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Planning Agricultural Research Concepts and Practice

Helio Tollini

Brazil

'...I have always believed firmly that the prime responsibility of the agricultural scientist is to serve the industry of which he is a part.'

C. P. McMeekan

THE need to avoid a high level of generalization and the author's limited experience suggest that this paper should discuss the topic assigned in relation to Brazilian conditions. Obviously, the discussion here of agricultural research within this context is valuable to us in Brazil. We hope, however, that this exercise also will be useful to other countries, since Brazil has just finished an appraisal of the problems of agricultural research and has begun the implementation of the proposed solution. We also hope that this solution may serve as support to other countries now facing similar problems.

It should be pointed out from the start that this paper does not necessarily represent the official views of the Brazilian institutions dealing with agricultural research. These are personal views and by and large should not be considered as definite opinions, but rather, as hypotheses to be discussed.

The review of literature for this paper was started with the published Proceedings of IAAE, as our intention was to learn what has been said and discussed about the subject in previous meetings. Among many interesting ideas, the one expressed by C. P. McMeekan¹ seemed to summarize in the proper way the core of this paper. It may sound obvious to say that the prime responsibility of the agricultural scientist is to serve agriculture. This must have been always the conscious and explicit objective of all agricultural research. However, even in those countries normally considered as examples of efficiency in the field, experience seems to indicate that the work of agricultural scientists, with some outstanding exceptions, is not serving adequately the agricultural sector. The conscious effort to serve agriculture and the lack of adequate results direct attention to the planning process in relation to agricultural research

in order to ensure that the results meet more adequately the needs of economic development.

Specifically, in the Brazilian case, the concern with planning of agricultural research starting from the diagnosis of the present situation, includes the need for an institutional, administrative and financial reorganization and anticipates the political co-ordination of agricultural research with the overall effort towards the advance of science and technology.

The initiative of reorganizing agricultural research in Brazil arises from the importance attached to the modernization of agriculture in the overall process of development. This observation is clearly stated in official documents, such as 'Metas e Bases para a Ação do Governo'² and the 'I Plano Nacional de Desenvolvimento (PND)—1972-74'.³

Agricultural policy measures in Brazil may be classified in four groups. In the first place there are incentives to investment and production, through fiscal and financial measures. These incentives are represented by tariff and tax exemptions, credit expansion and reduced interest rates, improved agricultural insurance, minimum price support, expansion of financing to marketing activities and support to the co-operative movement. Naturally, Brazil is not innovating in these areas, but rather is trying to use the available instruments to assure a good performance in the agriculture sector.

Secondly, agricultural policy envisages an improved production and marketing infrastructure through investments in rural roads, irrigation projects, rural electrification, supply centres and the development of a chain of warehouses at different points of the marketing process. Such efforts are implemented continuously and are highly complementary with other courses of action in the agricultural sector.

Thirdly, agricultural policy seeks the expansion of employment and both internal and foreign markets through projects for the enlargement of the agricultural frontier, colonization and agrarian reform, integration of the national economy, facilitating movement of farm products to seaports (corredores de exportação), etc. These efforts should bring about the necessary conditions for the guidance of the last group of measures in the area of agricultural policy.

Finally, Brazilian agricultural policy seeks to support agriculture in the areas of science and technology which are necessary to create conditions for a continued growth and make the established goals of the overall economy feasible.

It is generally recognized that new technologies which represent a 'sine-qua-non' condition for continued growth of the agricultural sector, can only be obtained, either from the adaptation of transferred technology or from the creation of a native technology, if the country has an adequate system of agricultural research facilities. This system will be adequate when it has human and financial resources in both the quantity and quality which are required for the identification and satisfaction of the needs generated from the new process of production and distribution of

agricultural products. In turn, these new processes should provide the impulse to achieve the basic anticipated development established for the overall economy.

It is a difficult task to define and carry out a programme of agricultural research which *a priori* could give assurance that its results will be useful and beneficial to society in general and to farmers in particular. This constraint is directly related to the difficulties of defining the objectives of agricultural research which, of course, is dependent upon what is understood by development of the agricultural sector as well as the whole economy. The simple measurement of the performance of the sector, and, therefore, the appraisal of the efforts towards agricultural development, using rates of growth in agriculture, restricts the set of policies which can be adopted. As a result, the objectives and the programme of agricultural research are also restricted. Levine⁴ discusses the problem of adjusting research priorities to the needs of development and his analysis points out the difficulties of achieving such adjustment. Schuh⁵ goes much further, showing how to set research priorities adjusted to development while discussing how the knowledge of the current economic situation in historical perspective, and the knowledge of the objectives and goals of a government, can be used to obtain guidelines for a policy of agricultural research. One can expect that this type of analysis will continue to serve increasingly as the basis for formulation of agricultural research policy.

AGRICULTURAL RESEARCH IN BRAZIL*

Until 1973 agricultural research in Brazil, at the federal level, was a development sponsored and directed by the National Department of Agricultural Research (DNPEA) of the Ministry of Agriculture. Besides the Federal Government, State Governments and other institutions—private for the most part—have also invested in agricultural research. The relative participation of these types of institutions is shown in Table 1.

It should be pointed out that the participation of State Governments is highly influenced by the State of São Paulo. Also, the resources invested per researcher also varies. Until recently, the amount of resources invested per researcher in São Paulo represented more than 150 per cent as compared to DNPEA.

The DNPEA has controlled a network of 9 Research Institutes, a Centre of Food and Agricultural Technology and 82 Experiment Stations covering all states and territories with the exception of Fernando de Noronha.

For 1973 the research programme of DNPEA⁷ indicated research work with nearly 1000 sub-projects. Of these, 39 per cent were in the field of plant technology, 22 per cent in basic research, 15 per cent in animal husbandry, 14 per cent in pedology, 7 per cent in animal pathology and 3

* This discussion is based on the diagnosis of the situation and suggestions about agricultural research as part of a study of the Ministry of Agriculture.⁶

per cent in technology (plant chemistry and food technology). This programme, when compared to the previous year, shows a relative increase in the area of animal husbandry and mainly with so-called basic research. The latter are related to problems of climatology, soils, agricultural engineering, experimental statistics and agricultural economics. The number of sub-projects in agricultural economics (6 for 1973) and experimental statistics (8 for 1973) is negligible. This reflects, apart from the efforts of the past administration of DNPEA, that work of an economic nature and statistics has been neglected through the years. For the most part, the initiative to cover the gaps was on a personal basis.

Another aspect of the programme for 1973 is its wide amplitude and coverage. Those research sub-projects cover more than 50 different products and about 15 areas of study (such as pasture and forage, plant

TABLE 1. *Relative participation of Federal, State and other institutions in agricultural research*

Institution	Research units (%)	Number of researchers (%)
Federal Government	56	44
State Governments	40	48
Others	4	8
Total	100	100

Source: Adapted from the Ministry of Agriculture.⁶

pathology, climatology, botany, etc.). This is an ambitious programme considering the resource limitations and the magnitude of problems to be faced. It is recognized that it is not possible to say that only 'important' products deserve research attention. When research with cotton started in São Paulo, cotton was not an important product, however, the rate of social return to this research investment was high. Nevertheless, it is necessary to concentrate the small amount of available resources on important products.

A document⁶ was prepared by the Ministry of Agriculture, indicating seven areas of work which are considered deficient within the research system represented by DNPEA. These refer to research policy, institutional aspects, research programming, human resources, mobilization of personnel, financial aspects and other general problems. This document points out 32 negative aspects as against 7 positive aspects! In fact, the majority of the negative points were already known by the last administration of DNPEA. However, any significant change in agriculture research would require drastic alterations in terms of institutional and related aspects, mainly in the financial-administrative

organization, in order to create conditions for an efficient planning of agricultural research. The institutional reorganization calls for national and regional groups to give guidelines for agricultural policy. These groups are the Regional and National Agricultural Research Councils that will be responsible for the preparation of Regional and National Indicative Plans. These Indicative Plans should consider the socio-economic development plans and programmes, the national policy towards science and technology, availability of resources, demand by the private sector and the results of appraisals of previous plans and programmes. For the execution of the national plan of agriculture research there was created the 'Empresa Brasileira de Pesquisa Agropecuária—EMBRAPA'. With the necessary administrative—financial flexibility to solve the financial and personnel problems, EMBRAPA will co-ordinate agricultural research along with the organizations which are now dedicated to this activity, such as universities, secretaries of Agriculture, government organizations and also the private sector.

The work of EMBRAPA is founded on five basic principles: (1) transfer of technology (2) planning (3) relationship with more general policies and other institutions, (4) administrative flexibility and (5) dissemination of knowledge and interdisciplinary techniques of the system. The central idea of transferring technology, through the transfer of more developed inputs and products, transfer of knowledge and scientific capacity, is to utilize what has been invested by other societies in research and development, provided that the adaptation is possible in technical terms and economically desirable. The principle of planning is to try to organize a research programme based on regional projects by products, without neglecting the possibilities of programmes of special areas with unique characteristics, such as the Amazon region, the North-East and the savannahs. This planning should follow regional and national priorities, demand for research and the financial possibilities, always introducing the idea of a 'technological package' and a mechanism to appraise the results. EMBRAPA aims at strengthening the links of the agricultural research system with the private sector, universities and the government. The administrative flexibility, as it has been proposed, is to facilitate the improvement of the technical groups of the research system, through a greater competition in the market for qualified technicians and a greater capacity for personnel training. It would also permit a better control of the budget (a better adjustment between programmes and budget), and also a better fiscalization of the research system on the part of the users of the results. The last principle is a recognition that agricultural problems have diverse aspects and that only through the co-ordinated work of specialists of different disciplines, will it be possible to reach solutions that can be implemented. This also encompasses the joint action of research and technical assistance in order to enforce both areas.

The above discussion shows in a summarized way some of the changes which are now taking place in the agricultural research system in Brazil. It reflects the pressures of demand on the Brazilian agricultural sector and

consequential adjustments in research to improve the possibilities of meeting this demand. This type of analysis represents one of the useful ways to plan agricultural research.

THE RESPONSIBILITY OF AGRICULTURAL RESEARCH

Brazilian agriculture has some missions to accomplish. The principal one is to feed a large population which grows at a rate of 3 per cent per year and which begins to move rapidly to urban centres and to absorb gains in terms of per capita income. Some 44 per cent of the total population of almost 100 million, which represent the rural population, have grown during the past decade at a rate somewhat less than 1 per cent per year, whereas the remaining 56 per cent representing the urban population has grown, during the same period, at an average greater than 5 per cent per year. If this trend continues throughout the present decade, by 1980

TABLE 2. *Growth rates of internal demand for food in Brazil during the decade of 1960*

Region	h	p_r	r_r	n_r	d_r	p_u	r_u	n_u	d_u	d
North	0.55	2.1	-0.1	0.44*	2.06	5.3	-1.1	0.62*	4.62	3.21
North-East	0.58	1.3	1.7	0.44	2.05	4.6	0.3	0.62	6.67	3.99
South-East	0.27	-1.8	2.3	0.38	-0.93	5.1	0.2	0.56	5.21	3.55
South	0.55	2.2	-0.3	0.36	2.09	5.2	0.2	0.50	5.30	3.53
Central West	0.52	3.1	3.0	0.40†	4.30	9.0	1.0	0.58†	9.58	6.83
Brazil	0.44	0.7	1.2	0.40	1.18	5.2	0.2	0.55	5.31	3.49

* Same values as given to the North-East because of lack of information.

† Selected values (slightly higher than the South-East) due to lack of estimates for the Central West.

the urban population of Brazil will represent about two-thirds of the total. If with the gains of per capita income which have started in recent years, and programmes of income redistribution activate the internal demand for agricultural products, then the challenge to Brazilian agriculture will be really great.

Up to now, what has been the performance of Brazilian agriculture regarding demand for food? Using a simple model in which the rate of growth of the internal demand for food (d) is the sum of this demand in the rural sector (d_r) the demand in the urban sector (d_u), and where $d_r = p_r + r_r n_r$, and $d_u = p_u + r_u n_u$, with p_r and p_u as rates of growths of the rural and urban population, r_r and r_u as the rates of the growth of the per capita incomes in the rural and urban sectors, and n_r and n_u as income elasticities of demand for food in the rural and urban sectors and when $d = h d_r + (1 - h) d_u$, where h is the proportion of the Brazilian population living in the rural sector and the remaining is urban, it is possible to make some evaluation of food needs in the country. Some estimates of the rates of growth of the internal demand for food are shown in Table 2.

Data on Table 2 are from different sources. Information of population are from the 'Fundação Instituto Brasileiro e Estatística—FIBGE'.⁸ Information on income elasticities of demand are from a study of the 'Fundação Getúlio Vargas—FGV', as used by the 'Instituto de Pesquisa Econômica Aplicada—IPEA'⁹ of the Ministry of Planning. Data on per capita income are from the 'Escritório de Análise Econômica e Política Agrícola—EAPA'¹⁰ of the Ministry of Agriculture.

It is important to consider that while the geometric rates of annual growth of the population cover the whole decade of 1960, the rates of growth in per capita income, only cover eight years of the decade, since the data of the last two years are not yet published. Therefore, the estimated rates of growth in per capita income, as indicated in Table 2 are conservative, as they refer to a period of reasonably low economic growth, with annual average rates of growth in GNP of 2.3 per cent on per capita basis, with some years of zero or even negative growth. During the decade of 1950 only two years indicated results inferior to this, and following 1968 the results have been substantially above that average. Under these conditions, the exercise or projecting future demands should consider these structural changes represented in Table 2.

What has been the response of the Brazilian agricultural sector to this growth in demand? Data from EAPA¹⁰ indicated that during the decade of 1960 the Brazilian agricultural production increased 2.9 per cent per year, showing the following regional increases: 4.9 per cent in the North, 3.9 per cent in the North-East, 1.4 per cent in the South-East, 3.8 per cent in the South and 5 per cent in the Central West. These estimates are somewhat less optimistic when compared with estimates by IPEA.⁹ Under these conditions, the North and the South would have expanded production at a rate higher than the regional demands. The North-East would have had an equilibrium between supply and demand, while in the South and in the Central West demand would have expanded more rapidly. It is interesting to note that the two regions where demand expansion was greater than production, South-East and Central West have shown the highest growth in per capita income in the rural sector. On the other hand, in the South and North where agricultural production increased faster than demand, the per capita income in the rural areas was slightly negative. For the whole country the expansion of demand for agricultural products would have expanded faster than production. The price trends for these same products seem to confirm such facts. The index of prices of food products (index 14) of the 'Fundação Getúlio Vargas' was above the general price level (index 2) during 7 years of the 1960 decade.

If Brazil wants to supply food and agricultural products in general at reduced prices and at the same time compete in foreign markets for these products, as indicated in the programme 'Corredores de Exportação', agricultural research will have to make a huge effort with a view to creating new technologies.

What to call for in terms of new technologies is the big question that

agricultural research will have to answer. Tollini and Teixeira¹¹ have shown that many new production processes recommended by agricultural research are not economical at the present time, given the relative price situation of the factors involved in production. In some cases the new processes seem to give poor results when compared to those now being used, even from the technical efficiency standpoints. With limited resources for research and the need to rapidly increase productivity in the agricultural sector, this situation cannot possibly continue. The country can no longer pay for research that does not have a good possibility of solving present problems. All this indicates the importance of analysing as deeply as possible what is the type of technology more desirable for a region and/or a product.

Obviously, the analysis of supply and demand indicated above is not sufficient to answer the question about the types of technologies that should be created or adapted. However, it represents the first and also an important step towards the answer. This analysis coupled with the careful appraisal of the performance of prices of agricultural products in the different regions will make it possible to anticipate future problems of production and also to estimate the levels of productivity of the land and labour which are necessary to overcome these problems.

The available information seems to indicate that the supply of agricultural products was more abundant in the 1950s as compared to the 1960s. This is due to the growth in demand via migration of population to urban centres and the growth of the Brazilian economy and also the pressures of foreign demand. However, at this aggregative level it is not possible to identify the specific points that need support at medium and long terms. It is necessary to carry out analysis at the level of product and region. Table 3 shows for a few basic products in the Brazilian diet, some estimates of the rates of expansion of production and demand in the different regions.

Data on Table 3 indicate a rather optimistic situation about the long-term performance of some products which are important in the food budget of the classes of low income. Of course, a positive balance between the growth of production and demand does not necessarily mean a situation of abundance. But, it indicates that abundance is increasing or shortage is decreasing. However, other products should be considered. What is probably taking place is a significant change in the composition of the demand, due to changes of preference and income of consumers. The situation, however, must be less optimistic compared with other products, probably of animal origin. Therefore, it is necessary that this analysis be continued, including other products, in order to explain the performance of supply and demand for each product within the different regions. Only then it will be possible to analyse the role of technological changes in the regional economy (production, income, employment and distribution) and in the economy of the individual products, when it will be possible to define the technological bottlenecks that the problems of agricultural research will represent. What cannot be justified is the belief

that agriculture has transformed technologically, growing at rates higher than the internal demand, when the foreign market is not in fact within the reach of farmers. Brazilian agriculture will be supplying the domestic market at prices which are relatively lower than with which it will actually be able to compete in foreign markets. It is important that the planning of agricultural research considers the overall aspects of the agricultural economy. To produce more with the same resources or to produce the same with less resources may have the same meaning in terms of productivity. However, it has a different meaning in terms of income, employment and welfare and, therefore, does not have the same meaning in terms of agricultural policy and planning of agricultural research.

TABLE 3. *Rate of expansion of production and demand for selected food products*

Product		Brazil	North	North-East	South-East	South	Central West
Rice	Production (%)	4.8	7.9	7.2	1.6	5.4	8.2
	Demand (%)	3.7	2.8	3.7	4.0	3.5	7.1
	Difference (%)	1.1	5.1	3.5	-2.4	1.9	1.1
Corn	Production (%)	5.2	5.2	5.9	3.8	5.7	8.3
	Demand (%)	3.2	2.8	2.3	3.0	3.6	5.5
	Difference (%)	2.0	2.4	3.6	0.8	2.1	2.8
Beans	Production (%)	4.0	4.1	6.6	-1.6	6.3	4.3
	Demand (%)	3.3	3.4	2.6	3.5	3.5	6.4
	Difference (%)	0.7	0.7	4.0	-5.1	2.8	-2.1
Manioc	Production (%)	6.9	6.5	5.2	4.2	7.5	6.3
	Demand (%)	3.5	3.0	3.7	3.6	3.6	6.7
	Difference (%)	3.4	3.5	1.5	0.6	3.9	-0.4
Oranges	Production (%)	6.0	4.5	7.6	7.3	2.4	3.0
	Demand (%)	3.9	2.4	2.9	4.8	3.5	8.6
	Difference (%)	2.1	2.1	4.7	2.5	-1.1	-5.6
Bananas	Production (%)	6.8	4.7	9.6	3.6	7.9	4.4
	Demand (%)	3.6	2.7	3.7	3.2	3.6	6.9
	Difference (%)	3.2	2.0	5.9	0.4	4.3	2.5

Planning of agricultural research should be linked with the overall policy for economic development regarding several problems, of which employment is one of the most important. Market for farm labour is relatively slow for adjustment, and labour market outside of agriculture does not expand in a desirable way. The burden of this maladjustment affects a relatively large fraction of the population. If on the one hand it is not easy to solve the problem of employment, on the other hand, the lack of consideration of the problem with the necessary emphasis by the people responsible for the planning of agricultural research can easily aggravate the situation in the future.

There is a confident hope that EMBRAPA, with its capacity of mobilization of human resources, can plan agricultural research with macro-economic considerations. The capacity for 'modernizing'

agriculture depends on the expansion of demand, which in turn depends on the creation of productive employment. It is a function of the new system of agricultural research to discover how the different guidelines of agricultural research will potentially affect the agricultural sector. Even if in 1980 only one-third of the Brazilian population remains in the rural sector, it will represent about 45 million people. Agricultural research always seeks to improve the welfare of this population and by doing so it is very likely that its capacity will be used to a maximum to the benefit of the urban population. This is why the phrase of C. P. McMeekan summarizes the core of this paper. It is indispensable to be 'efficient' in the planning of agricultural research. But it is also important that the agricultural sector does not represent a type of 'macroeconomic residual'. It would be a mistake to think that the agricultural sector is relatively more sensitive to short-term incentives than long-term pressures. This may be the case for some specific products but it is by no means the case for agriculture as a whole.

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SPECIAL GROUP F REPORT

The discussion dealt with many important points which included the following:

- (1) The need for increased emphasis on agricultural research in the solution of practical agricultural problems.
- (2) Lack of communication at various levels.
- (3) Priorities in planning agricultural research.
- (4) Diffusion of knowledge.
- (5) Problems of financing.

Very often research institutions and research workers concentrate on basic research with little or no relevance to the practical problems of the farmer. The need for an adjustment in this approach has been stressed and agricultural research should consider not only the problems of the individual farmer but also problems which occur at the macro-economic level (supply, demand, inflation, international trade, employment, etc.).

Communications at various levels was considered and lack of contact between agricultural researchers and farmers as well as among research workers themselves was considered a major deficiency. As a result, research workers and research institutions do not benefit from the feedback of information from farmers signalling their needs. Co-ordination of planning and execution of research programmes and projects have been inefficiently effected and duplication of efforts has been a common feature.

In discussing the planning of agricultural research and the establishment of priorities, initial stress was put on the need to avoid over-ambitious programmes and that programmes must be oriented towards economic development. These programmes it was agreed should take account not only of new practices in traditional products but also the possibilities of new products.

Attention was drawn to the fact that economic application of knowledge derived from research does not always tend to be feasible. Consequently research results must be properly tested by repeated experiments over a period of time before they are recommended to farmers.

Finally, the allocation of funds between extension and research was discussed. It was felt that the need exists for a much more rapid growth in funds for extension than for research. Extension workers, however, should become increasingly concerned with the appropriateness of the knowledge and methods introduced to farmers. As regards financing research, the constraints in using funds from private sources was emphasized. Developing countries in the process of planning and budgeting for agricultural research should recognize the possibility of importing technology.

Among the participants in the discussion were: J. Ackerman, *U.S.A.*; H. Drummond, *U.S.A.*; J. Gamboa, *Colombia*; C. A. G. Hunt, *Australia*; F. W. Michael, *Brazil*; G. C. Mandal, *India*.