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Evolution of Agricultural Research and Development since 1950:
Toward an Integrated Framework

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EVOLUTION OF AGRICULTURAL RESEARCH AND DEVELOPMENT SINCE 1950:

TOWARD AN INTEGRATED FRAMEWORK

Robert E. Rhoades

New viewpoints for improving the livelihood and nutrition of small farmers and consumers in Third World countries regularly crop up within agricultural research and development circles. Indeed, just when a development model is reaching national programmes, scientists and research managers in international centres are already pursuing emerging and largely untested new models[1]. Some of these are clearly seductive in their appeal for overcoming the shortcomings of earlier approaches, but whether or not the new direction is labelled a fad seems closely tied to one's personal and disciplinary involvement. This diversity of opinions gives the impression that much of agricultural Research and Development is cosmetic, faddish, and without direction.

The purpose of this article is to take a broader historical view of shifting emphases in agricultural research and development since the 1950s. I contend that each wave of enthusiasm for a new approach grows logically from its antecedents and is moulded by the broader sociopolitical environment encompassing the world's food problems and solutions. As experience deepens and the sociopolitical environment changes, both donors and scientists make new assumptions about proper approaches to agricultural research and development.

Those who pioneer and embrace each new direction are quick to play down the accomplishments of earlier approaches which, as time passes, seem to become intellectually obsolete. The recent shift away from Farming Systems Research (FSR) should be seen in this context. A mere ten years ago, proponents of FSR were criticising its predecessors in much the same way that FSR is being criticised today. Obviously, among the practitioners who are intellectually and emotionally involved, the debate over "old" versus "new" becomes subjective. The "old" always argues that the "new" is not so new ("we were doing it all along") while the "new" fiercely defends what it perceives to be "insurgent research" and the wave of the future. Objectivity is quickly lost in such push and pull debates and the long-term view is clouded. Perhaps we, as agricultural researchers and developers, spend too much time pointing out shortcomings of those approaches which are not of our own disciplinary or topical interest and not enough time reflecting on how the various "paradigms" for agricultural research and development fit together.

1. The term model is used loosely in this article, not in a strict scientific sense. Therefore, it is used interchangeably with movement, direction, approach, paradigm and focus. Examples are Green Revolution, Appropriate Technology, Farming Systems Research, Farmer Participatory Research, Sustainability, to mention a few.

The shifting focus of research and formation of new intellectual movements is a natural process common to all branches of science. In agricultural research, I argue that we are moving toward a more comprehensive view of the complex problems at hand, with each stage absorbing and synthesising valuable new insights. Beginning with the events of the 1950s and the Green Revolution of the late 1960s, I trace changes down to the newest emphasis on sustainability, and then project into the near future.

Developing country farmers are a central element throughout this process and the paper focuses on how they are perceived by the scientific and development community over time.

The four Stages of Agricultural Research

Four overlapping stages of awareness and perception of problems can be identified:

1. production stage (1950–1975);
2. economic stage (1975–1985);
3. ecological stage (1985–1995); and
4. institutional (1995–).

Each period is characterised by different goals and mix of disciplines, and each period leaves its mark and legacy on the period that emerges later. Table 1 overleaf outlines stages, notes examples of pioneering disciplines, expected outcomes, and how the farmer's role is perceived by researchers. The years indicating when the ecological stage will wane and institution building move to the forefront are strictly based on my own subjective peering into a cloudy crystal ball.

Each stage has been characterised as well by its own popular movement: the production stage by the famous Green Revolution, the economic stage by Farming Systems Research, today by Sustainability and tomorrow by institutional effectiveness. Likewise, at each stage new blood in terms of disciplines is added to the research and development process. The evolution of a broader interdisciplinary perspective has occurred with the result that the understanding of agriculture and food has become deeper. Historically, of course, farmers have always had to cope with these four forces while surviving on the land. Researchers, donors, and policy makers, however, are only now beginning to understand the complexity of micro-macro linkages in Third World agriculture.

Table 1 Evolution of agricultural research and development since the 1950s

Awareness Stage	Pioneering Disciples	Expected Outcomes	Farmer Roles as Perceived by Researchers
Production (1950–75)	Breeding and genetics (including pathology & physiology)	Adoption of high yielding varieties	Recipients of technology
Economic (1975–85)	Economics & Agronomy (Farming Systems Research)	Equity, gender issues and role of agricultural policy	Sources of information for technology design
Ecological (1985–95)	Anthropology, agroecology, agroforestry, integrated pest management and geography	Sustainability	Simultaneously victim and cause of ecological destruction; contributors of indigenous knowledge
Institutional (1995–)	Management organisational sociology, political science and education	Effective national programmes and networks closely linked to users of R&D	Full cooperators in research, emphasising households and farmer groups within national food systems

1. The Production Stage (1950–75)

A proper appreciation of the scientific outlook that accompanied the Green Revolution requires a step back in time to the forces which shaped the mind-set of agricultural scientists who worked during the famous post-war period. Since many young Turks leading the charge in the late 1970s to rectify the sins of the Green Revolution were too young to recall the world forces in operation in the 1950s and 1960s, it is instructive to reconstruct the challenges that the earlier generation faced. Equally important is to remember which disciplines practically confronted the problems of Third World agriculture at that time.

The late 1940s, 1950s and into the 1960s were turbulent periods during which much of Africa and Asia shed their colonial shackles. The number of new nations increased dramatically as did their populations. Widespread optimism for the future was accompanied by a belief in "stages of economic growth". What had begun to impress upon the world after it started to recover from the preoccupation of the World War and reconstruction of Europe, was the need for rapid economic growth and the need to alleviate widespread problems of starvation and famine in developing countries. Particularly, the spectre of mass starvation in India drew attention much as the African Sahel does today. Well into the 1970s, the world enjoyed cheap and abundant fossil fuels, the basis of agrochemical inputs, a luxury everyone thought would last forever.

The disciplines oriented toward addressing the issues of food during these decades were largely production-oriented sciences, mainly plant genetics with its well sharpened tools of breeding. Economists were present in agricultural organisations but mainly working at the national or international macro-level, not at the farm-level. The exceptions were farm management economists who had prior ties with the British colonial service in Africa.

Anthropologists and sociologists were not only absent, they were mainly disinterested in agriculture and applied research.

Despite all shortcomings and journalistic hype that surrounded the Green Revolution, progress in increasing food output was made by breeders in both international and national programmes. Many developing countries, especially in Asia, achieved not only food self-sufficiency within a few years but also became grain exporters. Farmers during this period, however, were seen largely as recipients of the new varieties and agrochemical technology. Awareness among scientists of the financial limitations of small, marginal farmers in rainfed areas for using high levels of inputs, notably chemical, was not widespread. It was only logical, therefore, that as the Green Revolution progressed and food production increased in irrigated regions, the next stage was reached, the **Economic Stage**.

2. The Economic Stage (1975–85)

The success of the production stage was the trigger which stimulated interest, particularly among economists, of uneven adoption rates and linkages between production and equity/distribution. Types of farmers quickly became an issue by the mid-1970s as the possibility emerged that agricultural research was playing into the hands of the rich, particularly well-to-do farmers. The new varieties and accompanying "packages" did not diffuse equally among farmers. The "poorest of the poor" became a development slogan while the target of research became not only growth but "growth with equity" (Horowitz, 1988). Breeders and plant specialists found themselves for the first time sitting at the same table, eyeball-to-eyeball, debating the issues with economists who were well versed in such issues. The equity arguments were persuasive: high yields on the experiment station, low yields on the farm; high adoption rates among resource-rich farmers, low adoption among small farmers; high benefits for the wealthier farmers, lower benefits for the poor farmer.

One of the more exciting ideas to arise from this period was "constraints research" and its aligned sister "cropping systems research", promoted by interdisciplinary teams of agronomists and economists. This, in turn, combined with the ideas being generated in Africa by agricultural economists, led ultimately to Farming Systems Research. One aim of FSR was to bring the production sciences in closer contact with their farmer clients through on-farm research and the generation of appropriate technologies.

Proponents of Farming Systems Research which focussed on small farmers promised to overcome the sins of the 1960s while simultaneously being "cost effective" and "time effective" (closing the time gap between generation of technology and acceptance by resource poor farmers). Farmers, therefore, became important sources of information for technology design and generation. The logic behind the FSR argument was so persuasive that it caught on among donors like a prairie fire after a long drought.

The farming systems movement, however, was not homogenous in conceptualisation and objectives. Commodity-based centres (e.g. crops and livestock) focussed on moving their technologies to small farmers while the newly-emerged, resource-based centres (tropical

agriculture, semi-arid tropics, arid tropics) focussed on designing totally new systems of production. A dialogue was thus established to debate the varying importance of "components" versus "systems". The component-based centres had a strong argument in favour of clarity of focus while the whole systems approach seemed more cumbersome, although enormously challenging. A thorny problem centred on how holistically designed systems on experiment stations would be adopted and used by farmers under real life conditions. By the late 1970s another discipline – anthropology – was given a chair around the international centre table, already surrounded by breeders, plant and animal scientists, some soil scientists, and economists. At first, the inexperienced anthropologists were asked to do after-the-fact evaluations of acceptability or social evaluations of technologies being tested by farming systems teams. In short, "why, beyond yields and profits, were farmers not adopting improved technologies?"

The established disciplines, namely plant science and economics, are not to blame that the upstart anthropologists were not especially interested in these important questions. Virtually all anthropologists in the centres were agricultural anthropologists or rural sociologists with a strong ecological orientation (not social anthropologists who were more inclined to seek academic jobs). Agricultural anthropologists were concerned not only with the last stage of technology adoption but in the entire human ecological context where technology had to fit (Rhoades, 1984). An additional factor was that while few plant scientists or economists were women, many anthropologists and rural sociologists were. Gender emerged as an issue in agriculture as these women scientists articulated views of the larger movement toward women's rights in the political sphere. The notion that farmers were also women came as a difficult thought for many agricultural scientists. Simultaneously, a new respect for farmers was underscored through anthropological research on indigenous technical knowledge systems. The introduction of the anthropological and ecological perspective, in addition to important worldwide forces to be discussed in the next section, led to the stage now underway: the **Ecological Stage**.

3. The Ecological Stage (1985–95)

The events of the 1980s have driven home, almost shockingly, the finely tuned nature of human existence on earth. The blows have come in constant waves: nuclear winter, greenhouse effect, destruction of the tropical and temperate forests, desertification, genetic erosion, and decay of the ozone layer. The realisation that all nations - rich and poor - are all in the same small, fragile boat, with shared destinies, has altered how policy makers in particular view agricultural research. Agricultural researchers now feel pressure from both politicians and donors, especially from the industrialised countries. The new name of the game is Sustainability. This new concept carries the over-reaching question: how will planet earth support over the long-term not only its growing human population but the natural resource base and the biological diversity required for survival of all nations?

The ecological stage will no doubt bring new disciplines – namely ecology and geography – to seek seats around the already crowded interdisciplinary table. Economists, anthropologists, and soil scientists will at first try to articulate the sustainability thesis on

their own, but in the end they will have to face the fact that much expertise is to be found in other disciplines. As sustainability is added to research agendas, the need for interdisciplinary problem solving will increase once again.

Although sustainability is narrowly seen by many scientists as a matter of soil erosion and ecosystem maintenance, common sense tells us that the challenge involves much more than the mere biological side of life. There is no use in arguing a case for sustainability if it is to be achieved "independently of or in opposition to the interests of the rural poor" (Horowitz, 1988). Try to argue with impoverished highland Andean migrants as they move to the Amazon basin, clearing the tropical forest as they go, that they should respect sustainability. Their goals are immediate and different: feed their families whatever the cost to the tropical forests or the mountain slopes.

Herein lies the crunch: how do we develop environmentally sound agricultural programmes which will guarantee at the same time an acceptable livelihood for small farmers? (Horowitz, 1988). To achieve sustainability, the rural poor need the production technology and economic resources required to reverse the rapid deterioration of environmental conditions. Thus, the ecological stage embodies much of the substance of the earlier stages, production and economics. But it also points to the need for viable and workable social and political institutions on a global scale. This brings us to the final and perhaps more difficult stage for the longer-term building of food self-sufficiency, nutritional security, and sustainable food systems, the **Institutional Stage**.

4. The Institutional Stage (1995–)

Concerns with institutional issues are not new and perhaps some observers would argue they are receiving much more attention today than the problem of sustainability. Emphasis on community development and agrarian reform in the 1960s testifies to earlier concern with institutions. The establishment of the International Service for National Agricultural Research (ISNAR) and renewed emphasis on Human Resource Development (HRD) in nearly all centres reflect strong contemporary interest in institutional matters. Despite these efforts, the most difficult long-term task for agricultural development agencies will be building workable human institutions for sustainable and equitable agrarian systems. An anthropological cultural law posits that human social organisations (forms of families, kinship, villages, and agricultural research agencies) tend to change much more slowly than the technical parts of life. Breeding a new wheat variety is one thing, building a viable national programme is of a different order. Designing an experimental sustainable agro-forestry system is relatively simple compared to organising extension services so that farmers can actually understand and use the new system. Furthermore, institutions are made up of people and their social relations, not simply plants or prices, thus making objectivity of analysis and implementation of changes far more difficult to achieve.

In a recent paper, Douglas Horton (1988) has raised a set of interesting questions about institutions and agricultural R&D. First, he notes what is often forgotten: priority clients of international centres are institutions (called national programmes by those international

centres), not farmers who are ultimate beneficiaries. Second, most commissioned reviews of international agricultural centres and national programmes focus not on production technologies but on problems of management and organisation. The point is then driven home that none of the disciplines around our elbow-to-elbow interdisciplinary table have the required expertise to deal with the nature of management and human organisational problems. Horton concludes with the argument that still yet "new interdisciplinary blood" could be of benefit: organisational sociologists and management scientists.

Precisely how these disciplines will play a role in understanding or building effective national programmes with which international centres or donor agencies is unclear at this point. This should not be a cause for alarm, given that early in every new stage no one was able to appreciate the vast bodies of methods and theories available in disciplines still marginal to the agricultural research and development establishment. It has taken foresight on the part of a donor, perhaps reflecting their constituents' desires, to provide the incentive to pursue new areas. To my knowledge no international centre has refused for long the offer to inject relevant "new blood" in the international agricultural research system. Building the same interdisciplinary perspective into national programmes may be more problematic although a few encouraging efforts are now underway. The International Potato Center (CIP), for example, has established a network in Asia which promotes the "user's perspective" in potato and sweet potato programmes. This project aims to support young Asian scientists from the social sciences, nutrition, food technology and other neglected disciplines to conduct research with technical scientists and develop methods which address important issues for households in food systems instead of "the farmer" in isolation from the broader socioeconomic context.

Most likely, at this early phase of the **institutional** stage basic research on the nature of national programmes and their link with farmers will be required. A scientific typology of different kinds of national programmes will be necessary as will an understanding of how different kinds of agricultural R&D agencies reach farm households and communities. Both private industry, in the form of seed and agro-chemical companies, and many nongovernmental organisations (NGOs), could be studied in terms of their comparative effectiveness vis-à-vis national programmes. Research on differences in perceptions of farmers toward the various kinds of organisations and improving information flows would be valuable. Farmers themselves will be seen, in turn, not as simply recipients of technology or sources of information for scientists, but as an intelligent driving force that will collaborate with scientists and policy makers to develop practical research agendas.

Conclusions

In this paper, I have outlined four awareness stages of agricultural research and development since 1950: (1) production, (2) economic, (3) ecological, and (4) institutional. These are not stages where problems are resolved and then forgotten in the next stage. In fact, the stages should be seen as dimensions – not time frames – of the world food problem. A growing human population requires more food, distribution and equity problems remain, the environment increasingly faces stress, and our institutions lag behind technological development. The four dimensions are also the four pillars upon which effective agricultural research and development must be built.

The risk, of course, in addressing too many issues is that scientists in the International Agricultural Research Centres and national programmes become too diffused to be effective. However, if we keep in mind the four threads in setting research agendas, formulating policy, and determining funding priorities, a balanced approach to agricultural R&D can be achieved. In rough sketches, this evolution reflects the sequential development of the sciences, beginning with biology and ending with sociology. These four stages or dimensions of agricultural research are elements of a single whole, not mutually exclusive parts, and the fact that the whole is more than the sum of the parts is a major reason for interdisciplinary research. Production and the role of plant and animal scientists are no less important today than they were in 1965. Economics is just as important as it was in 1975, if not more so. The same can be said of other disciplines added along the way. Our tendency to write off the efforts and impacts of disciplines other than our favoured ones serves no purpose except to aggrandise the importance of one's own area of interest. It is easy to be critical of plant breeding or conventional agricultural economics, but in fact today's young agricultural scientists stand on their shoulders, looking toward the future. Research and project managers must be careful that institutions and individuals do not become frozen in any stage, e.g. production or economics, refusing to become open to the enriching process of interdisciplinarity. The interdisciplinary table has become crowded, almost to the point of being unmanageable, but at the same time our understanding of agricultural R&D is moving beyond expecting simple solutions for inherently complex problems.

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The Sustainable Agriculture and Rural Livelihoods Programme

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