

**AGRICULTURAL RESEARCH, INSTITUTIONS AND RURAL POVERTY
ALLEVIATION**

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ABSTRACT

This paper addresses the issue of the institutional reforms that are needed in order to improve the contribution of agricultural research to reaching the goal of reducing by half the poverty that affects 1300 million people within the next 15 years. It is argued that agricultural research needs to follow differentiated strategies to attend the needs of different types of poor people, urban and rural, agricultural and non-agricultural. However, in all cases it will be essential for agricultural research to become embedded in broad-based, market-oriented innovation systems, as a *sine qua non* condition for achieving long-term sustainability of impacts at the scale which is relevant to 1300 million poor people.

Agricultural research, institutions and poverty

THE CONCEPT OF POVERTY

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 dynamic set of processes (Carney, 1999; World Bank, 1999; Munk Ravnborg, 1996). Maxwell (1999) identifies nine “fault-lines” in the conceptual debate about the meaning and measurement of poverty: individual or household measures; private consumption only or private consumption plus public goods; monetary or monetary plus non-monetary components of poverty; snapshot or timeline; actual or potential poverty; stock or flow measures; input or output measures; absolute or relative poverty; and objective or subjective perceptions of poverty.

Measures of poverty which attempt to capture this diversity do exist, notably the Human Development Index of the UN Development Program. However, for the purpose of this paper we have chosen to use the more conventional definition of “income poverty” or “economic well-being” (OECD, 1999), which refers to the proportion of people whose income is below a certain standard (a national poverty line, or, for the purpose of international comparisons, \$ 1 per day). This choice does not reflect any particular conceptual preference, but rather it is driven by the fact that information is more readily available for income poverty than for other, more complex measures. Besides, there is certainly a significant and strong relationship between household and per capita income and other indicators of poverty.

Despite large investments in agricultural and rural development, poverty continues to be a pervasive problem in all developing countries.

Table 1 shows that according to the World Bank (1999) almost 30% of the world's population lived in poverty in the developing countries in 1993. Between 1987 and 1993, the absolute number of the poor has increased in all the developing regions of the world with the exception of East Asia and the Pacific which shows a moderate decrease of 4%. Sub-Saharan Africa is a particularly critical region not only because of the extremely high number of poor people, but also because the number of poor increased by 22% over the period 1987-1993. Latin America also showed a very significant increase in the number of the poor (22%).

UNDP (1999) estimates that 44% of the population living in 44 'low human development' countries have an income below \$ 1/day, while 26% of the inhabitants of the 46 'medium human development' countries have incomes below this level.

In short, there are around 1300 million people living in poverty in the developing world. The situation varies by continent.

- **Latin America:** Different sources (Valdés and Wiens, 1996; IFAD, 1993; IADB, 1998) estimate that there are between 65–80 million poor, of whom 35–50 million can be defined as being extremely poor. Both in absolute and relative terms, rural poverty and extreme rural poverty have increased in Latin America during the past 15 years.
- **Africa:** According to Jazairy et al. (1992), rural poverty affected 204 million people, or 60% of the rural population, in Sub-Saharan Africa in 1988. In North

Africa and the Near East 27 million or 26% of the rural population were classified as poor.

- **Asia:** In 1988 there were 633 million rural poor, or 31% of the rural population. These figures change to 262 million and 46%, respectively, if China and India are excluded (Jazairy et al., 1992).

In total, in the late 1980s it is estimated that there were almost 1 billion poor rural people in 114 developing countries. This means that about 36% of the rural population was classified as poor (in income terms). It also means that about 75% of the total number of poor people in the developing world lived in rural areas.

The question of scale must be a major consideration when dealing with the relationship between agricultural research, institutions and rural poverty. Institutions are not scale-neutral: it is one thing to consider how research institutions can impact upon poverty at the level of a small watershed but quite another to contemplate this issue at a continental or global scale.

Much of what is feasible at the local level cannot be upscaled to the global level, for reasons of cost and organizational complexity. The institutions which can improve the performance of agricultural research vis-à-vis poverty in a small watershed, for example, may be effective precisely because they are based on face-to-face interactions, tightly integrated social networks and a tradition of collective action, all of which lower transactions costs for the key participants. It may be possible for the World Bank to finance a five-year rural poverty alleviation project in Chile with a total budget of \$15.7

million and 8,000 participating households, but it would cost \$ 150 billion to extend this same approach to all the rural poor in Latin America. Even to extend the project throughout Chile would cost an impossible \$ 300 million.

The time horizon for achieving change also makes a difference. Several development and multilateral agencies have adopted the OECD DAC target of reducing by half the proportion of people living in extreme poverty in developing countries by the year 2015 (OECD, 1996).

Hence, the question we address in this paper is as follows: What are the institutions and the institutional reforms that could improve the performance of agricultural research so that it makes a better contribution to the alleviation of extreme poverty by the year 2015, at a scale which is relevant to the magnitude of 1300 million poor and 900 million rural poor?

The difficulty of reaching this goal is highlighted when one considers that if current trends continue the numbers of chronically malnourished will drop by only 25% (from 800 to 600 million people) by 2015. This falls 50% short of the DAC target, and that is without taking into consideration the 2 billion additional people that will be added to the world's population over the next two decades or so (Monyo, undated).

THE HETEROGENEITY OF POVERTY AND AGRICULTURAL RESEARCH

Poverty and rural poverty are not homogeneous phenomena, and agricultural research policies, institutions and interventions need to be differentiated as a condition for success.

For the purpose of our analysis, we define four categories of poor people: (a) the urban poor, (b) landless poor rural households who are wage laborers in agriculture, (c) small farmers, and, (d) households whose members are employed in non-agricultural rural activities. We recognize that people may shift between categories both over time and within their households. However, in order to respond in a differentiated, and effective, way to poverty it is necessary to understand how people fall with respect to certain key axes. The ones we have chosen are place of residence – urban or rural – and, for the set of rural households, income composition – farm or off-farm.

Figure 1 shows that beyond the year 2020, the majority of the population in all regions of the developing world will be living in the urban areas, even in Africa and Asia. Correlated with this is a decline in the percentage of the population relying on agriculture: beyond the year 2010, more than two thirds of the world's population will be non-agricultural (figure 2). Thus our first category (the urban poor) is of growing importance.

Categories two and three are rural. Table 2 shows an estimate of the share of non-agricultural income in total rural income in different developing regions of the world (Reardon et al., 1998). It can be seen that non-farm activities provide a very large

proportion of the total household income, in all regions. This runs counter to the assumption that all or most poor households in the rural regions of the developing world are essentially dependent on self-employment in farming. Moreover, recent studies in Africa (for example, Chopak, 1991; Collier et al., 1990), Asia (for example, Hazell and Haggblade, 1991) and Latin America (for example, Berdegúe and Reardon, 1999), clearly show that the share of non-farm and non-agricultural rural income is on the rise.

Application of this analysis to specific countries helps clarify the different ways in which agricultural research can contribute to rural poverty alleviation. For example, in Chile two thirds of poor rural households do not have access to land any under any form of tenure (MIDEPLAN, 1999). The main income of 52% of rural households comes from wage labor in agriculture, and 32% of all rural households' income comes from non-agricultural jobs (Berdegúe et al., 1999). In Mexico, only a small percentage of the *campesinos* included in a recent large scale survey had access to the assets required for a livelihood based on agricultural self employment (de Janvry et al., 1997). In Nicaragua, one of the poorest countries in the Western hemisphere, 37% of the rural households are landless, but this rate increases to 52% in the poorest provinces (Corral and Reardon, 1999).

In the case of Africa, most – if not all – rural households have access to some land, and yet non-farm income can be very important. In the Sahelian areas of Burkina Faso the share of non-farm income relative to total household income is 34% (Reardon et al., 1994). In Kenya non-farm income ranges between 45% and 63%, depending on the region (Collier and Lal, 1984). In the most unfavorable regions of Namibia non farm income comprises 93% of total income while in the favorable ones it is still 56%

(Keyler, 1996). The corresponding figures for Senegal are 35% in the Guinean region (favorable) and 57% in the Sahelian part of the country (Kelly et al, 1993) and in the former homelands of South Africa, non-farm income accounts for 93% of total income (Nattrass and Nattrass, 1990).

A recent World Bank study (Mearns, 1999) shows that in India 11% of rural households do not own any land, 24% do not operate any land, and an additional 26% operate less than 0.4 ha. In short, about 50% of India's rural households are either landless or marginal farmers. About 30% of total rural income in India comes from non-farm sources (Reardon et al. 1998), but this figure can be as high as 53% in some regions (Walker et al., 1993). In Pakistan, where non-farm income and employment have been studied in several regions of the country, shares range from a low of 41% to a high of 87% (Ahmed, 1996; Arif et al., 1982; García and Alderman, 1993). A study in one region of Thailand reports the share of non-farm income at 44% in the irrigated areas and at 50–60% in the rainfed zones (Isvilinonda and Wattanutchariya, 1994).

Poverty oriented agricultural research has tended to focus on increasing the share of household income that is derived from self-employment in agriculture. However, the figures above show that this strategy is only relevant to a minority of the rural poor and hardly relevant at all for the urban poor (except for some advances in urban agriculture).

Agricultural research can, though, address urban poverty – as well as rural poverty where rural people are net food purchasers – by increasing the sustainable production of food in developing countries (or reversing the decline in food production). The 1999 Human Development Report (UNDP, 1999) shows that in 24 out of 46 'medium human

development' countries and in 29 out of 44 'low human development' countries per capita food production levels fell between 1980 and 1996. FAO's Agricultural Production Index (FAO, 1999) for Africa decreased from 113.2 to 98.8 between 1967 and 1997 and by 120.7 to 98.3 for the least developed countries as a whole (base 1989-1991 = 100).

Increasing the supply of food requires increases in productivity, since agricultural output cannot continue to increase by further exploitation of fragile environments (e.g., hillsides) and important reserves of biodiversity (e.g. tropical forests). Increased agricultural productivity also contributes to alleviating poverty through its direct and indirect effects on employment and on wages. These facts underline the role that a refocused global agricultural technology system, that recognizes that not all the poor are direct agricultural producers, has to play in the quest to address poverty at the scale of 1,300 million poor and 900 million rural poor.

It is our view that in the case of small-scale agriculture, the goal of agricultural research must be to assist in the competitive market integration of small farmers (Berdegúe and Escobar 1997; de Janvry and Sadoulet, 1998). Outside markets, there is little room to increase the net income of small farmers, at a scale compatible with the DAC targets. However, the situation is complicated by two facts.

(a) Productivity gains usually take place in regions where the poor do not live. For example, between 1961 and 1990, 71% of Latin America's increased production resulted from increased yields in the rich, Green Revolution areas such as the irrigated flatlands of Mexico and the humid Pampas of Argentina. The rest came from the

expansion of the agricultural frontier into the tropical forests and other fragile regions (World Bank, 1992). In India, productivity gains due to the Green Revolution were highest in the wheat- and rice-producing regions and in irrigated areas (Evenson et al., 1999).

The problem is compounded when one considers agricultural growth linkages. Growth of the farm sector induces the development of new activities to supply goods and services to agriculture. It also creates favorable conditions for agroprocessing, marketing and distribution services. For example, Hazell and Haggblade (1991) found that in India, an increase of 100 rupee in farm income is, on average, associated with a Rs 64 increase in rural non-farm income, of which 39% is spent in the rural areas and the rest in rural towns. The relationship between the farm and non-farm economies in India is stronger in the more dynamic and more productive agricultural regions such as the Punjab, a fact which has also been demonstrated in Chile (Berdegúe et al., 1999) and in Brazil (da Silva, 1996).

(b) Most small farmers are commodity producers. Commodity prices tend to be low and market transaction costs to be high or very high in most poor rural areas. Smallholders therefore have strong incentives to avoid market integration.

One way to address this latter problem is to assist small farmers to diversify into cropping systems that are coherent with the types of market incentives which they face. In Latin America, this has meant helping smallholders to become involved in non-traditional exports and contract farming (Berdegúe and Escobar, 1997). In Ecuador, fresh cassava consumption has decreased rapidly with urbanization. In collaboration

with national agencies, CIAT (the International Center for Tropical Agriculture) has developed new uses for cassava, including using it as an ingredient in feed pellets for the rapidly growing shrimp farm industry. This has led to the formation of rural microenterprises to process and market the new cassava products. Rural women play a particularly important role in this new industry (Ospina et al., 1995). A similar project in Colombia has resulted in 150 cassava-processing establishments. (Scobie, 1996).

However, this option is available to only a small fraction of small farmers, due to the requirements in terms of conducive institutional arrangements (e.g., enforceable contracts), risk management, irrigation, property rights, credit constraints, characteristics of the labor force, road infrastructure, the size of the market niches for many of the non-traditional products, etc.

IMPROVED INSTITUTIONS

If income poverty is to be alleviated, changes must take place in the incentives faced by the poor. But this alone is not sufficient. If the poor are to be able to respond effectively to the new incentives, their capacity will have to be increased. This means improving the assets status of poor individuals, households and communities. Without new incentives and greater access to assets, the poor will continue living in a state of deprivation.

However, the story does not end with assets. There are also institutional and organizational factors to be taken into consideration (these in turn play a large part in determining access to assets). Social institutions are never closed systems; they interact and are interdependent. This means that agricultural research can only contribute to

changing the system of incentives and to improving the assets of the poor, as part of larger innovation systems, and these in turn are fundamentally determined by the economic, social and legal environment.

There can therefore be no sustained and generalized processes of agricultural and rural innovation in the absence of economic growth, competitive and dynamic markets, peace, healthy legal and political institutions, tolerance, respect for civil and individual rights, etc. This is more than a vague pseudo-philosophical chat, it is a very practical matter, for the main causes for the lackluster impact of agricultural research on poverty alleviation, are likely be found at this level. In addition, there are serious implications for investment in research. If these conducive contextual elements are not present to a reasonable degree in a given country, efforts to improve the poverty reducing effects of agricultural technology and innovation systems are unlikely to yield fruit: whatever gains can be achieved in the technology system per se will be more than offset by failures at the larger scale.

One can follow this analysis and apply it, for example, to those countries which in the most recent UNDP Human Development Report were ranked as 'low human development'. There is an urgent need to reduce poverty in such countries. In principle, agricultural research should be able to help. However, there can be little cause for optimism about the contribution that agricultural research can make in countries such as Burundi, Rwanda or Haiti, where there has been a fundamental breakdown of the basic economic, social and political institutions. Talking about agricultural research improvement here, is like arranging the chairs in the sinking Titanic!

In those cases in which agricultural systems are competitively integrated into significant markets, it is the market itself that will provide the fundamental incentives for the larger innovation system to fall into place. When 'prices are right', little public action is needed to ensure reasonable input supply services, for investment to take place in agroprocessing and marketing facilities, for agricultural research administrators to channel the required funds to solve critical problems, for labor to be trained, etc. Agricultural systems in such situations will have a strong impact on poverty because they create hundreds of thousands of direct and indirect jobs (many of them for women), and because increased productivity means lower food prices.

Even when markets are working positively to alleviate poverty, there are still institutional innovations that could improve the performance of agricultural research. For example, the private sector can and should shoulder a very large part of the research effort (Byerlee, 1998; Echeverría, 1998; Falconi and Elliot, 1994; Anderson and de Haan, 1992).

Private research

Private research in agriculture is increasing, although it still accounts for less than 15% of total expenditures in developing countries. Byerlee and Alex (1992) estimate that in 1992, more than 50% of the expenditure on hybrid maize research was made by the private sector in Latin America and Asia (excluding China). In Colombia, the annual rate of growth of private sector research between 1980-1991 was of 6.9%, compared for 2.3% for the public sector. In Ecuador, public sector expenditures actually decreased at an annual rate of - 7.1%, while private research budgets increased by 1% p.a. between

1980 and 1991. In Jamaica, the rate of growth of public research is 200% that of the private sector (Falconi and Elliot, 1994).

Falconi and Elliot (1994) found that 90% of private research in Colombia was focused on applied and adaptive issues, as opposed to only 75% in the case of the public sector, which had a far greater tendency to concentrate on basic and strategic research. In Ecuador and Jamaica, 100% of private research was applied or adaptive, and was largely focused on agronomic and biological technologies. Private research in Colombia, Ecuador and Jamaica tended to concentrate on export and other high-value crops, while the public sector focused on food staples and traditional commodities. The private sector tends to get involved in natural resources management research only where there is clear potential for a win-win situation, as there was with the development of zero tillage machinery in Argentina, or with cost-driven reductions in pesticide and fertilizer use amongst Colombian coffee growers.

Clear regulatory frameworks and enforceable property rights help provide an incentive for private research. For example, in Chile the major fruit growers' and exporters' associations are funding research to find replacements for methyl bromide due to new environmental legislation.

Finally, private investment in research benefits from well defined national science and technology policies, that bring in a wide range of research and development organizations, that recognize the different comparative advantages of these organizations and aim to exploit the complementarities between them (Echeverría, 1998).

Technology policy also needs to take into account the fact that the public sector will continue to be responsible for research that targets public objectives, such as controlling and reducing the environmental externalities of agricultural intensification and creating effective and real opportunities for smallholders to participate in profitable and competitive markets.

Opportunities for institutional innovations in the public sector

The public sector can also benefit from incorporation of certain private sector principles into its working practices. This can be done, for example, through the establishment of competitive research funds (Gill and Carney, 1999; Echeverría, 1998). Competitive funds work best where (Gill and Carney, 1999):

- there is sufficient research and development capacity;
- governments lead the institutional reform process and have a clear vision of priorities;
- management is by independent institutions which do not bid for projects; and
- governing bodies are pluralistic with no majority from any one stakeholder.

On the other hand, current competitive funding mechanisms tend to favor short-term results, and by definition allocate resources on a project-by-project basis, so they may not be well-suited to addressing public objectives that require long-term and well focused and integrated research efforts.

Regional funds can be an alternative in the case of small countries with limited research capabilities, as well as to deal with research issues which transcend national boundaries; examples are Latin America's Regional Fund for Agricultural Technology (FONTAGRO), administered by the Inter-American Development Bank, and the Agricultural Technology Transfer Fund (ATTF) of the Association for Strengthening Agricultural Research in East and Central Africa.

Another alternative institutional mechanism that can help promote private-public cooperation in agricultural research, is the "mixed" private-public foundation, such as FUNDAGRO in Ecuador, Fundación Chile in Chile or the Jamaican Agricultural Development Foundation (Falconi and Elliot, 1994). While several of these foundations manage competitive funding mechanisms, they are also known for promoting direct research, for developing joint ventures between NARS and farmers' associations, and for identifying innovative mechanisms to promote the international transfer of technology.

Refocusing on poverty

However, even in the context of growth and innovation in the agricultural system, poverty will not diminish in the absence of explicit poverty-focused policy and action. Chile provides a good example (Berdegue, 1999a). Between 1987–1994, Chile's agricultural GDP grew by about 50%, and yet rural poverty levels have remained static since 1992. In Peru, the structural adjustment and liberalization policies of the 1980s had a positive impact on the productivity and income of some of the eleven types of

rural communities studied by Escobal (1996), but they had a strong negative effect on others.

So economic growth and markets in which the “prices are right”, are not unidirectional in their effects on rural poverty. Nevertheless, good economic policies provide a window of opportunity for agricultural research and other tools of agricultural development to make a difference, and they provide the conducive context required for agricultural innovation to take place.

The Chief Economist of The World Bank has recently stated: “These countries [which have now completed the first generation of reforms] have followed the dictums of the Washington consensus – bringing down inflation and budget deficits, liberalizing trade, privatizing state-owned enterprises, and “getting the process right” – but are still waiting for development. The reason for the failure of the Washington consensus to fulfill its promises is that it not only pursued too narrow a set of objectives – an increase in GDP per capita – but that it saw development from too narrow a perspective...” (Stiglitz, 1998, p. 11)

To be effective in poverty reduction, public bodies must incorporate criteria such as equity and poverty focus into market-driven agricultural development. For the topic in hand, this means that the voice and influence of smallholders in agricultural research in market-integrated agricultural systems must be strengthened (Rukuni et al., 1998). It is well known that large farmers have a disproportionate influence in defining agricultural research agendas. This often leaves smallholders facing the problem of technologies that

are inappropriate for reasons of scale, cost, managerial complexity or simply because they are irrelevant to the main problems of market integration.

Some competitive research and development funds have addressed this problem by directing their efforts specifically towards trying to help small farmers integrate into market-driven agricultural systems. An example is the Competitive Fund of Colombia's National Technology Transfer Program (PRONATTA), which has stimulated the development, adaptation and validation of technologies designed for smallholders, including "upscaled" indigenous technologies. Part of the success of PRONATTA is due to the fact that the Fund included resources to develop the demand side. These resources were used to stimulate the formation of regional multi-stakeholder networks that had the authority to formulate broad regional agricultural development priorities to guide the project review and selection process (Escobar and Berdegúé, 1999). It is a telling sign that in regions of Colombia characterized by high levels of violence and social conflict, the purpose of this "institutional strengthening component" of PRONATTA has been "to develop trust" between the different actors in the innovation system.

The system of incentives which predominate within NARS are a major cause of the discrimination against small farmers in setting and implementing the research agenda. If researchers are evaluated and compensated according to their publications in scientific journals, they will not carry out on-farm validation trials that have no academic gloss. If researchers are not evaluated at all, but simply draw a monthly salary regardless of their performance, they will generally feel no pressure to leave the research station and work in remote villages. If researchers' salaries are low or if they

remain unpaid for several months, researchers are often stimulated to become de facto consultants for large farmers.

However, motivation does not depend entirely upon wages and evaluation systems. Tendler (1997) has shown that performance within public service organizations, including agricultural research and extension, depends on civil servants being dedicated to their jobs, and that the environment in which they operate plays a large role in eliciting and rewarding such dedication. Governments can feed workers' sense of dedication by building a sense of calling, by publicizing their programs and by organizing their work in a client- and problem-oriented manner.

To change the incentive structure, it has been suggested that research and development funds might be directly managed and prioritized by farmers' organizations. Unfortunately, Carney (1996) has found that – at least in Africa – the role that farmers' organizations can play in redirecting agricultural research, “has been overstated”. Many of these formal organizations tend to be weak and would need to be substantially strengthened before they can play an effective leadership role in agricultural R&D. An exception seems to lie with those organizations with stronger market links, probably because market signals (in terms of prices, quality standards, etc.) simplify the task of defining the most relevant constraints and hence the priorities for agricultural research and development.

In Latin America there is more cause for optimism (Berdegue and Escobar, 1997). Economic organizations of small farmers acting in tandem with intermediate institutional agents (what used to be called “extension”, but which nowadays is an

institutional space filled by private organizations, such as NGOs, small agricultural advisory firms, the technical branches of municipal governments, and even individuals who provide consulting services to small farmers), have shown great potential in structuring technology development agendas and putting pressure on governments and research organizations to attend to these priorities. Hence, building up effective economic organizations of small farmers and a complementary network of intermediate agricultural development institutions, is an effective mechanism to stimulate greater allocation of public funds to the technology development problems of smallholders (Berdegúe, 1999b).

Another institutional option for forging stronger links between smallholders and agricultural R&D, is contract farming (Schejtman, 1998). Contract farming is effective for small farmers when:

- there are no large economies of scales in primary production;
- production systems are labor intensive;
- products have a high value per hectare and relative to transportation costs;
- products are perishable; and
- there are significant opportunities for adding value through industrial processing.

In such cases, agroindustries can intermediate effectively between smallholders and the agricultural research system.

Unfortunately, a very large proportion of the rural poor live in regions in which there are few opportunities for effective integration into competitive and dynamic agricultural whether through contract farming or otherwise. It is here that agricultural research faces

its greatest challenges. If markets do not exist or are very imperfect, they cannot be expected to provide the organizing principle for effective innovation systems.

In such circumstances, the traditional approach of agricultural research and extension has been to act like an ostrich, hiding its head in the sand and attempting to improve productivity within a set of near impossible constraints. Even with these constraints, though, there have been some successes. Local agricultural development projects have tested criteria, methods and processes and shown that if certain conditions are met, it is possible to increase food production in these marginalized rural regions of the world. But the most frequent mistake of these projects is to be too inward-looking: resources are used to improve the productivity, the production, the income or even the well-being of the X number of individuals and households who are the participants in the project. But, as a farmer recently told one of us: “It is one thing to think in terms of a project, and another to make our agriculture into a good business”.

A fundamental reform that must take place is to visualize and design projects as *catalysts* for self-sustaining innovation systems. These innovation systems can only be self-sustaining if they are linked to markets. If this is not the case, there has to be an assumption that some other (non-market) institution will be prepared to sustain external funding for very long periods of time. The international record has shown conclusively that this is no more than a sweet dream (although in projects it is often expressed as an assumption: “The government is expected to continue funding X and Y components after the project ends...”).

There is, though, a third alternative. Many will argue that a more viable option is to think about development processes which are based on local – often traditional or indigenous – technologies and institutions that require low external inputs.

Indigenous institutions are often extremely effective at managing common property resources and other local public or semi-public goods (Ostrom, 1990). Likewise, low external input technologies can be effective in dealing with many agricultural and natural resource management issues (Altieri, 1987). Pretty (1995) finds that many successful cases of what he calls ‘sustainable agriculture’ have three things in common: (i) use of locally adapted resource-conserving technologies; (ii) co-ordinated action by groups and communities at the local level; and (iii) supportive external institutions. In regions largely untouched by modern agriculture such sustainable agricultural practices can have a significant impact on local food production. The problem, as Pretty recognizes, is that “most successes are still only small scale... probably only a few thousand communities throughout the world have benefited” (1995, p. 238).

Our argument here is that it is Pretty’s third element that is the key. If there are supportive external institutions that can supply the resources (financial and otherwise) to *mimic* or substitute for those that in a normal situation would be supplied by the State – and in the long run the market – then success is much more likely.

In projects – both ‘sustainable agriculture’ projects and ‘agricultural modernization projects’ – the problem is one of sustainability and scale. Although the debate about the merits of these two approaches is very real and has strong institutional implications, for reasons of space and simplicity we would like to argue that both face the common

challenge of linking local development initiatives to market forces, as a condition for long-term sustainability and success on a scale compatible with the goal of reducing the poverty of 1300 million persons in 15 years.

However, we have already noted that in marginalized regions, there are no dynamic markets with which to link innovation systems. So, if not the market, then the state? Unfortunately, there is no reason to think that a state-controlled, state-financed and state-implemented development effort can get anywhere in many, if not most, of the less developed countries.

The only remaining institutional alternative is – using concepts derived from Röling and Jiggins (1998) and from Evans (1996) – for embedded public-private platforms to negotiate and implement market-oriented (as opposed to market-linked) innovation processes.

Röling and Jiggins (1998) analyze a situation in which sustainable practices at system level A are increasingly determined at a higher system level. This is the case for poverty in marginalized rural regions. Stakeholders who recognize that the outcomes of their actions are dependent on others, are ready to “scale up human agency to a level of social aggregation which is commensurate with the level of the [system] perceived to be in need of interactive management” (Röling and Jiggins, 1998, p. 301).

Examples of this are the smallholders who organize themselves and in cooperation with NGOs, foreign donors and commercial agribusiness create a whole new industry of non-traditional exports in the highlands of Guatemala (Carletto et al., 1999; Schejtman,

1998); or the Andean communities in Peru, which tired of the traditional potato-production projects and with the help of an IFAD (International Fund for Agricultural Development) project, a private entrepreneur, and an export company, start producing trout in Lake Titicaca.

Evans (1996) uses the concept of embeddedness to describe synergistic relations that connect governments and groups of citizens across the public-private divide. Embeddedness implies more than simple contractual cooperation, in which – as in the case of the competitive funds – the government provides inputs A and B, and lets private sector agents use them to produce product Z. Embeddedness implies a form of cooperation in which the public-private divide blurs, as is the case in many local development schemes in which an external observer would have difficulty seeing who and what is government and who and what is non-government.

The most important institutional implication of this concept of embedded negotiation platforms is that the linear model of technology development which has prevailed for the last 40 years or so (strategic and basic research leads to applied research which leads to adaptive research which leads to extension which leads to production) must be discarded when dealing with issues of innovation in marginalized regions of the developing world. Broad-based innovation processes require stakeholders who learn and discover, rather than transfer and adapt ready-made solutions. Recent analyses have concluded that previous studies about the impact of such linear models (such as the paradigmatic Training and Visit system) tended to overestimate their results (Gautam and Anderson, 1999). Much has been learned about on-site, participatory research in recent years from movements such as (FSR) Farming Systems Research and PTD

(Participatory Technology Development), including the fact that even FSR and PTD failed when technology development was segregated from the broader innovation system.

A condition for the success of such an embedded negotiation platform is that it should be market-oriented. That is, it should set its sights on creating the conditions which will allow the successful integration of the improved agricultural system into a specific market, within a period of time that is compatible with the expected duration of the flow of external resources (financial or otherwise).

This has the following implications for agricultural research.

(a) Research efforts must give priority status to determining the highest long term cost/benefit structures of different production systems, to avoid the problem of farmers chasing after commodities and other products which in the long run can be produced more cheaply elsewhere (D. Baker, personal communication). Information about cost/benefit ratios is also crucial to allow for reasonable decision-making about the allocation of scarce resources between the wide range of activities that need to be undertaken to stimulate sustainable innovation processes.

(b) Research organizations must get accustomed to controlling the cost and duration of research. This includes giving serious consideration to issues of comparative advantage amongst different types of organizations (including research institutes, NGOs, extension services, and even farmers' organizations) in technology development. In this way, agricultural research organizations can act as catalysts for wider innovation processes that involve the organizations themselves but also require the contribution of others who can provide specific capabilities and competencies.

It is very unlikely that innovation processes can be sustained in marginalized regions on the basis of primary agricultural production alone. We have already seen that non-farm rural income ranges between 30 and 40% of total income, depending on the region of the world. Innovation processes must attend to and take advantage of this growing trend. This will mean a change in overall scope so that improvements of the agricultural system are not limited to primary production, but are extended to include upstream and downstream production and expenditures linkages. This approach would have the added benefit of being able to involve sectors of rural communities which would otherwise be excluded (e.g. the landless, small merchants and artisans, etc.).

(c) Evaluation criteria for agricultural technologies must consider the possibility that households, even in labor surplus areas, will want to free up labor from on-farm activities in order to engage in non-agricultural tasks.

(d) Attention will need to be paid to those attributes of production systems or products that may provide entry points for new or enhanced farm-off farm linkages (such as options for small scale mechanization of certain tasks, or the characteristics of a product which may make it more amenable to processing or transportation).

(e) More resources may have to be dedicated to agroprocessing issues.

(f) Since there appear to be greater opportunities for forward production linkages and adding value to non-commodity products, a shift of emphasis and priorities is likely to be required. (Commodities generally receive much more support from the research organizations of developing countries.)

Agricultural research organizations must then begin to conceptualize the innovation process as occurring beyond the walls of their research stations, and as extending

beyond agriculture itself. Rather than attempting to become all-inclusive bureaucratic monsters that monopolize all sides of the game, agricultural research organizations should place a strong emphasis on building alliances and partnerships with others.

CONCLUSIONS

In dealing with the issue of institutional reforms to improve the contribution of agricultural research to poverty alleviation, we have stayed away from the commonly addressed issues of management and organization of agricultural research institutes. This does not imply that these “inside the firm” issues are not important. However, we feel that while strategic planning, prioritization methods, organizational charts, stakeholder analysis, negotiation cycles and fear maps can be helpful tools to manage change in agricultural research organizations (Hobbs, 1999), the most pressing issues lie outside the research organization per se.

These issues include: (a) the way in which poverty is conceptualized which determines the manner in which research organizations define their role with respect the critical question of poverty alleviation; (b) the way in which agricultural research can differentiate its contributions according to the specific characteristics and needs of different strata of poor people and their livelihood strategies, and of the regions and agricultural systems in which it intervenes, and; (c) the way in which agricultural research becomes part of larger, complex and broad-based innovation systems.

If agricultural research continues to view its role in the traditional manner, it is very likely that its contribution will be limited to those cases in which innovation will take

place regardless of its own activities (due to the great forces created by dynamic markets and conducive policies and institutions). Yet, even this limited contribution would be substantial, as it has been for the past 40 or 50 years.

But if agricultural research wishes to move beyond this friendly terrain into the uncharted waters of marginalized regions, less developed countries, and complex and confusing livelihood strategies, then it must adopt a fresh outlook, in which the borders of agricultural research per se would have to become much more diffuse and interwoven with those of other actors and other institutions. We grant that this path is institutionally complex and messy, but we also believe that there is a choice to be made between “standardization or customization”, moving away from models with clear-cut manuals, as Tendler (1997) has concluded in the case of North Eastern Brazil.

This is not a simple choice, in particularly in countries in which agricultural research is doing a good job along more traditional lines. There is definitely not one single answer, and the process of change would in all cases be full of uncertainties and risks.

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Table 1. Population living below US\$ 1 per day

Regions	Number of poor (millions)		
	1987	1990	1993
East Asia and the Pacific	464.0	468.2	445.8
Eastern Europe and Central Asia	2.2	n.a.	14.5
Latin America and the Caribbean	91.2	101.0	109.6
Middle East and North Africa	10.3	10.4	10.7
South Asia	479.9	480.4	514.7
Sub-Saharan Africa	179.6	201.2	218.6
Total	1224.9	n.a.	1299.3

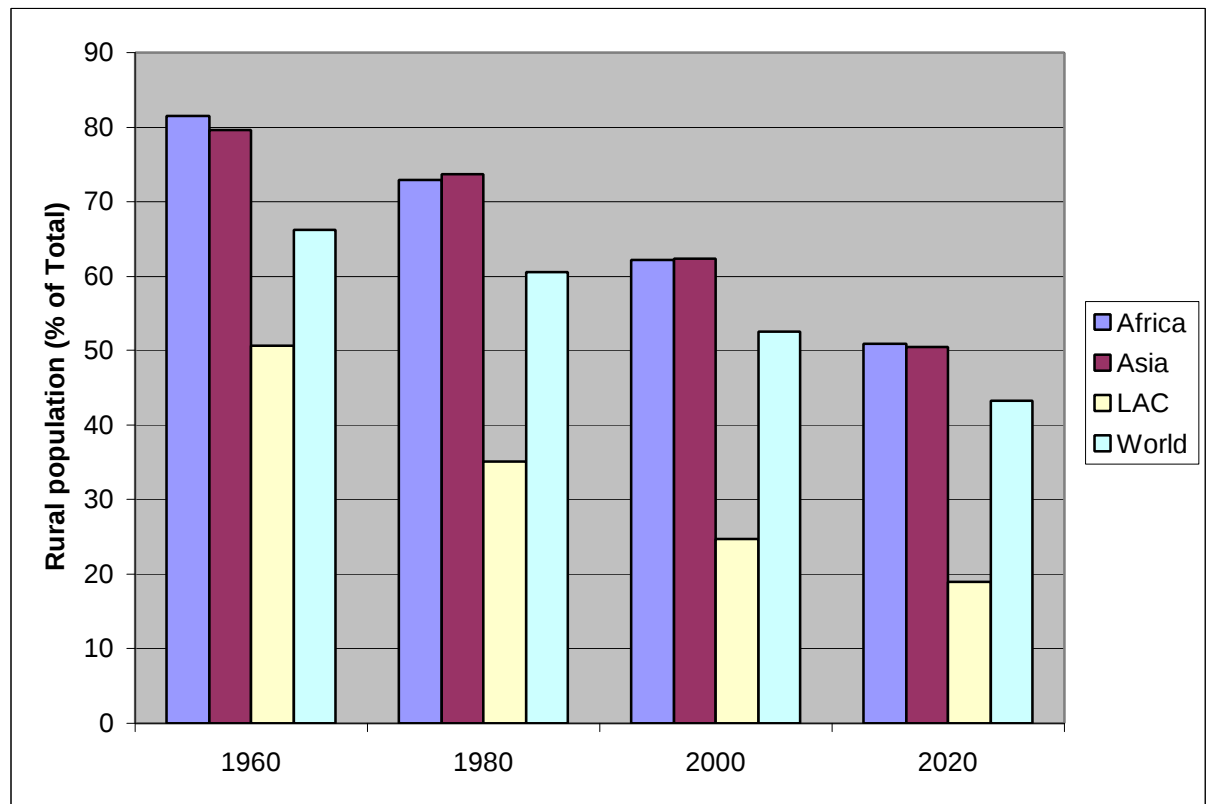
Source: World Bank, 1999

Table 2. Share of non-farm income and employment in total income and employment¹

Region	Non-farm income share (%)	Non-farm employment share (%)
Africa	42	n.a.
<i>East and Southern Africa</i>	45	<i>n.a.</i>
<i>West Africa</i>	36	<i>n.a.</i>
Asia	32	44
<i>East Asia</i>	35	44
<i>South Asia</i>	29	43
Latin America	40	25

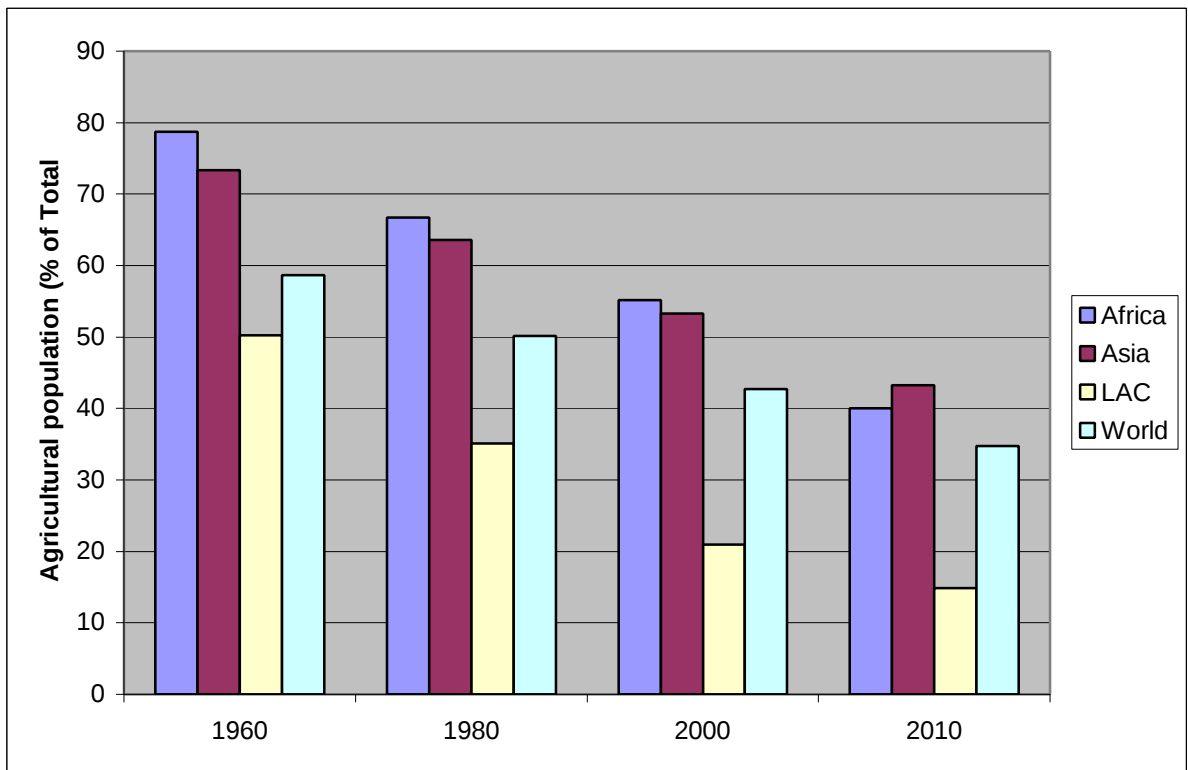
¹ Data are regional averages of country cases

Source: Reardon et al., 1998



Source: FAO, 1999

Figure 1. Trends in rural population



Source: FAO, 1999

Figure 2. Trends in agricultural population