

MAKING AGRICULTURAL RESEARCH A PRIORITY FOR PUBLIC INVESTMENT

Eliseu Roberto de Andrade Alves¹

INTRODUCTION

From society's point of view, the question is whether investment in Agricultural research should be considered as a priority for the public sector. In other words, should a major objective be to increase total funds allocated to agricultural research? This issue has been given inadequate treatment in the literature as opposed to establishing priorities for allocating available funds which has received considerable coverage in economic literature.

FORMULATION OF A DEMAND FOR AGRICULTURAL RESEARCH

1. Perception of the need for new knowledge

The increase in agricultural research activities results from a conscious perception of a need for new knowledge, expressed as an effective demand for new technology made by the private and public sectors. As a result, research institutions are created by both sectors, eventually resulting in the supply of agricultural research services.

Two relevant questions can be raised:

- a. How does demand for agricultural research emerge and how does it grow?

¹ President, Brazilian Agricultural Research Corporation (EMBRAPA).

b. How can government properly interpret this demand?

The demand for agricultural research is different from, say, food demand. In fact, there is no organized market for agricultural research activities where a price and relevant quantity can be established.

Still, the demand for agricultural research is derived from the product and production factor markets.

Let us trace this process: initially, a given country is in an equilibrium condition between its population and its natural resources. The population is stable, or grows in proportion to the increased cultivated areas. Technology is based on land and labour. Technical change, if any, is not significant.

In other words, as food demand grows, supply responds through expansion of the so-called agricultural frontier. As long as this is possible without increase in production cost there is no demand for agricultural research and resulting new technology. There may even be pressure from a selected group, with outside motivation provided by the developed countries; however there is very little chance for development of agricultural research institutions. The existing trade-off between expansion, through bringing into production new lands, and increasing productivity of cultivated areas, favors the first.

As the country grows, it changes. Industrialization takes place and some social services such as health care, improve. Demographic growth increases, wealth grows, poverty decreases and exports need to be stepped up. Increased urbanization, as a result of rural exodus, creates a fast-growing food demand that the traditional food supply can not satisfy.

2. The General Chain of Events

The following chain of events eventually creates demand for agricultural research services:

- a. **Increasing Food Prices in Urban Areas** – The increased cost of production due to rising prices of agricultural inputs results in producers demanding higher commodity prices.

As food prices grow in urban areas, the low-income groups, many from a new urban population that came from rural areas, are the ones that suffer most. This leads the consumer to react, sometimes violently, to

food price increases. Social disturbances become a real danger. The stability of government and other established institutions is endangered. These social conditions create an urgent need for agricultural development.

- b. **Increasing Cost of Land and Labor** – The expanding food demand puts pressure on the costs of traditional production factors such as land and labor. The agricultural sector attempts to obtain higher prices or subsidies. There is potential for a conflict of interest between agricultural producers and urban consumers. This potential conflict exists between cities and rural areas. It also involves the new agroindustry and traditional agriculture.
- c. **Decrease of Agricultural Surpluses Reserved for Exports** – Due to a decrease in the number of agricultural producers and an increase in urban consumers, local consumption is increased. Thus, exports of agricultural surpluses are diminished, resulting in a balance of payments problem.
- d. **Urgent Need to Increase Productivity** – The country now is in a situation in which there is an absolute necessity to increase the productivity of land and labour. This involves the use of modern agricultural inputs that replace the need for traditional land and labour. It also includes the integration of bio-chemical technology, replacing mainly land, with mechanized technology, substituting labor.

Even though consumers, producers, and even exporters do not consciously speak about agricultural research, the demand for an accelerated development of the agricultural research system has been created, although not readily recognized by the government.

3. Brazilian Experience as an Illustration

In the Brazilian case, the search for a solution to the crises provoked by an increase in agricultural prices, went through the following stages:

- a. **Expansion of the Agricultural Frontier Through Railroad and Highway Building** – An attempt was made to expand the occupation rate of new agricultural frontier lands, first through building railroads, and later through large highway construction schemes.
- b. **Building a Storage Infrastructure** – Since construction of a transportation

infrastructure was not enough, an additional program of building a storage infrastructure was undertaken. This was justified, since it was presumed that 15% of the commodities produced were lost during marketing and transportation. Decreasing this loss could supply a part of the growing food demand.

- c. **An Attempt to Increase Productivity Through Extension** – The food shortages continued. There was a clear indication that land productivity had to be increased. It was assumed that there was a sufficient amount of knowledge, partly accumulated by progressive farmers and partly stored in the archives of the agricultural research workers. Based on this assumption, a massive technical assistance and extension program, including large investments in subsidized credit for modern inputs and guaranteed minimum prices, was undertaken. At the same time, research funding was decreased, since it was assumed that it was possible to have self-sustained agricultural productivity growth without major investment in agricultural research.
- d. **Recognition of the Importance of Agricultural Research** – Finally, starting in the Seventies, it was realized that only through a systematic effort at organizing and expanding agricultural research, could a self-sustained agricultural productivity growth be achieved. In other words, several failures to increase food and other agricultural production, based on extension and supervised credit, had to be experienced before the real needs for agricultural research activities became fully realized.

4. Obstacles Delaying Organization of a Viable Agricultural Research System

As was shown in the case of Brazil, establishing viable agricultural research programs in developing countries usually faces serious obstacles. These obstacles delay the recognition, by appropriate authorities, of the signals that indicate growing demand for agricultural research. Some examples of these obstacles follow:

- a. **Priority for Investment With Short-term Benefits** – As a result of the low-level of savings and shortage of capital, investment priorities have been oriented toward short-term projects giving immediate returns. In other words, investing and obtaining the return should be done in the shortest possible period. These opportunities appear in the case of the consumption goods industry and in the expansion of the agricultural frontier. This policy cannot include the investment needed to create advanced agricultural technology; the full cycle is rather long if we consider training

research workers, the development of new technology, and its adoption. It must be mentioned that a research institution is just like a hydro-electric plant that initially takes some time and investment to build, but once constructed, provides a continuous supply of electric power. In the case of an agricultural research system, after the initial training and institution building period a continuous flow of some research results can be expected. But some long-term research projects of great importance may take long periods of time to obtain results.

- b. **Priority of Forced Industrialization** – Another parallel situation occurs in countries that have given high priority to forced industrialization, and as a result, have invested all their savings in urban-sector industries and services. Agriculture has been left to grow through incorporation of new land and additional labor. That is, an extensive rather than an intensive form of agricultural production growth has been chosen. Agricultural research is conceived of as a form of creating demand for modern inputs, requiring additional capital for the agricultural production process, and allocation of a part of savings to agriculture in rural areas instead of to the urban-industrial complexes. This is not considered a priority within the above-mentioned policy of accelerated urban-industrial development.
- c. **Shortage of Trained Personnel** – Agricultural research needs human capital in the form of highly trained research workers, laboratory personnel, and others. These types of professionals are in short supply. This is due to the fact that graduate training has not been institutionalized or is just incipient.
- d. **Low Salaries of Research Personnel** – Proper institutional development of research systems requires paying salaries well above the existing scales for most public service personnel. In addition, the cost of hiring foreign technicians must have to be included. The political structure may not tolerate a high salary differential within public service. Once the differential is institutionalized, political pressures may develop, forcing, in part, allegiance rather than professional merit as the criteria for filling any high-paying position.
- e. **Temporary Nature of Salary Increase Due to Inflation** – In addition, inflation may wipe out any established salary differential due to the common practice of adjusting salaries at a rate below the actual level of inflation. Thus, the critical mass of research scientists could easily be lost

to the urban industrial complexes of developing countries, or may even be absorbed by the developed countries, before they are able to make any significant contribution to their own country and its agriculture.

- f. Shortage of Complementary Financial Resources** — Even when the government is mature enough to accept increased salaries for its research personnel, it may not be able to allocate additional resources for complementary expenses such as: foreign specialists, outside training, and the purchase of modern research equipment. In this case, international financing institutions become very important. It is worth mentioning that various bilateral and multilateral assistance agencies have, during the last ten years, learned how to and have accepted the need to finance research. Still, there is a long way to go before the needed flexibility can be worked into foreign grants and loans given to agricultural research.

MOTIVATING INVESTMENT IN AGRICULTURAL RESEARCH

1. Showing the Need to Increase Productivity

The question is: how can the public authorities be convinced to invest in agricultural research, when it becomes clear the vertical, or productivity frontier, represents a better alternative for increased production, as compared to the traditional horizontal frontier, or the occupation of new agricultural areas? The last alternative may be based on opening new production areas in faraway, and sometimes nonfertile lands with no infrastructure. It can happen, as in case of the Amazon basin in Brazil, that rational exploitation of new frontiers, located in a different ecological system, depends on new research results. Quite often a country may have run out of new, unexploited land, and has no alternative except to increase the productivity of already cultivated land.

The major task is to make society and decision-makers realize that: increasing the productivity of agriculture is a necessary condition to adjusting the interests of consumers and producers; that it is the best way to stop rising food prices without diminishing the food supply and related items, and also the best means to increase their competitive position in foreign markets. Finally, it is essential for the success of the overall development policy.

2. Organizing a Public Information and Education Campaign

It requires time to change traditional attitudes of indifference or even

opposition to research to one of full-hearted support, particularly when little has been invested in education. The only solution is to start an action program aimed at educating the people and their leaders to the potential value of agricultural research and to the great need for building a strong research system.

Mobilizing the overall support of society, including support by special interest groups, is the best way to assure the continuous allocation of resources to a given activity such as agricultural research.

Sponsoring debates at the universities, and at other educational institutions, leading to continuous coverage by the popular press as well as special seminars and other cultural activities, dealing with particular subjects, may have to be undertaken into consideration the special situation of each country and/or a particular region. Some examples of the topics are given below:

- The role of research in improving nutrition and stabilizing food prices.
- The role of research in improving the quality of food and reducing environmental pollution.
- Research as an instrument of self-reliance. This, it could be argued, is to decreasing dependence on food and non renewable energy imports.
- Research as a means of increasing export earnings. The agricultural surpluses, resulting from increasing productivity, could pay for imports needed for development programs.
- The income distribution effect of research. Here, one can show that increased food prices affect adversely the low-income population and a decreased food budget results in liberating a significant percentage of additional income for the same group.
- Research as a factor of social stability. Since food shortages, contribute to inflation and may result in public disturbances, this may affect the stability of government and other institutions.
- Research as a means of stabilizing and increasing rural income. Better yields and control of the environment will decrease the risk, stabilize production and will increase the individual income of the rural population.
- Relate research programs and results to major problems affecting the country. Just listing the actual and potential program and results, without showing the connection between these and the great problems faced by the country, may have little impact. Thus, the program and expected results must be presented within the context of the social and economic problems faced by the country.

Too often this task falls upon traditional research workers and research

administrators who are used to dealing with scientists and technicians within research establishments, and not with people outside the research institutions. As a result, poor communication between the researcher and the general public may constitute a major bottleneck. Thus, these efforts have to be undertaken by professionals acquainted with the social sciences such as economics, communications, public relations, and politics.

3. Making Efforts to Identify and Reach Special Target Groups

The effort to influence the general public is a slow process. The work on special-interest or target groups may have a faster pay-off.

These groups include those that at present hold political and economic power and influence the process of allocating public and private resources. Since the research must be based on long-term financial stability, building a support base can not be limited to members of the existing power structure. Due attention should be given to those who may eventually replace the current power structure.

a. Identifying Special Target Groups – Among special target groups, one can mention:

- Elected and appointed executives including the Congress
- Members of the established press
- Economists and other social scientists
- Members of the military establishments
- Church organizations
- Producers' organizations and labor unions

b. Methods to Influence Special Target Groups – Some techniques capable of influencing these groups can be listed:

- Preparation of special, short, and easily readable material showing potential and actual benefits of research
- Organization of special events with wide participation such as: opening and inauguration ceremonies of new research units, release of new cultivars, and other public activities.
- Lectures by researchers and research administrators during various public events.
- Organized visits and guided tours of research units with special emphasis on showing research results.

- Providing special advisory services to selected farms or whole regions.
- Undertaking joint research projects with the private sector.
- Special child or student programs, including specially selected schools from various neighborhoods. In some cases, parents can be easily influenced through the creation of a good image among their sons and daughters.
- Organizing media programs on television, on radio, through popular newspapers, through magazine articles, etc.
- Special efforts to establish good relations with the resource allocation and decision-making community such as: state and federal officials, legislatures, and others.
- Participation in academic activities, when possible, with university systems, particularly through graduate training programs.

4. Coordinating Efforts Among Various Research Institutions

It is worth mentioning that agricultural research is often spread among a large number of public institutions without any coordinating structure. In this case, it is advisable to establish an ad hoc committee to coordinate the above-mentioned activities. This is due to the fact that individual efforts to get recognition by each institution separately, may hurt the whole system or result in duplication of efforts and waste of precious resources such as the researcher's time and of money needed for experimental work.

5. Using Special Skill Groups to Increase Investment in Agricultural Research

The agricultural research system, in addition to both young and established research professionals, must include two special skill groups. First, it must include professional journalists with established reputations and access to the communications media; they will help to create a good, direct contact with the media, and show the research community how best to deal with the general public. The other group must consist of economists trained and experienced in macro-economics who will concentrate their research on aggregate, sectoral, or regional planning, and relevant resource allocation activities of various governmental and private organizations affecting research.

6. Training Research Workers in Communicating with General Public

Finally, it is worth emphasizing again that it is of paramount importance to have research workers trained and experienced in relating not only to professionals, but also to the general public. They should be able to give talks and make public

appearances, whenever possible, presenting their individual results without exaggeration, excess humility, or shyness. They should know how to appear on television, radio, give interviews, and prepare news releases for the popular press. There must be a continuous effort to promote and recognize good research workers and to obtain society's respect and even admiration for these professionals when possible.

SELECTING RESEARCH PRIORITIES IN A WAY TO MAINTAIN AND INCREASE OVERALL RESEARCH FUNDS

Once a sufficient amount of resources has been mobilized, all efforts must be made to allocate these resources in the most optimal form. This section deals with the problems of establishing priorities in allocating resources within a research institution in a way to maintain and increase overall research funds. In the case of mature and established research institutions with a tradition and a mission, this process is rather self-perpetuating and has a self-correcting feedback system. The problems come in the case of new organizations that are in the process of institution-building and searching for the best alternative among various possibilities, including identifying the target groups. Here, the situation will vary from country to country, and from one region to another.

1. Criteria for Selection of Research Projects

For those countries with a large urban-industrial complex, the major preoccupation is with food supply for the urban population. For others trying to keep their population in rural areas, the emphasis is on improving per capita income, nutrition, and the food supply at the farm level. In other words, one has to carefully identify the location of major social problems and current trends in terms of population movements and rates of migration. The following are the resulting implications for allocations of resources for research:

- a. **Time Needed to Generate Results** – The research projects portfolio. It is necessary to keep in mind that the research projects must be selected in such a way as to help the institution to get established and to grow. For this reason, the great majority of projects selected have to be able to present results in a short period of time, with potential impact on relatively large areas. The crops that are easier to work with are those that have been under research for a long period of time in the advanced and developing countries. In these cases it is possible, by adaptive research, to obtain results in the short-run. But it may happen that these crops are cultivated on large land holdings and are export crops. Conflicts on

interests between the small farmers and consumers are likely to appear. In addition, these crops may not be included in the priorities of the donor community that supports the interests of the small farmers. If the interest of consumers and small farmers in research is really strong, the tendency for the research project mix is to concentrate on the crops for the internal market mostly cultivated by the small farmers. In most cases these crops have not been researched, and consequently it is possible that the results will not come in the short-run which may lead to the discrediting of the research institution. In the selection of research priorities, it is therefore important to balance the interests of the pressure groups like small farmers and consumers and the need to obtain results in the shortest period of time possible.

- b. Balance Between Rural and Urban Welfare** – Welfare of urban and rural population. When one makes the welfare of the rural population the major criterion for selecting priorities in agricultural research, the emphasis on small farmer technology becomes evident, given the larger number of small producers. However, the small scale production of these farmers results in small surpluses, if any, to be offered to the urban sector. If the larger part of the total population is located in the urban sector, including the majority of low-income groups, the supply of technology to the low-income farmers to improve their economic condition may further deteriorate the food supply and increase poverty in urban areas. At the same time a country may be experiencing rural migration to such an extent that, by the time technology for the small farmer has been developed, he may already emigrated to the city, and there will be no more small farmers in a particular area to use the technology developed for them. Or, these small farmers may have formed a cooperative to use modern large-scale technology, and some have may grown into larger farmers who will not be interested in small-scale technology. In this case the resources allocated to create technology specially and solely adopted to the small farmer may not be of any use and will constitute a lost cause. As a result, one has to consider the existing trends and project the movement of population and the time needed to generate special kinds of technology so as obtain the proper technology mix at some future time that will best serve all social groups involved. That is, research must follow the historic trend of social progress and related technological development and not go against it. The conflict of interest, if any, between large and small farmers can only be analyzed in terms of the level of urbanization of the country and the real objectives of economic development policy. In addition, research institutions can not neglect economically strong interest

groups within commercial agriculture who could have influence in terms of overall allocation of public and prival resources to agricultural research.

- c. **The Extent of Losses in the Marketing System** – With the increase in urbanization, a new area of research, marketing losses between producer and consumer, becomes a priority. These losses can grow to the extent that may cancel most of the increase in productivity and decreased cost at the farm level as far as prices paid by consumers are concerned:
- d. **Expansion of new arable land, as opposed to increased productivity of already cultivated land** – Some countries still have large potentially arable areas and have very little available knowledge about their agricultural potential and limitations.

The research benefits derived from the application of new technology to cultivate these areas are not obtainable in a short period of time. This is due to the fact that agricultural activities first have to be implemented and only then can one see the actual fruits of research. There are always strong political pressures to develop these areas. In spite of their need to generate quick results, agricultural research institutions sometimes have to get involved in long-term undertakings with no immediate results to show to the public. There is a temptation to start research in new areas by first producing a detailed inventory of existing natural resources, including photogrammetric mapping, soil surveys and establishing a climatic data bank. This type of research work does not provide concrete results in terms of increased agricultural production as far as the general public is able to perceive. Even though this work is essential, an immediate action program should be undertaken aimed at the problems of the already established agricultural producers in the area. This may include introduction of new crops and livestock production systems.

- e. **Production for local consumptions, as opposed to energy and export crops.** The problem appears in the newly industrializing countries with a high percentage of urban population and an urban-rural conflict of interest. In general, most of the crops consumed locally are produced by small farmers. At the same time, export, and more recently energy crops, in some countries like Brazil, are dominated by large commercial farmers usually well represented in the existing power structure. It is difficult for a research system to be established and have continuous financial support without showing concrete results related to these crops. At the same time, society undergoes a transition that affects food habits, and moves toward

increased consumption of meats, fruits, and vegetables. This includes mostly higher income groups. The low-income population still follows the traditional subsistence diet based on starch and vegetable protein. Since these commodities have a low income and price elasticity of demand, the commercial producers try to avoid these crops. As a result, these products either show high increases in prices, heavily affecting the urban poor, or drastic lowering of prices at the farm level, affecting producers, without substantial price decreases for urban consumers, with most of the benefits absorbed by the intermediate sector. The political implications of these rises and falls in price are dramatic for the research establishment. Sometimes research is made the scapegoat and is blamed for neglecting basic food crops. There is no way but to insure adequate coverage of these crops, in terms of research projects producing fast results. Still, changing preferences and habits have to be included in medium to long-term programs to avoid future criticisms.

- f. **Energy Efficiency** — As far as the energy consumption of various agricultural technologies is concerned, when energy and not land is the limiting factor, the proper technology assessment should be based on the production obtained from the use of a unit of energy, and not the traditional concept of the consumption of energy per hectare. At the same time, measuring the efficiency of energy should not be limited to on-the-farm consumption, but should be expanded to include the total energy used until it reaches the consumers.

Sometimes the strong urban-industrial and marketing interests pressure agricultural producers to decrease the use of energy, or pressure the government to make energy more expensive for the farmers. This pressure may result in a decreased consumption on farms, but an increase in transportation, storage distribution channels, and that is where these groups have vested interests. For example, a large-scale production of food, using few modern energy intensive inputs in areas far away from major urban consumption centers, resulting in a high transportation cost, may be less energy efficient when compared to increasing productivity through energy-intensive inputs in areas close to the urban consumption centers, and thus having a low transportation cost.

2. The Case of Intermediate Technology

A strong pressure is exerted on research to generate simple technologies with relatively low energy inputs, easily adaptable to existing production systems and

capable of assimilation by large masses of producers. As long as the spread of this kind of technology does not substitute a more productive alternative technology and limit potential productivity of land and labor, it should be encouraged. However, if this types of technology has an opportunity cost in terms of sacrificing potential increases in productivity and total production, resulting in welfare loss to consumers and decreasing export earning potential, it has to be re-evaluated. In other words, in newly industrializing countries, with a high percentage of urban population, overemphasis on intermediate technology that does not make full use of available scientific knowledge and does not result in high productivity of agriculture may lead to limiting overall growth and development. In this case, on a national level, a larger number of people will lose from not using the full capacity of science-based agriculture, as compared to the number of those who will benefit from the practice of less-than-optimum agricultural production technology.

3. The Case of Social Science Research

There is a strong tendency and tradition, among agricultural research institutions of developing countries not to invest in economics and rural sociology research. At the same time, this type of research generates most of the information needed for establishing research priorities, based on actual and potential problems of the target population. For example, economic evaluation of potential adoption rate, and its extent, provides a feedback for scheduling various research programs and project. Relating technical recommendations to market conditions will indicate the most economically sound new technologies for immediate diffusion and adoption. In addition, as mentioned, the presence of a well-trained group of social scientists acts as a liaison or go-between for the political and economic power structure that controls public and private resources.

4. Exclusion Principle and the Use of Organizational Technology

The rationale for any resource allocation system is based on the Exclusion Principle. This means that we assume that most of the technology developed for large farmers automatically excludes small ones; that the technology developed for commercial farmers excludes subsistence groups. Or, if the interest of the consumer is taken into consideration, this will exclude any benefit, or even may hurt producers.

This may be due to the fact that we are not properly using organizational technology and a new management systems approach that can solve many of the above mentioned potential conflicts. These so called small producers can be as

sophisticated as the larger ones, when given proper technical assistance, and/or organized into cooperatives to solve economy-of-scale problems inherent in many modern technologies. An alternative to buying large-scale machinery is having machinery-renting firms, or cooperatives, that will provide mechanization, at cost, for any farmer, and will provide artificial insemination and other services not usually available to small farmers in developing countries. Examples of this can be seen in Puerto Rico, Japan, and some European countries. In other words, the Exclusion Principle, that constitutes the essence of most potential allocation conflicts, loses its importance when potential application of modern management or organizational technology, including electronic data processing and new computer technology, is fully exploited.

FINAL REMARKS

This paper has concentrated on practical problems encountered by a young and growing agricultural research institution, in terms of having society allocate a substantial flow of resources to agricultural research. As far as allocating these resources among alternative programs and projects is concerned, only some major issues have mentioned that will facilitate an increase of overall allocation of resources to agricultural research and will stimulate discussion and indicate the need for establishing priorities. These priorities have to be established for each developing country based on its stage of development and projected growth.