be so in others (where IPR is strong).
- ii. Research is considered to be a risky activity, particularly with respect to the uncertainty of research results. The absence of effective insurance markets means that private researchers will tend to follow less risky research than may be deemed socially optimal.
- iii. Research suffers from perceived indivisibilities and increasing returns. With high levels of investment required for example, in laboratory equipment and the recruitment of highly skilled scientists, there may be barriers to entry which encourage monopoly supply and therefore sub-optimal resource allocation.
- iv. Finally, some research output may involve externalities, the costs of which are not fully reflected in the price of the activity. This could be of particular importance for health and safety research, especially regarding safe application levels of pesticides and other chemicals.

In response to these market failures, the state may decide to intervene to boost the quantity of research and raise economic efficiency. Governments may:

- provide public funds for research;
- permit the raising of levies on beneficiaries to fund research;
- strengthen IPR legislation;
- regulate to forbid or require certain practices.

These actions may lower the costs of research and improve the ability of private researchers to appropriate the benefits of their activity. The policy options which governments may implement include improving macroeconomic and sectoral policies to reduce risk; increasing educational expenditure to increase the supply of researchers; and improving access to foreign technologies and technologists.

Most low-income countries have opted to address these market failure issues through public spending—in part because of the institutional and political difficulties of strengthening legislation and policy. To ensure maximum efficiency, public spending should concentrate on the types of high-return research where the free-rider, risk and externality arguments are most likely to discourage private sector activity. In practice, this would suggest that research on easily excludable areas such as mechanical and chemical research—where patenting rules are comparatively straight-forward and allow excludability—should be left to the private sector. Increasingly, biological research is susceptible to patenting and would therefore imply a greater participation from the private sector, too. Difficulties arise where the private sector is discouraged because of public good characteristics of technology, for example in the development of self-pollinating seeds—important to those unable to finance seasonal purchase of hybrid seed. Finally, a classic domain of publicly funded research is managerial research as it is almost impossible to exclude non-paying customers from the benefits.

A1.3 Demand and supply influences on the poverty impact of publicly funded research

The efficiency-based arguments of publicly-funded NR research and its justification where it provides a cost-effective means of directly reducing poverty have already been discussed. However, there are many variables associated with undertaking NR research and the strength of the ultimate impact of the research. On the demand side, the major variables involve the nature of farm households—their size, tenurial status, production and consumption habits, access to credit, factors of production and infrastructure. On the supply side, the major variables involve the nature of the institutions which undertake and extend research. These variables must be taken into account by policy makers and research managers when planning their activities.

A1.3.1 Demand side influences

(i) Farm size and technical change

Agricultural production in low-income countries is subject to the influence of technical and institutional economies of scale. On the technical side, higher labour costs—particularly management and supervision—can make some larger farms less efficient than smaller ones. From an institutional perspective, however, small farmers may experience difficulties obtaining access to a range of inputs, including extension advice and credit. Unless these institutional biases can be corrected, some large production units can be more efficient than smallholder units. Given the high degree of labour availability in most low income countries and a rapid growth in the labour force, there are strong arguments that small farms are generally more efficient than large farms (Tomich *et al*, 1995).

During the green revolution, there was considerable controversy about whether the new technology was biased in favour of large farms and therefore undermined the comparative efficiency of the smaller farms. In a number of studies which have taken place since the green revolution began, it is increasingly accepted that modern varieties were scale neutral and discriminated neither in favour of small nor large farmers (Conway, 1997) (see Box A1.1).

Box A1.1 The impact of the green revolution on poverty

In a recent book, Conway summarises the impact of the green revolution on the poor. He concludes that the basic elements of the new technology—high yielding seed varieties—have the potential to combat poverty but only when the broader issues of sound rural development practice are taken into account. He emphasises five points:

- Impact is often spread over time—the impact of the new technologies is not confined to one particular moment in time, but comes in successive waves. As a result, the ultimate mix of beneficiaries is often different from the original mix. For example, in the initial years of adoption of high yielding varieties (HYVs), there was often an increase in labour demand and wages (with some benefits accruing to poor landless labourers). This can prompt landowners to adopt labour-saving mechanised devices such as tractors, combines and threshers, which skew subsequent benefits towards landowners and machine manufacturers.
- Impact is felt through demand as well as supply factors—in addition to raising the output of crops and therefore increasing food availability for poor households, the higher yields have beneficial income and expenditure effects. Higher output usually leads to lower prices, which amount to an increase in the real wage of labourers and urban dwellers. Moreover, the higher labour demand occasioned by the higher output will also raise incomes.
- Impact is not confined to output of targeted crops—in many cases, the higher productivity of HYVs has allowed farmers to reduce acreage allocated to subsistence or food crops whilst maintaining output levels. The released land can then be used to grow cash crops.
- Impact is critically dependent on domestic policies—the question of who gains and who loses from the new technologies is strongly influenced by the policies of national governments. In particular, the attitude of governments towards mechanisation is critical. In some areas, the power of the land-holding elite has led to government support for machine subsidies (such as subsidies on fuel, credit and foreign exchange) to larger farmers, which effectively displace labour.
- Impact depends on the availability of complementary inputs—in India, adoption of the new seeds was highest where irrigation was well established. This is because the new seeds were most effective when planted on good, well irrigated land.

Source: Conway (1997)

Nevertheless, some difference does exist in the timing of adoption of new technologies between small and large farm enterprises (Tomich *op. cit.*). Since early adopters will tend to reap a price premium which is not available to later adopters, a disproportionate benefit could in some cases accrue to large farmers. There may be a number of explanations for differential rates of uptake.

- First, large scale commercial farmers are generally better placed to access services from rural private sector service providers including banks, agrochemical suppliers and machinery providers. Smaller farmers tend to be more reliant on publicly funded or organised services, particularly extension service agents. As a result, the degree of access of small farmers to information and materials associated with new technologies is different, and usually—given the poor quality of most extension services—worse than that of large farmers.
- Second, large farmers generally possess higher levels of education, which is likely to be a key factor in determining awareness of new technologies.
- Third, the adoption of new technologies involves higher risk the earlier they are adopted. Poor households are usually more vulnerable to risk than wealthy ones and will tend to avoid risk where possible. The poor are therefore less likely to be early adopters.¹⁴

¹⁴ Some authors argue that the riskiness of new technologies has been over-estimated (Walker and Ryan, 1990).

Another interpretation for these differential rates of adoption was offered by a study conducted twenty years ago in Mexico. In a study of the Plan Puebla, Perrin and Winkleman (1976) explained the differential adoption of new varieties and fertiliser regimens by reference to the differential impacts which the new technologies had on the complex small farms in the area. In most cases, farmers were found to have rejected modern varieties because of the low yields which modern varieties possessed relative to traditional varieties under the conditions faced in their farms.

Whilst it seems to be broadly accepted that farm size was no impediment to technology adoption during the green revolution, there are cases where bias in favour of larger farms could exist, particularly where new technologies emphasise capital-intensive change and where there are significant information disparities between wealthy and poor farmers. With respect to perceived bias in the green revolution itself, this arose more from high levels of subsidy on mechanisation and credit for large farmers than from any inherent bias in the modern varieties.

(ii) Farm tenure and technical change

It is now generally accepted that the types of sharecropping arrangements which develop in low-income agriculture are an efficient response to (often unequal) social and economic circumstances¹⁵, but subsequent analysis has demonstrated that sharecropping systems are far more complex than mere transactions over land use. In fact, such systems also provide a means of access to credit, of minimising labour supervision costs for the landlord, a way of sharing risk and a system of decentralising production decision making (Berry and Cline, 1979). In principle, poor households operating sharecropping arrangements should be at no disadvantage when it comes to adopting new technologies such as the modern varieties extended during the green revolution. Indeed, their improved access to credit compared with other smallholders and lower levels of risk should lead to higher rates of adoption.

In practice, the degree to which smallholders will be in a position to adopt new technologies will depend on the specific conditions of the landlord-tenant relationship. These terms will be dictated by the relative power of the landlord and tenant; in some (highly exploitative) cases, these could render the tenant little better off than a labourer. The security of the tenancy will also help to determine the degree to which long-term productivity enhancing technologies are adopted. Clearly, with limited security, tenants will be disinclined to invest their labour in improving the productive capacity of leased land.

An important conclusion to be drawn from this analysis is that there are limits to the degree in which technology can effectively be targeted at small farms *rather than large farms*. The only occasions where this might not be the case are for commodities or livestock grown and consumed exclusively by the poor, or technology biased towards the factor endowments of small farms—particularly unskilled labour.

(iii) Production and consumption effects and the distribution of technical change

Distributional effects of NR research will depend on the split between household production using the new technologies, and household consumption of the fruits of the new technologies. Box A1.3 shows how some of these issues relate to the experience of maize research in Africa.

15 As the tenant only received a fixed proportion of the benefit from their investment and therefore invested sub-optimal levels of input.

The production effects of new technology are restricted to households with access (though not necessarily formal title) to land, water courses or livestock. As section A1.1 illustrated, such access for low income households is different in Asia and SSA. In Asia, the poorest households are landless, so their access to production-sourced benefits from new technology will be limited. In SSA, the bulk of the poorest are smallholders in their own right and would, therefore, stand to gain more via production-sourced benefits.

At its most basic, production increases brought about by new technology will increase productivity and therefore increase income for a given level of input or reduce the input requirement for a given level of output. This should release labour or other inputs for work in other remunerative areas. More realistically, most producers will also gain through consumption effects as a certain proportion of their output increase is likely to be consumed on the farm. A study by Hayami and Herdt (1976) looked at the price effects of the adoption of HYVs in the Philippines. In their simple model, the researchers found that a 10 per cent increase in supply had raised consumer surplus by four to eight per cent, whilst producer surplus had increased between one and two per cent. However, their findings assumed that large farmers have no power to influence prices, and that the local market and international markets are not highly integrated. If these two conditions were found not to be the case, then the gains would accrue disproportionately to producers—and to large producers at that.

Although not all poor households are producers and subject to production effects of technological change, the vast majority of poor households are net buyers of food. The consumption effect of technical change—whereby a shift in the supply function reduces prices paid by consumers—is particularly important in determining poverty impact. Indeed, since the poor spend proportionately more of their income on food than the wealthy, their relative benefit from technical changes which reduce food prices will be greater.

Box A1.2 The impact of maize research in sub-Saharan Africa

Scientific research on maize began in sub-Saharan Africa during the 1930s, but accelerated in the 1960s. Over thirty years, researchers developed a range of innovations—particularly improved germplasm—which helped to raise yields and output. A team of researchers assembled in the early 1990s to assess the impact of maize research in the continent. Their research covered 39 per cent of the region’s population and 28 per cent of total maize production and produced the following findings:

- *Production*—maize output increased in SSA by an annual rate of 2.6 per cent over the 25 years to 1991. This increase was attributable to increased yield and acreage. Comparing actual production with various ‘without research’ scenarios, the team concluded that maize research resulted in a reduction in import requirements in the region from 1986-90 of between \$0.6 and \$1.0 billion. The research also produced an increase in agricultural GDP of one to two per cent. Impact has been greatest in East Africa, where maize is the main staple. In West and Central Africa, increases in output are correlated with changes in climate, input supply, markets and farming practices.
- *Yield*—maize yields from 1966-88 have risen by an annual rate of approximately 0.7 per cent throughout the region. Research impact has to be separated from the effects of expansion into marginal zones, higher cultivation intensity and falling soil fertility. The researchers noted that high yields *per se* were not the major reason for farmer adoption of the new varieties—instead, farmers’ decisions were more often based on the increases in returns to labour and land of the new varieties.
- *Obscured and invisible impacts*—the researchers noted that “the true character and dimensions of (this) change are eclipsed by cross currents of policy, environmental changes, war, peace and structural adjustment” (Gilbert, 1995). Detailed investigation of the production responses of farm households to the new varieties revealed further complexities in isolating impact. In Kenya for example, rather than leading to increased output of maize, evidence suggests that some farmers used the new varieties to produce the same amount of maize *on less and poorer-quality land*, releasing resources for the production of more profitable products such as coffee, tea and horticultural crops. In Zaire, farmers used the profits from the new maize to go into trading. In other words, many farmers had adopted new varieties in order to ‘save resources’, so that conventional means of estimating research impact by calculating national area, production and yield statistics would not reveal the full story.
- *Environmental impacts*—in some areas, the increased profitability of maize has led to encroachment on fragile soils, wetlands, pastures and forests. Researchers point out however, that the root cause of this encroachment is the interaction of population growth, demand increases and inflexible land tenure systems, not innovation. In other areas, increasing yields have actually reduced pressure on these vulnerable areas.
- *Socio-economic impacts*—the researchers observed that in Zimbabwe, lower income groups have probably benefited more than large-scale producers, reducing levels of inequality in the country. In west and central Africa, rural and urban consumers have benefited from greater supplies and lower prices of maize. Where maize has replaced sorghum and millet, women benefit through the easier processing characteristics of maize. But in Malawi, the poor are still discriminated against in access to inputs such as credit and fertilisers so that they cannot adopt the new varieties.

Source: Gilbert (1995)

The full impact of lower food prices on consumption and nutrition will be dependent on three factors—the food value of the commodity, its importance in the diet of the poor, and the price elasticity of demand. The more elastic the demand for a commodity, the greater the producer impact and the lower the consumer impact. However, given that policy reforms—especially in Africa—are bringing domestic food prices increasingly into line with world market prices, supply changes may in reality have a reduced impact on price, and the net effect of supply increases will be more likely to benefit producers than consumers (Alston *et al*, 1995).

Alternatively, governments may opt to use food surpluses generated through the use of the modern seed varieties to support targeted feeding programmes rather than to produce a general across the board reduction in food prices (Alexandratos, 1995). To the extent that the poor are successfully targeted, this would have a stronger impact on the very poor.

Finally, consumption effects will also be conditioned by the degree to which technical changes embrace the types of commodity which are typically consumed by the poorest. Despite the success of the green revolution in improving the output of the world's most important cereals—wheat, rice and maize—the output improvements for the types of cereals, roots and tubers which typically dominate the diet of the poorest have been less marked (see, for example, the 1992 report of the World Bank's sectoral assessment of Zambian agriculture).

(iv) Household access to factors of production

Technical change in natural resource-based production systems involves reducing the inputs needed to produce a given level of output—i.e. improving the efficiency or productivity of one or more of the factors of production. Technical innovations generally focus on one of these factors of production—mechanical research, for example, emphasises the use of capital (and generally displaces labour).

The distributional impact of such technical innovations will depend on household entitlements to the income generated by these factors of production. Poor households tend to have relatively abundant labour¹⁶ but lack access to capital largely as a result of inadequacies in credit markets, and (especially in South Asia) land. Capital intensive technologies, therefore, offer limited benefits to poor households.

The issue of factor intensity of new technologies is therefore of some importance in determining the poverty impact of natural resources research. In conventional neoclassical economics, technical change is considered to be exogenous and is not explained in terms of the changes in underlying economic factors (such as a change in relative factor prices)¹⁷. The issue of bias in technical change is crucial to tracing the impact of any given technology and lies behind the criticisms which have been levelled at, for example, farm mechanisation in the developing world. The logic of the criticism is that mechanisation—particularly tractors and combine harvesters—is inherently labour saving or capital biased and results in a lower share of total production income to labour; a situation many consider to be inappropriate to the situations of labour abundance which are encountered in much of the developing world.

The notion of exogenous technical change may not hold in all cases. To respond to this, the theory of induced innovation was developed to explain the differential paths of technological change in the agricultural systems of different countries (notably Japan and the United States). According to the theory, technical change is endogenous and is impelled or induced by changes in relative factor scarcities and therefore costs (Ruttan, 1975). So, in the case of mechanisation (in US agriculture, say), the increasing scarcity of labour and its consequent increased relative cost compared with more abundant inputs such as land and capital, pushes public and private research systems to develop labour saving options for technical change. The importance of this theory is that research systems need not be inherently biased towards capital, or labour saving, but may simply respond to the factor scarcities specific to their own farming businesses.

16 Although this is clearly not the case for the old and the infirm.

17 Technical change can then be defined in terms of its bias towards the various factors involved in production. Change which increases the income share of one factor against another (for example, raising the income share of capital against labour in a simple two input model) is said to be (capital) biased or (labour) saving. This contrasts to the situation where no bias exists (which would involve a constant labour/capital ratio), this is the so-called Hicks-neutrality.

However, the induced innovation model has shortcomings in explaining the impact of technical change on the poor. Amongst the most important issues raised are that it:

- Takes no account of the different factor scarcities faced by different types of farmers. In SSA, large farmers typically face higher wage costs than those faced by smallholders—supervision and management costs for hired labour are incurred by largeholders and not by smallholders working on their own plots. As a result, there is a comparatively greater incentive for largeholders to seek labour-saving technologies. The ‘induced’ innovation would therefore be different for large and smallholder producers.
- Takes no account of the differential influence and lobbying capacity of large and smallholder producers on the technology generation practices of formal private and public research systems.
- Fails to recognise the degree to which many technologies have been, in effect, forced on farmers by policy makers and even researchers—what has been termed ‘directed’ innovation.

These criticisms underline the inherent bias in national research systems toward large farmers, generating research results which are more relevant to wealthier farmers.

(v) Wage labour effects

As has been emphasised, a key difference between rich and poor households is the level of access to productive resources. Many of the poor have comparatively limited access to land and capital but relatively abundant supplies of family labour. Moreover, in most countries, reductions in mortality rates have not yet been matched by reductions in fertility, resulting in large and growing populations—driving down labour productivity and increasing the size of the labour force. For labour abundant developing countries, the result is that the opportunity cost of labour is low compared to land and capital. New technologies should, therefore, aim to exploit this relatively abundant resource at the expense of other, more scarce, inputs. This conclusion is supported by the analysis in A1.1, which demonstrated that the poorest households tend to be most reliant on wage earnings, whether from other farms (small and large), from rural industries or from urban centres.

Policy choices, however, can be of considerable importance in determining the impact of technologies on low-income households. In its early years, the green revolution provided just the types of labouring opportunities upon which poor households rely. Large increases in the number of people required for weeding, harvesting and processing led to major benefits accruing to the poor. The distribution of benefits began to move away from labourers, however, as governments adopted policies which subsidised capital and encouraged the use of labour replacing rather than labour using technologies (see Box A1.1). Tractors, threshing machines, combine harvesters and herbicides all led to a diminution of the benefit and direct employment effects of the new technologies.

A1.3.2 Supply-side influences

So far, the analysis has looked at demand-side issues associated with the potential beneficiaries of natural resources research. Distributional issues also arise as a result of supply-side, institutional factors associated with public research. The potential poverty impact of NR research begins to be shaped from the very outset of the research process. The decisions made by governments and by researchers about which types of commodities, livelihood systems and factors of production to focus on go a long way towards determining the type of impact on the poor.

These institutional issues arise at two stages in the research-adoption continuum:

- i. between the research effort and the development of potentially viable pro-poor technology; and
- ii. between the potentially viable pro-poor technology and its adoption. The main institutional issues here involve those of political economy and the quality and quantity of mechanisms for adapting, disseminating and educating end users of the technology.

(i) Linking research and technology development

As noted in the introduction, public sector NR research is conducted by a variety of actors, including universities, ministries of agriculture and donors (including the international centres). Each publicly financed research structure has implications for poverty impact and contrasts with privately funded research¹⁸, where effort is likely to be well-focused on the constraints and weaknesses identified and/or faced by the research funders¹⁹.

Universities may tend to focus on linkages between teaching and research, so that the poverty reduction imperative or issues of practical implementation are not uppermost. Also, the staff promotion and reward system in universities prioritises academic pursuits such as publication, potentially at the expense of poverty focus (although there have been attempts to improve coordination between universities and national research systems, including in World Bank-sponsored projects in Ghana and Nigeria, which ought to bring the objectives of universities and ministries into closer harmony).

Research conducted by ministries of agriculture is likely to be closely tied to the priorities of the ministry and government policies. Research conducted at ministry research stations is, however, by no means immune from the type of academic imperative that typifies some university research. Political economy factors also have to be taken into account in assessing the likelihood of publicly-funded ministry research addressing poor people's issues. Poor farmers generally lack effective representation in the setting of public priorities. This has led to a focus on crops and production techniques which are more representative of wealthier farmers—who are more likely to have an effective voice—and a neglect of the resource realities faced by poor farmers and the linkages between research effort and the landless poor (de Janvry and Dethier, 1985). One solution to this is to attempt to alter methodologies so that the interests of poor people are taken into account more explicitly. New approaches, such as farmer participatory research, now involve the farmer in research problem identification and priority setting. This still leaves the broader issue of research priority setting to be determined without the influence of the poor. In recent years, some have begun to advocate the creation of funding systems for research which give greater weight to the views and utility of the poor. However, no substantial changes have been widely adopted to strengthen the hand of the poor in this regard.

At the same time as efforts are made to strengthen the influence of farmers—and of the poor in particular—on research planning, the relations between the priorities of donors and of governments can complicate priority setting. Donor funded NR research predominates in many developing countries for a number of reasons (a poor record of effectiveness, weak lobbying power and limited cost recovery mechanisms) and is often disproportionately cut at times of budget stringency. Coupled with the attractiveness of discrete research projects for donors, this means that funding is often not available through the types of channels which would help to ensure coordination with nationally determined priorities. As a result, donors often have a strong influence over the research focus of low income countries and will sometimes follow an agenda quite different from that of the recipient country. Under these circumstances, adequate consultation between donor, national planning authority and line ministries is extremely important. Research Master Plans and multi-donor national research programmes have in recent years been a widely used mechanism to create consistency between the priorities of donors and of governments; despite being sometimes cumbersome they can be an effective means of coordination.

18 In the private sector, six different providers of research are identified (Carney, 1998a): multinationals, national companies, family enterprises, commodity boards, non-governmental organisations and farmers themselves.

19 This may vary somewhat with, for example, individual farmers having close and direct control over the type of research activity they support (or, more likely, undertake) and the commodity boards whose decision makers are more removed from the final beneficiaries. Nonetheless, since they provide funding in the form of access for their board's research activities, growers will have a degree of control over the end results of board research activities.

(ii) *The importance of complementary services*

For pro-poor technology to have the desired impact requires that potentially viable technologies can be communicated with and taken up by the poor. The degree to which this can be achieved is a function of a range of complementary services, including extension services, national research systems, credit agencies and other input suppliers. The in-depth analysis of the impact and effectiveness of these various services is beyond the scope of this paper²⁰ so only the key elements of each is discussed.

Agricultural extension systems—extension systems represent the main link in a public system between technology developers (the researchers) and end users, providing information about the technology and often supporting the initial supply of the key modern inputs such as seeds, fertilisers and pesticides. The effectiveness of the extension systems in Asia was fundamental in supporting the successful extension of green revolution technologies. Unfortunately, in Africa, the recent history of agricultural extension has been poor. Just as has occurred with National Agricultural Research System (NARS), extension systems have often been characterised by low cost-effectiveness and poor quality. Some reforms have begun which may improve matters—pilot schemes for out-sourced services have been established, extension for commercial farmers is being privatised and efforts are being made to find more cost-effective means of technology transfer and communication, involving the media, as well as techniques involving participation with communities. But large, centralised, supply-led, state-funded and state-provided extension of often doubtful effectiveness still predominates and where innovations have occurred, they tend to focus on commercial agriculture and hold little prospect of improving services for the poor, those in isolated areas and female farmers.

National agricultural research systems—another key determinant of the relevance to the poor of new technologies is the strength of the NARS in developing and adapting technologies to specific economic and agro-climatic conditions, and in linking with research users. Where NARS are weak, (as a result of underfunding, poor quality and unmotivated staff, or inadequate linkages with farmers and the extension system), their ability to adapt external technologies (e.g. from the CGIAR system) would be compromised, resulting in a dearth of appropriate technologies for the poor farmer. To the extent that NARS are also responsible for more basic and strategic research, the same weaknesses will apply²¹.

Local input suppliers—where new technologies rely on the use of purchased inputs, the availability of those inputs through reliable and efficient local channels is of paramount importance. Yet, particularly in areas where high input agriculture has not been practised and/or where the state has in the past taken the lead in providing inputs, these supporting institutions are unlikely to be robust. During the green revolution in Asia, the fertiliser/hybrid seed inputs were often provided by state extension officers, and public agencies have predominated in much of eastern and southern Africa. During recent reforms, input supply systems have often been the first to be privatised, and while there is evidence of private sector response, many gaps remain and poor farmers in particular are not well served. Weaknesses can be explained in part by the persistence of market failures, particularly in the parallel area of credit. As a result, interlinked markets have emerged where, for example, buyers of crops also supply credit and other inputs.

20 For a full discussion of the role and impact of rural services see, for example, Ellis (1992); also the proceedings of DFID's 1995 Natural Resource Advisers' Conference *RNR Services at a Crossroads*.

21 It should be noted that collaborative research between NARS and donors can generate important improvements in participatory skills which will lead to major improvements in the quality of research activity in low income countries.

Output markets—in many developing countries, output market reforms have proceeded rapidly, and have improved many of the worst instances where sectoral development was obstructed by high cost and ineffective state marketing organisations. The private sector has grown rapidly, decentralising services and creating formal and informal employment. However, many weaknesses remain. Weak rural infrastructure means that many marketing systems continue to be high-cost and poorly integrated with wider markets which could contribute to stabilisation. The private sector has also shown itself unable or unwilling to undertake inter-year storage. There is also much scope for enabling smallholder farmers to produce for higher-value markets, including for export.

Availability of credit—as agriculture becomes more intensive and market-based, the demand for credit has accelerated at the same time as structural adjustment processes have reduced the operations of formerly loss-making public development finance institutions. But credit market imperfections have tended to result in large farmers having cheaper access to credit than smallholders. This is a reflection of economies of scale in transaction costs for loans, the use of land as a form of collateral and policy biases which provide preferential credit terms to larger farmers. Together, these effects restrict access to credit by poor households with a consequent impact on their ability to withstand periods of drought or flood (through credit-based income smoothing) or to invest in technology generated by the research system.

It should, of course, be recognised that NR research may seek to exert an influence on the complementary services. Alone or in conjunction with the bilateral programme, NR research may strengthen the capacity of extension and research systems to identify and target poor groups. It may also feed into the development of policies or strategies which determine the emphasis given to developing *pro-poor* technologies. In these ways institutional blocks to successful adoption of poverty-oriented research may be mitigated.

A1.4 Conclusions

There are two basic rationales for public sector involvement in NR research. The first aims to promote efficient growth and is based on the inadequacy of private sector research activity where it is affected by market failures. The second is a distributional issue, where the public sector becomes involved in research as a direct means of improving the livelihoods of low income producers and consumers.

In fact, both rationales have poverty implications. Where publicly financed research leads to improvements in efficiency, and national and sectoral policies are appropriate, broad-based growth will increase employment and incomes in rural and urban areas with consequent reductions in poverty. Publicly funded NR research is a crucial component of a wider policy and investment package.

With respect to the distributional objective, the analysis in this paper suggests that NR research is a blunt instrument for achieving social objectives: while it can promote broad patterns of growth from the which the poor can and often do benefit, it is difficult to target in such a way that the poor disproportionately benefit. Its impact is highly dependent on a range of demand and supply-based variables which often do not favour the poor. With respect to demand-based issues, the key questions concern the access of potential beneficiaries to factors of production, especially labour, and the split between *production* based on new technologies and *consumption* of resulting benefits. Issues of farm size and tenure are not considered to be of over-riding importance, although there are concerns about the ability of large farmers to adopt new technologies earlier than smallholders. With respect to supply-based issues, the distributional impact will be influenced by the institutional characteristics of the organisations conducting research and the existence and quality of a range of complementary services, including credit, extension and input suppliers. All of these factors need to be taken into account in determining the likely poverty impact of NR research.

Annex 2 Towards a toolkit for assessing the poverty focus of NR research

The main body of this report examined the nature of poverty, how it might be assessed, the factors that contribute to it and the way in which NR research can have an impact on the livelihoods of poor people. There we attempt to operationalise these concepts by developing a toolkit which assesses the likely impact of research initiatives and so allows:

- a) programmes of research to be re-specified so that they address poverty more fully;
- b) individual project proposals to be screened for their likely poverty impact.

A2.1 Toolkit components

The toolkit is conceived as a matrix to be filled out by research managers, project designers and others involved in developing and monitoring research activity in the natural resources. The matrix poses a set of questions to the research professionals which hope to reveal the extent to which any activity, or set of activities, will impact on the poor. Questions which will be addressed by the matrix include:

- which groups of poor people will benefit from the research?
- in what ways will each of these groups benefit?
- how important are conditioning factors (such as government policy) in influencing the degree of benefit each group will experience?

Given the complexity of the linkages between research activity and poverty impact (a subject which has occupied much of this paper), the responses to these questions may be difficult to provide outright. For this reason, a series of preliminary checklists have been developed to draw out the key information required in order to fill in the matrix.

A2.2 Possible data sources

A major source of data is the raft of World Bank PAs and participatory PAs. The former help to quantify levels of poverty and may help identify which regions the poor are found in and what their socio-economic characteristics are. The latter, as discussed in Section 2, provide additional contextual information often yielding insights into the causes of poverty.

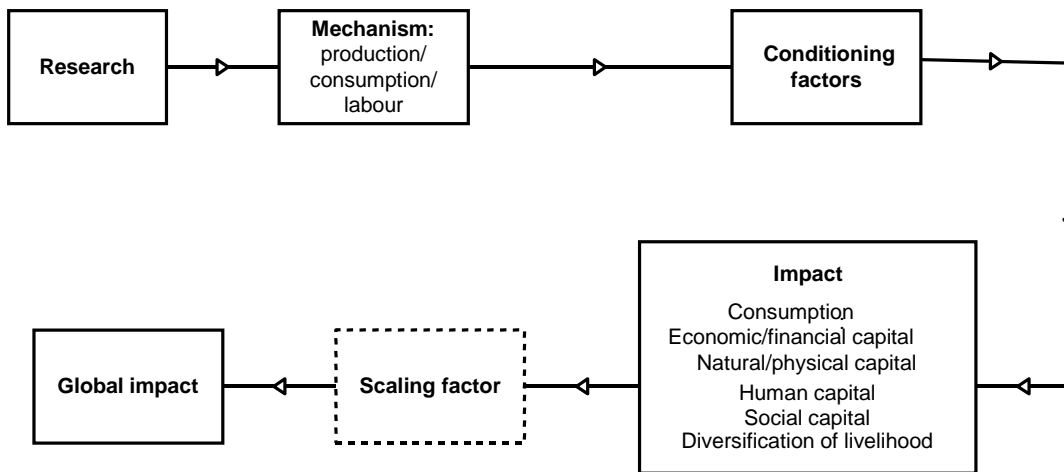
A further source which will become increasingly important is studies commissioned at the country level within the context of the UK bilateral programme. In India, for example, there have been state level studies of the characteristics of poverty, studies of gender relations and a number of sectoral studies. These may be of value in helping to identify the conditioning factors which may assist or hinder the realisation of benefits from research. A number of other European bilateral donors also commission such studies, including the Netherlands which has commissioned detailed sector studies on a country, regional or global basis.

In some cases it may be necessary for programme managers to commission small studies to supplement these and illuminate particular issues. It may be of benefit to carry out literature surveys on the ways in which particular technologies or crops have benefited (or otherwise) the poor and non-poor, or to assess the strengths or weaknesses of extension systems within particular countries and the scope for research to interact with them to the benefit of the poor.

A2.3 Framework for the toolkit

Diagrammatically, the framework for the toolkit is as shown in Figure A2.1.

Figure A2.1 Sequence of research impact



The toolkit itself comprises the following:

- First, a simple checklist focuses on the mechanisms through which poor households will derive benefit from the research. These relate to production, consumption and wage employment issues and also take in questions about the timing of benefit.
- Second, a basic checklist on the ‘conditioning factors’ has been developed. This aims to identify key institutional and organisational assumptions underlying the presumed poverty impact of the research activity. If these conditioning factors are not (or may not be) in place, there may be a case for undertaking some institutional strengthening activities to complement the research.
- Third, a series of questions is posed about the potential ‘scaling-up’ of research impact. If the research is designed to benefit poverty group x in production system y and region z , the questionnaire asks for estimates or evidence of total numbers of people potentially effected. The checklist also asks about the degree of co-operation between researchers in donor countries and low-income countries and the degree of farmer involvement in the research. These factors will go some way towards answering questions about the degree of sustainability of the research activity.
- Finally, a matrix is provided which allows the researcher to summarise responses to the key questions about the poverty impact of new technologies.

Each checklist is discussed below, beginning with an introductory section explaining the objectives of the question and referring to the main points in the text where explanations of the key relationships are developed.

Table A2.1 Mechanisms through which impact on poor is mediated

Mechanism	Scale, degree and type of impact on poor groups (1):		How are poor targeted? (2)
	Short term impact (during project or shortly afterward)	Long term impact (within 1-2 decades)	
<i>As producers:</i>			
+/- in production/ gathering/etc.			
+/- in productivity			
<i>As labourers:</i>			
+/- in amount of livelihood			
+/- in wage			
<i>As consumers</i> (e.g. change in price/ range of commodities, e.g. food)			

1) Poor groups include:

- smallholders;
- landless;
- nomads;
- artisanal fisherfolk;
- refugees/displaced;
- ethnic groups;
- female-headed households;
- forest users;
- urban poor.

2) The poor may be targeted through:

- *production systems* (e.g. semi-arid smallholders tend to be poor);
- *crop or activity* (e.g. pearl millet is grown mainly in low-potential areas by poor people, or baskets for artisanal fisherwomen);
- *low-cost technology* (e.g. soaking seeds, is extremely cheap and therefore highly accessible to poor, along with others).

Table A2.2 Conditioning factors

Factor	Relevance (High, Med, Low)		<ul style="list-style-type: none"> • Nature of relevance; • Specific relevance to poor groups; • Extent to which project or bilateral programme can influence factor.
	Short term	Long term	
Public-sector extension system			
Private-sector extension system			
Access to markets			
Pricing/access to inputs			
Food, etc., pricing and distribution policies			
Access to microfinance			
Village/regional infrastructure			
Population pressure			
Gender-bias in labour markets			
Political decentralisation and access of poor to political system			
NGO/grassroots capacity			
Access to social services			
Developed country protectionism			
Other			

Notes:

Assuming that a given research project is generating results relevant to the poor, the extent to which this translates into impact on poor people is determined by the existence or not of a supportive policy and institutional environment. Different institutional and policy issues may be more or less relevant depending on the nature of the research (e.g. adaptive and participatory, as opposed to long-term strategic research), whether it is intended to be operationalised in the short run in a particular region or country, and the nature of the intended beneficiaries.

The quality of the NARS system may be a key factor determining whether the impact generated by research projects conducted in a specific region spreads to other regions (or states) or to the country as a whole. The extent to which the research project—alone or in conjunction with the bilateral programme—is intended to mitigate any constraints should also be indicated.

Certain factors may be of particular relevance to poor groups—such as access to micro-finance—which may condition adoption where the nature of the technological change requires access to complementary inputs such as fertiliser, etc.

Factors may be more or less relevant in the short and long term, and may be relevant to different groups at different times.

Table A2.3 Scale of likely uptake of the research project

Project scale defined by:	Short term (project lifetime or soon after)	Long run (1-2 decades)
<ul style="list-style-type: none"> • all-developing countries; • region; • country; • region within country; • production system; • crop/activity specific. 		

Notes:

The intention here is to indicate the initial and potential scope of the research project.

Is it likely to have an *immediate short-term impact* on a relatively limited number of people? It may have the potential for scaling up in the long run to a country or broader regional level. It may be applicable in the longer-run to similar production systems (e.g. semi-arid areas in general, or a subset of them).

Will it have very little short-term impact, e.g. genetic research conducted in the UK, but which could potentially have a long-term application across all developing countries, or all foresters, or all artisanal fisherfolk?

Table A2.4 Impact matrix—type and degree of impact on poor groups

Type of impact	Degree of benefit/cost, or change in vulnerability, for poor groups including women (specify)
Income	
Consumption	
Diversification of livelihood	
Natural capital (both private and common-pool)	
Human capital (health, nutrition, skill status, amount of household labour/time)	
Social capital (e.g. empowerment function)	
Other	

Notes:

The intention here is to summarise the different types of impact a research project may have on different groups. Both benefits and costs should be included, such as a positive impact on the income level of the urban poor, but a cost to smallholders. The poor may benefit from a reduction in vulnerability, e.g. through the introduction of a technology which reduces variability in yield even if this does not raise production itself. Even if consumption or income do not increase, risk and vulnerability may be lowered, both of which are highly valued by the poor.

A2.4 Conclusions

In setting out the steps that can be taken under each of the Poverty Aim Markers in order to enhance the poverty focus of NR research we have argued that steps need to be taken under enabling, inclusive and focused modes of action. Some of these fall squarely within the competence of NRRD and the RNRRS. For instance, although it would be administratively time-consuming, it would not be particularly difficult to have RNRRS Programme Managers introduce the kinds of screening mechanism discussed in this Annex. Such mechanisms could also be broadened to include assessments of how far particular projects are participatory (and therefore inclusive) in their design.

However, responsibility within DFID for responding to constraints in other types of inclusive or enabling actions lies primarily with the individual country programmes. Poverty-focused country reviews will be needed to guide such support, and these will need to be somewhat broader than the NR sector reviews commissioned hitherto by NRPAD. However NRPAD's leading role in developing a Sustainable Rural Livelihoods Strategy within DFID clearly signals that it will have a contribution to make to such poverty-focused reviews.

In all events, the message is clear: for NRRD to achieve stronger orientation of NR research to poverty reduction, it will be important for it to forge stronger links with both country programmes and with NRPAD in future.

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