

## RURAL DIVERSITY, AGRICULTURAL INNOVATION POLICIES AND POVERTY REDUCTION

**Julio A. Berdegúe and Germán Escobar**

### Abstract

*The paper explores the implications of rural livelihood diversity for agricultural innovation policies. It summarises literature on the nature of rural poverty, with particular emphasis on the relative roles of farm and non-farm income. It also reviews the various roles, direct and indirect, that agricultural innovation can play in rural poverty reduction. Finally, it uses an agricultural knowledge and information systems (AKIS) perspective to argue for a differentiated approach to targeting agricultural innovations, based on an analysis of rural assets.*

### Research findings

- *The diversification of rural employment and income is an increasingly important fact of life in the developing world; the agricultural path out of income poverty is relevant for only a portion of the rural poor.*
- *Technological innovation can make direct contributions to farm household welfare, but the effects vary according to the level of integration of agricultural markets.*
- *Technological innovation can also have indirect benefits for the poor through effects on food prices, employment and backward and forward linkages with other parts of the economy.*
- *Recent changes in the funding of agricultural research and extension and increasing institutional complexity necessitate the development of new approaches to prioritising and targeting agricultural innovation.*

### Policy implications

- *Policy support for agricultural innovation must differentiate among potential targets. The paper proposes a tripartite division.*
- *Where assets are favourable for competitive agricultural development, particular emphasis should be given to commercial initiatives and private sector contributions.*
- *Where farmers have the potential to embark on market-oriented agriculture but are constrained by their asset base, public (and private) efforts should aim to provide resources and experience to develop a vibrant small-farm sector.*
- *Where rural households lack many of the assets that might allow them to profit from commercial agriculture, more broad-based rural poverty reduction policies must be pursued, often in collaboration with local organisations and NGOs that can facilitate building linkages and institutions.*

#### Contact details

Julio A. Berdegúe and Germán Escobar can be contacted at:

RIMISP,  
Casilla 228 - 22,  
Santiago,  
CHILE.  
Email: [jberdegue@rimisp.cl](mailto:jberdegue@rimisp.cl)

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## CONTENTS

### Page

<b>Abstract</b>	<b>i</b>
<b>Contact details</b>	<b>i</b>
<b>Acronyms</b>	<b>iv</b>
<b>1 INTRODUCTION</b>	<b>1</b>
<b>2 RURAL POVERTY OR RURAL POVERTIES?</b> Poverty and its determinants	<b>1</b>
<b>3 DIRECT AND INDIRECT EFFECTS OF AGRICULTURAL INNOVATION ON POVERTY</b> Direct effects Indirect effects Household market integration and the impact of direct and indirect effects	<b>2</b>
<b>4 INSTITUTIONAL CHANGES IN THE AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEMS OF DEVELOPING COUNTRIES</b> Should the public sector invest in agricultural research and extension? A more complex environment	<b>5</b>
<b>5 DIFFERENTIAL STRATEGIES TO IMPACT ON RURAL POVERTY</b> Market-driven AKIS Market-oriented, asset-constrained AKIS Context- and asset-constrained AKIS	<b>7</b>
<b>6 CONCLUSIONS</b>	<b>10</b>
<b>REFERENCES</b>	<b>12</b>
<b>ENDNOTES</b>	<b>14</b>
<b>Tables and figures</b>	
Table 1 Aggregate impact of direct and indirect effects under different contexts	4
Figure 1 Differential strategies for the development of agricultural knowledge and information systems	8

## **Acronyms**

AKIS	Agricultural Knowledge Information System
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
GDP	Gross Domestic Product
IFAD	International Fund for Agricultural Development
NARO	National Agricultural Research Organisation
NARS	National Agricultural Research System
NGO	Non Governmental Organisation
R&D	Research and Development

# **RURAL DIVERSITY, AGRICULTURAL INNOVATION POLICIES AND POVERTY REDUCTION**

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## **1 INTRODUCTION**

The purpose of this paper is to explore how agricultural innovation policies can better serve the goal of poverty reduction. The paper is based on a larger study commissioned by the World Bank (Berdegúe and Escobar, 2001). It focuses on the institutional factors that can favour poverty-reducing innovation in agriculture. The main premise is that agricultural innovation policies and programmes cannot start from agricultural research and extension and then hope to address poverty. This can only lead to standardised, 'one size fits all' solutions. The starting point has to be the analysis of the different types of poverty, their determinants and the contexts in which they occur, and the livelihood strategies that the poor implement to respond to their condition. From there we can move back to determine possible strategies for agricultural innovation, and only then can we look at the potential role of agricultural research and extension within each strategy.

The paper emphasises that not all poor rural households are agricultural, nor is agriculture the best avenue for reducing income poverty for them all. Agricultural production can be a major element in poverty-reducing strategies, or it may play no role at all. The role of agricultural innovation in poverty reduction must be based on an analysis of the assets and context of rural poverty in specific locations and on an understanding of both the direct and the indirect effects of increases in agricultural productivity on different classes of poor people.

Section 2 of the paper reviews the nature of rural poverty, emphasising its complexity and the relative importance of farm and non-farm activities. Section 3 examines the effects of agricultural innovation on poverty; its direct effects include increased production and income for farmers, while indirect effects include lower food prices and increased employment opportunities. Section 4 reviews the concept of agricultural knowledge and information systems (AKIS) and examines the changing institutional scope of agricultural innovation. Section 5 presents three sets of strategies for rural poverty reduction, based on an understanding of the asset and contextual base of different classes of rural residents. These strategies differ significantly in their emphasis on different types of agricultural development for poverty reduction. Section 6 summarises the argument and presents conclusions.

## **2 RURAL POVERTY OR RURAL POVERTIES?**

According to World Bank (2000a) estimates, 1.2 billion people lived in absolute poverty in 1998, depending on an income of less than US\$1 per day. An additional

1.6 billion lived on less than \$2 per day. The number of people in the former category has remained constant in the last decade, while there are now an additional 250 millions living on less than \$2 per day.

Around two-thirds of the world's poor live in the rural areas of the developing world, and in sub-Saharan Africa they can constitute as much as 50 to 90% of the population (World Bank, 2000b). It is estimated that in the late 1980s there was a total of nearly one billion poor rural people in 114 developing countries. While there is a broad consensus that agricultural development cannot by itself overcome the state of deprivation of so many people, there is also little doubt that without the long-term and significant growth of the agricultural sector, there would be fewer opportunities for significantly reducing rural poverty. One reason is that in the year 2000 almost 60% of the total population of the developing countries lived in rural areas (FAO, 2000).

### **Poverty and its determinants**

Poverty is multi-dimensional. Its causes are diverse, its manifestations and definitions are contextual, and it is not only a state of deprivation but also a set of processes (Carney, 1999; World Bank, 1999; Ravnborg, 1996). Rural people, their goals and the livelihood strategies they adopt to achieve them, are very diverse (Ashley and Carney, 1999; Carney, 1999; Barrett et al., 2000). Their livelihood strategies are aimed at increasing income, reducing vulnerability, improving well-being and ensuring food security. These outcomes are explained by the asset position of households and the characteristics of the context where assets are used (including institutions, power structures, markets and policies and their organisations, trends and shocks) (de Janvry and Sadoulet, 2000).

Access to land is a major determinant of the livelihood strategies of rural households (Lipton, 1985). The highly uneven distribution of land is a major reason for rural poverty in many countries of Asia and Latin America, while, according to a paper published by the International Monetary Fund, in sub-Saharan Africa, 'the poor quality of land and the erosion of customary land rights have become the major obstacles to agricultural growth and alleviation of poverty' (Khan, 2000:17). In India, about 70% of rural households own less than one ha of land, 11% are landless, and 24% do not operate any land at all, sometimes even when they own it (Mearns, undated). In sub-Saharan Africa and Asia, one-third of smallholders subsist on plots too small to support their families (Oxfam International, 1997). In the more agriculturally favoured parts of Nepal, 40% of landless or almost landless households

are poor, while only 18% of medium and large farmers are in this condition; in the mountains, poverty incidence among the same groups is 77% and 24% respectively (Sharma, 1999). In Mexico, access to land is the most important determinant of total rural household income (de Janvry and Sadoulet, 2000). Access to irrigated land has a particularly strong effect on total income.

Human capital assets are another major determinant of the livelihood strategies of rural people. In Mexico, the number of years of education of the adult members of the households has a strong positive effect on total income (de Janvry and Sadoulet, 2000). However, this study also concludes that access to education has a higher pay off in the non-agricultural rural labour markets, and in fact has a negative effect on agricultural income because educated household members seek employment in other sectors of the economy. In Ghana education plays a role in increasing household welfare only after completion of primary or secondary school (Canagarajah et al., 1998). In China, increased literacy due to higher investment in education has made the largest contribution to rural poverty reduction (Fan et al., 2000a).

Rural infrastructure directly and indirectly affects the livelihood strategies of rural households. In China, improved rural roads, electrification, telecommunications and irrigation infrastructure have significantly contributed to the reduction in poverty (Fan et al., 2000a). In India it has been shown that public investment in roads has made a major contribution to poverty alleviation in some of the less favoured agroecoregions (Fan and Hazell, 1999).

Given that their assets and contexts are so heterogeneous, it is no surprise that rural households pursue a number of different livelihood strategies. Agricultural production can be a major element here, or it may play no role at all. The notion that all rural households are agricultural or that agriculture is the best way of reducing income poverty for them all should be discarded as untrue and unrealistic.

The need to diversify rural employment and income is increasingly important in all developing regions in the world. Based on a review of a large number of national and sub-national studies, Reardon et al. (1998) estimate that non-farm activities account for 36% of total rural income in West Africa, 45% in East and Southern Africa, 35% in East Asia, 29% in South Asia, and 40% in Latin America.

In rural China, employment in the non-farm sector grew from 7% in 1978 to 29% in 1997. In 1997, 36% of rural income came from non-farm sources, although agriculture accounted for up to 90% of total income in the less developed areas of the country. In 1997 rural non-farm enterprises accounted for more than 25% of the national GDP, up from nearly zero in 1978. Without this growth of the rural non-farm economy, China's GDP growth rate would have been lower by 2.4% per year (Fan et al., 2000a).

When the only source of income is agriculture, household income correlates strongly with land ownership. However when non-agricultural livelihood

sources are available, this link is broken and it becomes possible for income inequality to be reduced even if land holdings are unequal. In Egypt, Adams (1999) has shown that non-farm income is of great importance to the poor. It contributes almost 60% of their total income and is the most significant contributor to the reduction of inequality.

The agricultural path out of income poverty is directly relevant only to some of the rural poor: those who have access to sufficient land and other assets needed for agricultural production, and who operate in contexts that provide the correct incentives for those assets to be sufficiently productive over long enough periods of time, to lever their households out of poverty. Attempting to force households and communities who lack these resources and contexts to base their development on agricultural production, is to push them deeper into a poverty trap.

### **3 DIRECT AND INDIRECT EFFECTS OF AGRICULTURAL INNOVATION ON POVERTY**

Agricultural innovation can have both direct and indirect effects on reducing poverty. Which is more important will be determined largely by the relative speed with which a household adopts new technologies, by the status of the household as a net food buyer or seller, by the degree of market liberalisation conditioning whether particular products are tradable or non-tradable, and by the institutions and incentives facing farmers.

#### **Direct effects**

The direct effects of technological innovation on poverty reduction are those benefits captured by the farmers who actually implement the changes, and they manifest themselves in the form of higher profits.

New technologies can improve a farmer's income when they reduce the marginal cost of producing one unit of output. Since output prices will for a time be driven by the prevalent (old) technology, profits will increase for those who adopt the new one, with early adopters benefiting the most. Eventually all or many farmers may adopt the new technology, causing increases in output and a possible reduction in output prices. The profit margin created by the new technology may or may not disappear completely. Late adopters or non-adopters (who continue to produce with the old technologies when costs and prices are already determined by the new ones) may be negatively affected.

If this occurs in a closed economy, or in a region which is in effect protected due to poor access or any other variable, the adverse effect (from the producer's point of view) of a new productivity-enhancing technology on farm prices will be faster, and there will be a higher premium on early adoption. If the process takes place in an open economy, local innovation will have a very small or even negligible effect on reducing the price of agricultural products, but increased productivity will reduce costs per unit of output, and adopting farmers will benefit from larger profit margins.

However, farming in an open economy means competing on a global scale, with output prices determined by the most productive. Poor farmers are not usually among the early adopters; they lack the necessary access to information, capital, skilled labour, roads, and other such factors. It follows that they stand to gain much less than larger, commercial farmers from the direct effects of technical change, particularly in open economies. Millions of such poor farmers in recently liberalised economies are having great difficulty matching the unit costs of production of their counterparts working under better conditions. In a very real sense, they are running behind international prices determined by the higher productivity of farmers in parts of the world with better comparative advantages, due to more favourable asset positions and production environments, better technologies and policies and institutional incentives more conducive to success.

### **Indirect effects**

The indirect effects of technological innovation on poverty reduction are the benefits passed on to others by the farmers who actually implement the changes.

These effects can take one or more of several forms: (a) lower food prices due to higher agricultural productivity and output; (b) employment generation in agriculture; and (c) broad-based economic growth through production and consumption linkages with the non-farm economy.

#### *Lower food prices*

Lower food prices are an inevitable consequence of increased productivity due to technical change. Recent studies have established that in the absence of Green Revolution technologies, food crop prices would have been 27 to 41% higher over the past 25 years (CGIAR, 2000). Lower food prices are a fundamental contribution to increasing the welfare of the 300 million urban people who live in absolute poverty and who spend very large proportions of their meagre income on food. In India, the poorest two-thirds of the population – which include the majority of rural people – spend 73% of their income on food (Ravallion, 2000).

Lower food prices also have a major impact on the vast majority of the rural poor, who are net buyers of food either because they are landless, or because they have insufficient land to meet household consumption needs. Eleven percent of India's rural inhabitants have no access to land, and 27% do not operate a farm (Mearns, undated). In Mexico, only 28% of the peasants in the 'land reformed' sector (*ejidos*) are net sellers of maize, the main food staple of the rural population and main component of the traditional peasant farming systems (de Janvry et al., 1997). In Nicaragua, 23% and 28% of rural households are net buyers of maize and beans respectively, while only 39% and 37% are net sellers of these two major food crops (Davis et al., 1997). Because of this, it has long been argued that the main impact of agricultural innovation on both urban and rural poverty should come from increased productivity resulting in lower food prices.

As in the case of the direct effects, market liberalisation alters the importance of indirect effects on poverty through food prices. The price of food paid by the urban poor and by rural net food buyers will largely be defined by global trends rather than by what occurs at a local or even national level. Whether a country with a liberalised economy is self-sufficient in a particular tradable agricultural product will mean little in terms of its average price to consumers.

#### *Agricultural employment and wages*

Some improved agricultural technologies can increase total on-farm employment, particularly when they stimulate agricultural output per unit of land per year. Depending on the conditions of the labour market, this can result in increased wage rates.

Otsuka et al. (1994) and Otsuka (2000) studied the effect of agricultural innovation on labour demands in the Philippines and other Asian countries. While the first-round effect of adopting modern varieties of rice did increase labour use (both because of greater yields per cropping season and because of multiple cropping), they also found that such innovation soon led to the adoption of labour-saving technologies (agricultural machinery in particular), which more than offsets the gain. In the Philippines, for example, the average use of labour per hectare of rice declined by 20% between 1985 and 1998.

After reviewing the evidence on the impact of technological change on the labour markets, Renkow (2000:470) concludes that 'although rising real wages might appear to be the obvious result of increased labor demand caused by technological change, empirical confirmation for this is small. Rather, available evidence indicates stagnation or, at best, small increases in real wages...'

#### *Linkages with the non-farm economy*

There can be production linkages between the farm and non-farm sectors. Upstream linkages are those stimulated by growth in the farm sector, inducing the non-farm sector to increase its activities to supply inputs and services to the farm sector. Downstream linkages arise when the non-farm sector is induced to invest in capacity to supply agro-processing and distribution services, using farm products as inputs. An analysis of these linkages is beyond the scope of this paper, but the reader is referred to Reardon et al., 2001 and 1998.

### **Household market integration and the impact of direct and indirect effects**

The net impact of direct and indirect effects on poverty reduction will depend to a large extent on the influence of three factors: (a) the tradable status of the product; (b) the position of the household in the market as net buyer or net seller of the product; and (c) if the household is a farming family, its position as an early, late or non-adopter of the technology.

Table 1 summarises the discussion that follows. The effect of agricultural innovation on food prices is highly dependent on the tradability of the commodity in

**Table 1 Aggregate impact of direct and indirect effects under different contexts**

Effect	Net buyer of food		Net seller of food			
			Early adopter		Late or non-adopter	
	Product is non-tradable in the location of the household	Product is non-tradable in the location of the household	Product is tradable in the location of the household	Product is non-tradable in the location of the household	Product is tradable in the location of the household	Product is non-tradable in the location of the household
<b>Direct (farm profit)</b>	Not applicable	Not applicable	Very positive Prices remain unaffected but marginal cost is lower	Positive Profits increase for a time, but product prices tend to go down	Neutral Although adopters are benefiting from technical change, prices remain unchanged	Negative Prices driven down by technical change in other farms
<b>Indirect (food prices)</b>	Neutral Food prices determined by world market are not affected by local technical change	Positive Local technical change drives food prices down. Household benefits in proportion to share of expenditures on food	Not applicable	Not applicable	Not applicable	Not applicable

question. As a general rule, when a commodity is non-tradable, increases in productivity will have a faster and stronger effect on the price of outputs, and consumers will tend to benefit most, followed by those farmers who are among the early adopters. Late or non-adopters (which often include most poor farmers) will benefit least or even lose, although they may benefit if they are net consumers of the particular product.

On the other hand, when a commodity is tradable, local prices will reflect international prices. Local increases in productivity will not have a significant effect on lowering food prices, and thus adopting producers stand to gain while the effect on consumers is neutral.

While a commodity may be tradable in the world market or in the urban centres of a given country, it can also be non-tradable elsewhere because of poor roads, long distances, or cultural food preferences (Byerlee, 2000). In regions such as Latin America, West Asia and North Africa where many or most of the poor are located in urban areas and where local prices reflect international prices, the indirect effect of local gains in productivity due to technical change in agriculture will be low, but the direct effect on the farm income of adopting net producers will be high. In countries – such as many in sub-Saharan Africa and some areas of South East Asia – where most of the poor live in areas under *de facto* protection due to poor roads and high transaction costs, the indirect effect on food prices of local gains in productivity due to technical change in agriculture will be high for consumers, but the direct effects on the farm income of net producers will be low (Byerlee, 2000).

From the point of view of poverty reduction, the relevant price is determined by the idiosyncratic position of each household *vis-à-vis* that market (de Janvry and Sadoulet, 1998). For net buyers of food, the relevant price is the market price plus the transaction costs of purchasing. For net sellers it is the market price net of the transaction costs of selling. Households that neither sell nor buy a particular crop find themselves with a farm gate implicit price that is too low to sell and too high to buy (de Janvry and Sadoulet, 1998).

The process of technical change can create losers, or winners and losers simultaneously. As Kerr and Kolavalli (1999) point out, the distributional effects of technical change (among different types of farmers, between farmers and wage labourers, between producers and consumers, among regions) will depend on policies and institutions. De Janvry and Sadoulet (2000) add that trade-offs between the direct and indirect effects of agricultural technology on poverty reduction will be higher when there are institutional gaps or barriers that discriminate against the poor in their access to public goods, when there are large market failures, and when land and other assets are unequally distributed.

Thus it does not make sense to select one single strategy *a priori* as the most convenient to reduce poverty. The constituency of poverty-reducing agricultural innovation includes the urban poor, small farmers who are net sellers of their outputs, small farmers who are net buyers of food, agricultural wage workers, the rural non-farm wage and self-employed, and, of course, the very large number of those whose livelihood strategies combine elements of several of the above.



The correct mix of policies and instruments has to be determined on a case-by-case basis. Standardised and universal recipes, such as 'prioritising poor farmers in marginal regions' or 'prioritising resource-rich farmers in high-potential areas' is not what is needed if the goal is to improve the impact of agricultural innovation on poverty. More likely than not, what developing countries need are comprehensive sets of differential policies, each aimed at addressing specific populations and objectives. A problem of this approach is that designing, managing and implementing such policies is much more difficult and demanding than a 'one size fits all' strategy.

#### **4 INSTITUTIONAL CHANGES IN THE AGRICULTURAL KNOWLEDGE AND INFORMATION SYSTEMS OF DEVELOPING COUNTRIES**

The concept of agricultural knowledge and information systems (AKIS) was coined by Röling (1986). According to FAO and the World Bank (2000), 'an Agricultural Knowledge and Information System links people and institutions to promote mutual learning and generate, share and utilise agriculture-related technology, knowledge and information. The system integrates farmers, agricultural educators, researchers and extensionists to harness knowledge and information from various sources for better farming and improved livelihoods.'

An essential element in the AKIS concept is that it views agricultural research and extension as necessary but, by themselves, insufficient elements in complex innovation-oriented institutional arrangements. The concept clarifies the distinction between agricultural research and extension, and innovation and technological change. As Anderson (1997) has pointed out, it is not correct to attribute all the effects of technological change to agricultural research and extension. The focus is not on research or on extension *per se*, but on *innovation* and on the institutional arrangements that can favour it.

This is a sharp departure from the conventional view of innovation as a linear and rather mechanistic process started in highly skilled and specialised organisations (usually in the North) conducting basic and strategic research, then moving down the line to applied research, adaptive research, technology transfer, extension and, finally, farmers as passive adopters of knowledge and information generated elsewhere.

As Röling and Jiggins (1998:304) have stated: 'It has become common practice to speak about 'agricultural knowledge systems', i.e., to use a (soft) systems approach for looking at the interaction among the (institutional) actors operating in a 'theatre of agricultural innovation'. Innovation emerges from this interaction and is no longer seen, as was customary in the 'transfer of technology perspective', as the end-of-pipe product of a sequential process.'

Agricultural research, extension and/or development projects are important ways of stimulating agricultural innovation. However, only a fraction of the world's poor are directly involved in such projects. Hence,

while it is very important that they are well designed and managed so that they can better alleviate poverty, their largest impact will be *indirect* and will include the diffusion of innovations propelled by factors not under the direct control of any project. If we are concerned with reducing poverty, particularly rural poverty, on a scale compatible with its global magnitude, we must emphasise policies and processes with wider effects at national and international levels.

#### **Should the public sector invest in agricultural research and extension?**

Agricultural knowledge and information flow through a variety of channels, including private sector firms, universities, NGOs, agro-industries and commercial suppliers of agricultural inputs and equipment. According to the concept of subsidiarity of the state, public action is justified when market failure prevents the provision of a socially optimal level of a good or service, and/or when there are externalities associated with that good or service (McMahon and Nielson, 1998).

In the case of rural poverty reduction, the key argument is that, in the absence of public intervention, a large number of potential users will be denied access to agricultural knowledge and information which is readily available to other, non-poor farmers. Most people would agree that levelling the field in this respect is a basic public responsibility. Also much of the knowledge and information generated and disseminated by research and extension is in the nature of public goods (non-rival and non-excludable benefits).

#### **A more complex environment**

The environment in which agricultural research and extension operate today is increasingly more complex than in the days of the Green Revolution.

#### *Decreasing public funding for agricultural research and extension*

During the 1960s and 1970s, investment in research grew rapidly, at an estimated global average of over 6% per year (Alston et al., 1998; Pardey and Alston, 1995). During the 1980s, investment stagnated or declined, particularly in Africa and Latin America (Echeverría, 1998), influenced not so much by new public policies *vis-à-vis* research, but more by overall efforts to cut public spending as part of the structural adjustment programmes of the 1980s.

The decline in public funding caught the national research organisations badly prepared, as in many countries the research institutes' administrative costs and number of scientists had grown faster than the budget for new investments and operational expenses. In Latin America, for example, between 1981-5 and 1992, the number of researchers grew by 22%, while the total budgets decreased by 15% (Echeverría, 1998). Many of the better qualified scientists left the public institutes as their real salaries dropped and the possibility of doing effective research declined.

Similar trends were experienced by the international institutes of the CGIAR, which suffered important

budget cuts at the same time as the number of centres – and the demands placed on them – increased. In the 1980s, these trends were even more drastic in the case of extension. In Latin America, many national governments (such as Mexico and Brazil) simply abolished their extension services, which were widely seen as having become grossly inefficient, bureaucratic and ineffective (Berdegué, 1998).

The decline in public funding has been only partly offset by the growing importance of private research efforts, which by the late 1990s accounted for only 10 to 15% of the total investment in developing countries (Echeverría, 1998; Byerlee, 1998). Moreover, much of this private research is concerned with commodities and technologies of little importance to small and poor farmers.

The result is that in many developing countries, the current calls for greater research and extension support for poverty reduction policies are constrained by the lack of research and extension systems capable of rising to the challenge. In many countries, efforts to revive these national organisations through internationally-funded programmes, have led nowhere.

#### *Greater institutional complexity*

At the same time as the official research and extension agencies were experiencing the decline described above, new institutional actors began to make an impact in developing regions. These include private firms, NGOs, universities and research institutes, foundations, farmers' organisations, new ministries for environment, social welfare and science and technology, agro-industries, and, more recently, local governments at the regional and municipal levels. Some of these have become involved directly in the organisation and delivery of agricultural knowledge and information, while others have played a major role in the formulation and advocacy of policy. A recent study (Rees et al., 2000) of four rural districts in Kenya, for example, reports the active involvement of over 30 different organisations in each district, including local community groups, seed suppliers, NGOs, traders, plus official research and extension programmes and institutes. All of them provide farmers with services of direct importance for agricultural innovation at the local level.

Unfortunately many studies conclude that these numerous agencies often act with little or no coordination or even contact among themselves. Each promotes its own agenda or pursues its private objectives. Farmers' and community organisations often lack the skills, power and resources to take control and manage this complexity on behalf of their members (Carney, 1996).

It is not only that there are now many more actors involved in agricultural innovation in developing countries, but also that the mechanisms for planning, designing and delivering services are themselves also more diverse. In many countries the financing and delivery of extension services are now separate functions, for which different institutions are responsible. In some areas private agro-industrial firms contract production out to small and medium farmers;

sometimes these private firms sign specific contracts with government agencies or universities to conduct applied and adaptive research to solve specific bottlenecks. NGOs often formulate their own programmes and projects, taking advantage of a very well developed networking capacity. On other occasions, NGOs act as subcontractors for official programmes, or develop joint venture agreements with them. Governments in many Latin American countries have established foundations that act as quasi-private organisations. Liberalisation has opened up a market for small and medium private entrepreneurs and local community organisations to take charge of input supply and technical advisory services.

Funding mechanisms for agricultural research and extension have also evolved. The old ways of block grants or regular financing through the national budgets are giving way to an array of procedures that share the common characteristic of linking funding to the delivery of specific and well defined outputs. Competitive funds are increasingly being used in Latin America, Asia and Africa for this purpose (Gill and Carney, 1999). While the move to emphasise delivery of outputs is healthy in many situations, it has also resulted in a significant dispersion of research efforts, lack of strategic goals, exacerbation of competition for funds, weakened cooperation among different agencies, and dwindling support for long-term investment in research facilities and human resources (Gill and Carney, 1999; Echeverría, 1998). Of particular concern is that in practice these competitive funds often discriminate against the poor and the marginal regions, simply because the supply side of the equation tends to be weaker compared with that for dynamic regions, profitable and competitive commodities, and commercial farmers.

National research agencies are also attempting to commercialise research results and services, applying intellectual property rights when needed. Most Latin American agricultural research institutes now have procedures in place or have developed subsidiaries to patent and charge royalties for their products or to establish contracts with private firms to evaluate inputs, conduct soil tests, or multiply seed (Echeverría, 1998). As governments push research agencies to generate an increasing share of their budgets from these commercial operations, problems important to small and poor farmers and marginal regions are often ignored since they offer fewer opportunities for commercialisation.

In summary, while all of these developments have helped to resolve at least some of the many important shortcomings of the traditional agricultural research and extension systems, and while the great variety of agencies involved contributes to the richness of a country's agricultural knowledge and innovation system, one cannot lose sight of the fact that the poor are very often worse off. The emphasis on shorter-term results, on better rates of 'success', on greater financial self-sufficiency, on relatively simple problems that fit within the framework of three- or four-year

projects, on a greater capacity from the supply side to formulate and prioritise problems and place them in project formats, on improved ability to seek information about multiple options and negotiate with multiple potential partners constitute the new 'rules of the game' for agricultural research and extension these days, and they make it very difficult for the poor to 'play'.

#### *Targeting the poor in research and extension*

Partly in response to the above trends and their effects on the poor there has been a move to develop new approaches to prioritise and target the needs of small farmers in agricultural research and extension. Byerlee (2000) discusses different approaches to improve the targeting of agricultural research for poverty reduction. The basic economic surplus models used by many national agricultural research organisations (NAROs) to prioritise research can be refined to differentiate between different categories of consumers (typically, income or expenditure groups) and producers (normally represented by classes of farmers according to farm size). Also, geographical information systems are used to add a regional perspective to the allocation of research, and this can relate to poverty alleviation if there are differential spatial distributions between the poor and the non-poor. According to Byerlee (2000: 434), 'the effectiveness of targeting will depend on the extent that: (i) benefits of research are captured by producers; (ii) poor producers depend on agricultural incomes; (iii) poverty is correlated to the targeting variable, (iv) the targeted research can generate economic surplus higher than the cost of the research; and (v) the degree and nature of technological spillovers.'

Demand-led, participatory targeting and prioritisation approaches are being increasingly applied in agricultural research, extension and development (Scoones and Thompson, 1994; Byerlee, 1998; Chambers et al., 1989; Ashby, 1990; Collion and Rondot, 1998; Guijt and Gaventa, 1998). In this area there has been an explosion in the number and variety of methods and tools, from the now more traditional participatory technology development and rapid rural appraisals, to the promotion of local farmers' research committees and farmers' field schools, participation of farmers and farmers' organisations in the boards of the research and extension agencies and the relatively recent development of competitive agricultural technology funds.

These participatory, demand-led approaches have provided practical, effective and cost-efficient solutions to the very complex problem of how to make agricultural research, extension and development more relevant to the needs of poor farmers. However, they are not free of limitations. Pretty (1998), for example, estimates that in the mid-1990s there were about two million farmers, in 20 countries, involved in projects promoting participatory sustainable agricultural technologies and processes, and yet he states that these are 'small islands of success' and that 'there remains a huge challenge to find ways to spread or scale up'

these processes (p. 28). Farmer participation does not always ensure that the poor lead in influencing the agenda of these programmes; local rural elites tend to control decision-making, as in the case of the local farmers' research committees promoted by the International Centre for Tropical Agriculture (CIAT) and others in Honduras, where illiterate farmers are under-represented in local organisations (Humphries et al., 2000). Finally, it must be said that these types of participatory methods are most appropriate when the purpose is to maximise the direct effects of agricultural innovation on participating individuals, households or communities, but are less relevant in contexts in which indirect effects are important.

## **5 DIFFERENTIAL STRATEGIES TO IMPACT ON RURAL POVERTY**

In the previous pages we have argued that the net impact of agricultural innovation on poverty will be the result of: (a) the livelihood strategies of the households, which in turn are conditioned by the interaction between their assets (capacities) and their contexts (incentives); and (b) the relative impact of the effects of agricultural innovation on the net income of farming families, food prices and agricultural and non-agricultural employment.

The interplay of the above elements suggests that differential strategies are required to build situation-specific AKIS relevant to particular combinations of these factors (Figure 1).

(A) Market-driven AKIS that impact on poverty primarily through lower costs of food for the urban poor and for rural poor who are net buyers of food, through more and better employment opportunities, and through production, consumption and investment linksto stimulate the non-farm rural economy (B) Market-oriented, asset-constrained AKIS, that may impact on poverty through direct and indirect effects (C) Context- and asset-constrained AKIS, where agricultural innovation can make limited direct contributions to poverty reduction and where non-agricultural livelihood strategies predominate

### **Market-driven AKIS**

The first strategy is relevant to situations in which agricultural innovation is spurred by favourable contexts and asset positions. In sector A of Figure 1, agriculture is a profitable and competitive enterprise. AKIS develop primarily due to the action of market forces, and specifically because of the profit opportunities found by commercial farmers and private firms and entrepreneurs in the services and agro-industrial sectors. The profit motive is behind the linkages and interactions in this strategy. Research and extension find here near optimal conditions to display their capabilities. Private research naturally targets these type-A situations. Commercial farmers have the skills, education, networks, organisations, political power and capital required to mobilise and influence both public and private agricultural research and extension when and where necessary.

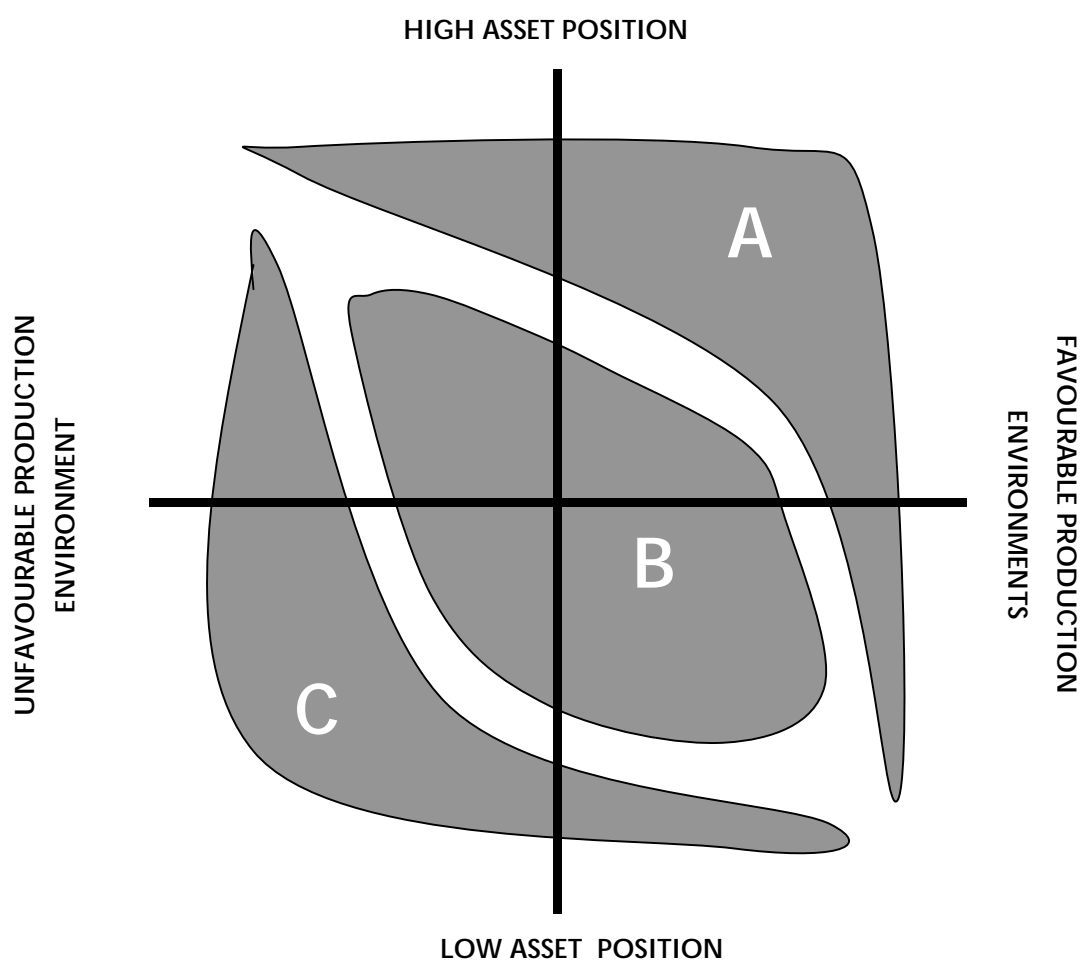
Direct effects on poverty are of little importance in this situation, as few of the farmers operating in these conditions are poor to begin with. On the other hand, it is under these conditions that indirect effects are maximised: high adoption rates result in rapid improvements in productivity, driving food prices down on a global scale. When intensive agricultural systems are the norm, thousands of jobs can be created, and these areas are characterised by large seasonal migration of farm workers from less favoured regions, often across countries. By definition, these agricultural systems are linked in many ways with the non-farm economy, as their requirements for transportation, supplies, professional services, marketing systems and processing are very high. Typically high-income farmers and dynamic farms are also investment-linked with non-farm enterprises.

Is there a role in developing countries for public policies and interventions directly related to agricultural innovation under such conditions?<sup>1</sup> The answer is a resounding yes. But these policies and interventions will tend to be of a horizontal nature, the kind that

generally create or strengthen institutional frameworks. These public policies and interventions should have the goal of exploiting the intersection between public goods and private interests, by:

- developing clear regulatory frameworks and strengthening intellectual property rights
- protecting these agricultural systems from unfair trade competition and non-trade tariffs and barriers to commerce, as well as promoting private-public cooperation for the purpose of opening new international markets
- developing national science and technology policies that do not discriminate in favour of any one particular kind of research organisation but that, on the contrary, promote diversity, specialisation and competition, all of which will lead to cooperation when necessary, in particular if the private sector is provided additional incentives through such means as competitive science and technology funds or specific research contracts
- supporting through direct public investment basic and strategic research in those fields of science and

Figure 1 Differential strategies for the development of agricultural knowledge and information systems



technology that are most relevant to agricultural systems with actual or potential competitive advantage

- funding the specialised training of highly skilled young scientists
- promoting the establishment of cooperation agreements between national universities and research institutes and their counterparts in other countries
- stimulating linkages and cooperation for innovation between different actors in agro-industrial and marketing chains
- investing in public but non governmental organisations (such as foundations endowed with public and private funds) that manage venture capital for new enterprises to bring new technologies into the country
- adopting policies that create favourable conditions for foreign investments in R&E and in innovative for-profit enterprises

If the correct institutions and policies are in place to ensure that the benefits of growth and innovation are broadly shared in a society, all the above public policies and interventions will lead to win-win scenarios for growth and poverty reduction. In addition, if successful in stimulating greater private investment in research and extension, these policies and instruments could free public resources for investment in other situations.

### **Market-oriented, asset-constrained AKIS**

Zone B in Figure 1 depicts a situation in which small farmers, who may have the incentives to embark on market-oriented agricultural innovation processes, are predominant but lack the capacity to respond fully to this favourable context, either because their assets are too limited, the productivity of such assets is low, or because the transaction costs they face are too high. For reasons that will be discussed in the following paragraphs, it is likely that this group of small family farms represents the best opportunity (in economic, social and also political terms) for linking agricultural innovation and poverty reduction policies in developing countries.

Effective type-B policies and programmes will yield both direct and indirect impacts on poverty. Many of the farmers in type-B situations are poor, and this opens space for direct effects on the net income of farming households. Second, all the research on the non-farm rural economy shows that it is in this type of situation that farm/non-farm linkages develop best and have the largest effects on the welfare of rural communities. Third, small farmers in type-B situations produce a large share of the world's food, as in the notable case of rice in Asia or vegetables for the domestic market in much of Latin America, or milk in Africa.

The market will not produce these results by itself, otherwise it would have already done so. Neither will results be achieved in the absence of clear and viable links to markets. Strategies for type-B conditions must have a clear and strong market orientation, for which proactive public policies are needed.

In type-B situations, one often finds the condition described by Röling and Jiggins (1998), namely that

there is potential for AKIS to develop, but that a lack of synergy among the different private and public agents constrains its realisation.

Public policies and interventions under type-B conditions are needed to: (a) increase the assets available to small farmers, as well as their productivity; (b) lower transaction costs and diminish the institutional constraints and the market failures that hamper the productivity and innovation potentials of family farms; and (c) promote the development of an effective AKIS by stimulating synergistic interaction between public and private agents, including farmers.

What types of public policies and interventions can be successful in this context?<sup>2</sup>

- Supporting efficient and effective NARS, understanding that the concept must not be restricted to the conventional agricultural research agencies, but should apply also to universities, private R&D firms, NGOs, farmers' organisations, foundations, etc. While action on the demand side (e.g., competitive funds targeted at small-scale farmers) is of great importance, there is also a need for policies and interventions that more directly target the development of capabilities on the supply side. These include investment in the training of the NARS's staff and improving their management systems. Demand-driven approaches do not work well in the face of weak suppliers of agricultural research and extension services.
- Revitalising extension and farm advisory services. This means changing their outlook from primary production to a market orientation, empowering users so that they exert ownership over the extension services, decoupling public financing from private service delivery, decentralising decision-making and involving local governments.
- To the extent that it is feasible at any given time and place, give priority attention to non-food crops (e.g., cash crops, boutique and niche products, non-traditional exports, crops that can be produced under contract with agro-industries), as well as rural farm-based enterprises that generate new types of goods and services demanded by the growing urban sectors, such as agro-tourism and the management of rural areas for recreational purposes. Of course, large-scale emphasis of non-food staples will be practical and feasible only when the country has the foreign exchange required to purchase basic food staples on the world market, and when the infrastructure and the marketing and processing sectors are developed to the extent needed for the services-intensive production of these kinds of agricultural products.
- Framing agricultural innovation within broader policies and programmes aimed at the broad-based development of local rural economies. In particular, agricultural research and extension should strive to link small-scale farming with the non-farm economy, by prioritising those enterprises, processes and production and post-harvest technologies that: (a) are more intensely linked with rural services and industries; and (b) save labour from on-farm work

so that it can be invested in non-farm self- or wage-employment, wherever these opportunities exist.

- Promote small farmers' economic organisations as institutional platforms for collective action to confront problems of barriers to market access, economies of scale, and transaction costs (Berdegue, 2001).

### **Context- and asset-constrained AKIS**

Sector C in Figure 1 represents a situation in which households lack most types of assets aside from unskilled labour and, sometimes, a very little land (e.g., less than a hectare), and, at the same time, operate in unfavourable environments. In short, the potential for agricultural development resulting in sustainable reduction of poverty levels is very limited or non-existent. While agricultural development projects can create artificial systems of incentives for a certain period and for a limited fraction of these millions of households, the fact remains that often these regions lack growth engines (i.e., regular and dynamic sources of demand either for labour, services or products) to provide the stimuli needed for long-term and widespread poverty reduction.

As discussed in previous sections, those type-C households with access to land often engage in subsistence farming because: (a) they lack better employment options; (b) they have developed diversified livelihood strategies in which agricultural production complements other sources of income, often from unskilled agricultural labour, remittances and subsidies or from what Reardon et al. (2001) call refuge rural non-farm activities; and (c) transaction costs are so high as to effectively bar them from operating in the market as sellers and/or as buyers of most agricultural products.

In type-C situations, poverty reduction policies and programmes must be even more broad-based than in type-B scenarios. Given the very limited endowment of agricultural assets, even significant long-term increments in agricultural productivity will usually have a very small impact on total household income. Farming systems under these conditions are very often in a state of finely tuned equilibrium within their very constraining contexts, which means that unless the constraints are removed or at least significantly reduced by means of broad-based development policies, there is little room for improvement.

Broad-based development policies aimed at type-C situations will normally include interventions aimed at trying to move these households towards a type-B condition, by enhancing their asset position (e.g., land distribution, access to credit, training, education, and health programmes, strengthening community organisations), and/or by improving the context in which they operate (e.g., roads, irrigation, improving the capacity of local governments, supporting more efficient markets). In the absence of such changes, the potential for agriculture-based development will remain very low.

Does this mean that agricultural research and development cannot play a role under type-C conditions? Of course not. But successful efforts will tend to be based on an understanding that, under type-C conditions, self-

employment in agriculture will often be only one element – many times not even the most important one – of diversified household livelihood strategies.

Many people call for a greater share of agricultural R&D resources to be targeted on regions characterised by marginal environments for agricultural production. Their arguments include considerations of public versus private roles and of the efficiency of public investments: if the private sector largely takes care of type-A areas and farmers, this should free public resources for investment in agricultural R&D in areas, crops, problems and populations not being served by private agricultural technology companies (Altieri and Waters-Bayers, 2000).

The equity argument is based on the notion that the vast majority of the rural poor are located in marginal areas and, conversely, that there are few rural poor in the more favoured agricultural environments. While this is true in the sense that most poor rural people do live in marginal areas, there is also a very significant number living in more favourable environments (Renkow, 2000; Fan et al., 2000b)

While these arguments show that there is certainly some room for agricultural innovation to contribute through direct effects to a reduction in income poverty, they do not dispel the findings of many other studies that conclude that the poorest of the poor, in the worst environments, almost always develop diversified livelihood strategies to try to improve their well-being and their income.

What types of agricultural innovation policies and interventions can maximise the contribution – whatever its magnitude – of agriculture to poverty reduction in type-C situations? Recent research has shown that, while local networks of social capital play important insurance and solidarity functions, they can promote significant movement towards reducing poverty only when they cut across traditional family, clan, tribal or local community groups and link to outside networks (Narayan, undated). In other words, successful innovation in type-C situations depends on building local institutions, networks and organisations that help mobilise the very scarce resources of these communities, and link them to external networks.

The strategies that have shown the greatest potential for spurring institutional innovation for agricultural development under type-C conditions include participatory technology development, on-farm adaptive research by NGOs and local organisations, and farmer-to-farmer extension systems. In Peru and Bolivia, the International Fund for Agricultural Development (IFAD) has experimented with programmes that transfer cash to local organisations empowered to hire technical assistance services as needed, with minimal external intervention. These organisations often enter into risk- and profit-sharing agreements with their advisers to develop new market-oriented enterprises. Also, in the Andean region of Latin America, many municipalities with high proportions of indigenous populations and with active NGOs, have seen the rise of '*mesas de concertación*' (concerted action round tables), which are institutional arrangements for developing private-public medium-

term action plans for local development, in which agriculture and natural resource management projects often play a very important role. The biggest challenge – yet unresolved – is to find a way in which these local experiences can be extended so that their impacts are commensurate with the magnitude of one billion poor rural people.

In type-C situations, formal research and extension organisations will probably be effective if they operate through agreements with local organisations and NGOs able to facilitate local-level innovation processes, with the research organisation playing a technical and methodological backstopping role, as CIAT has done in Colombia and Central America (Braun et al., 2000; Humphries et al., 2000).

## 6 CONCLUSIONS

1. Poverty is multi-dimensional. Its causes are diverse, its manifestations and meanings are contextual, and it is not only a state of deprivation but also a set of processes. Failure to recognise these facts has led to a succession of fads of simplistic 'one size fits all' approaches. If we want to improve the performance of agricultural knowledge and information systems *vis-à-vis* poverty, it is time that we learned to deal with its diversity by means of customised approaches.
2. When the goal is poverty reduction, agricultural innovation policies and programmes cannot start from agricultural research and extension and move towards poverty. The starting point has to be the analysis of the different types of poverty (rural and urban), their determinants, the contexts in which they occur, and the livelihood strategies that the poor implement to respond to their condition. The more we move into conditions of poverty, deprivation, and unfavourable environments, the greater the need for these types of broad-based approaches. Only in certain circumstances will research and extension find themselves in the driver's seat. Even then, to impact on poverty, R&E will have to be framed in the context of broad-based development policies. They will fail if they try to tackle this issue in isolation.
3. Given how heterogeneous the assets and contexts of the poor and the determinants of poverty are, it is no surprise that rural households pursue a number of different livelihood strategies. Agricultural production can be a major element in such strategies, or it may play no role at all. The notion that all rural households are agricultural, or that agriculture is the best way of reducing income poverty for them all, must be discarded as untrue and unrealistic. The agricultural path out of income poverty is relevant only to those who have access to sufficient land and other assets needed for agricultural production, and who operate in contexts that provide incentives for such assets to be sufficiently productive over long enough periods of time to lever the household out of poverty.
4. Under the increasingly prevalent condition of liberalised agricultural markets, those farmers who are early adopters of new technologies and who can keep pace with continual innovation, stand to gain from the direct effects of technological change. In the long run, many poor farmers in developing countries will only be able to benefit from the direct effects of agricultural innovation if they operate under conditions of *de facto* or *de jure* protection from international trade, or if public policies are put in place to allow them to significantly increase their productivity and/or to diversify into production systems in which they have a competitive advantage.
5. Indirect effects of agricultural innovation through lower food prices are a fundamental contribution to increasing the welfare of the urban poor and also to a vast proportion of the rural poor who are net buyers of food. There is little hope for progress in the fight against poverty on a global scale if agricultural research and extension diminish their overall support to those regions and farmers that can create this type of indirect effect. However, the rise of privately-funded R&D in developing countries offers a new set of conditions for defining the contribution of the public sector to agricultural innovation which targets these types of indirect effects on poverty. There are now much greater opportunities for the public sector to reduce its direct involvement in implementing the research and delivery of extension while at the same time enhancing its capacity to stimulate and support private efforts, and to take care of those objectives that are outside the scope of private (i.e., commercial) interests.
6. An additional indirect effect of agricultural innovation that needs to receive much greater attention than in the past is the growth of the rural non-farm economies. All the recent evidence shows conclusively that growing numbers of rural households derive an increasing share of their total income from this source. Non-farm income is of particular importance to the rural poor, including many agricultural households. Some traditional concepts need to be sharply revised, such as that which states that pro-poor agricultural technologies must be labour-intensive, as if the poor do not have other, better remunerated employment opportunities. Agricultural research should actively seek and exploit opportunities for developing and strengthening production, expenditure and investment linkages with the non-farm economy.
7. During the last two decades of the twentieth century, the AKIS of developing countries have undergone significant institutional changes. The budgets of the traditional government research and extension agencies have tended to decrease, often accompanied by a more general weakening of the organisations' capacities. At the same time, a positive development has taken place in many countries, with the growth of a number of private, quasi-private, not-for-profit and community-based organisations taking over many of the tasks and services that used to be provided by government. In order to improve the effectiveness of this

institutional complex *vis-à-vis* the rural poor, the public sector should support the institutional strengthening and empowerment of rural communities and farmers' organisations and put in place policies and programmes that foster institutional innovation at all levels.

8. Differentiated policies for agricultural innovation must be designed to fit the needs and possibilities of different situations, such as the three described in this paper. Given the range of situations, it makes little sense to commit to any single option. In general terms, one can recognise three different strategies to develop AKIS in support of poverty reduction:

(a) In situations where agricultural innovation is spurred by favourable contexts and asset positions, and where agriculture is a profitable and competitive enterprise, much of the impetus will be due to the action of market forces, and specifically to the profit opportunities found by commercial farmers and private firms and entrepreneurs in the services and agro-industrial sectors. In this case, public policies and interventions should have the goal of exploiting the intersection between public goods and private interests.

(b) The second set of strategies involves millions of small farmers in developing countries who have the incentives to embark on market-oriented agricultural innovation processes, but lack the capacity to respond fully to this favourable context, either because their assets are too limited, the productivity of such assets is low, or because the transaction costs they face are too high. This group of small family farms represents the best opportunity for linking agricultural innovation and poverty reduction policies in developing countries, and as such they should be the primary target of national and international efforts. Developing the full potential of these small farmers and their communities requires pro-active, market-oriented public policies.

The third set of strategies applies to rural households lacking most types of assets aside from unskilled labour and sometimes a very little land, which at the same time operate in unfavourable environments. Under these conditions, poverty reduction policies and programmes must be even more broad-based than in the second case, and will normally include interventions aimed at trying to move these households towards a better condition, by enhancing their asset position and/or improving the context in which they operate. In the absence of such changes, the potential for agriculture-based development will remain very low. Successful innovation in these conditions depends on building local institutions, networks and organisations that help to mobilise the very scarce resources of these communities and link them to external networks. Formal research organisations would probably be effective if they operated through agreements with local organisations and NGOs to facilitate local-level innovation processes.

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## ENDNOTES

- 1 It is outside the scope of this paper to detail the strong need for public action unrelated to agricultural research and extension, to ensure that the growth and wealth generated in these areas are equitably distributed and that they contribute to the overall fight against poverty. These include fiscal, labour and environmental policies, development of public services for farm workers, land use planning to avoid the collapse of cities and services, etc.
- 2 As in the previous case, for reasons of focus and of space, we refrain from discussing public policies and actions that, although not directly related to agricultural research and extension, would have obvious effects favourable to agricultural innovation in type-B situations. These include, among others: development of roads, electricity, irrigation and telecommunications infrastructure in these rural areas; improved education, regulatory frameworks and specific policies that stimulate the development of small and medium rural enterprises, improving the access of small farmers to land and financial markets; removing biases in agricultural policies that favour large-scale farming at the expense of small-scale landholders, etc. These types of policies and interventions are of fundamental and irreplaceable importance for the success and consolidation of viable family farms in developing countries.



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