

National and International Agricultural Research and Extension Programs. By James K. Boyce and Robert E. Evenson. New York: Agricultural Development Council 1975. IX+Pp. 229. \$4.50.

Various studies on research and technology development have established that research and extension programs have contributed substantially towards the productivity gains in the agricultural sector of the high income countries. A greater emphasis is being placed on agricultural research and extension activities, in developing countries, and new programs are being planned and existing ones being strengthened, either through their own resources or with the help of various international aid agencies.

Adequate and genuine technology transfers can help late comers in their race for development. However, transfer of agricultural technology is limited by geo-climatic factors; it is important for the specific countries and the donor agencies to know where potentially transferable discoveries of technology and technical knowledge are being made and which one of these offer the greatest potential. Moreover the provision of adequate data on research and extension and inter country and inter region comparisons of these data will stimulate further investigations that will be helpful in providing guidelines for the rational allocation of the limited scientific and material resources. The monograph, under review, is a valuable addition to the inventory of research data. It is organized in six chapters. Chapter I provides a general summary of the data and main findings of the monograph. Chapter II deals with Investment in Public Sector Research and Extension Institutions, chapter III deals with International Aid and National and International Research Programs, chapter IV with Agricultural Research in the Private Sector and chapter V with Organization, Commodity Emphasis and Skill Levels in National Research Systems. Finally a brief survey of studies based on national data in this field of research is provided in the last chapter on Economic Properties of Agricultural Research and Extension.

The total expenditure on agricultural research is higher throughout the reported period in those regions which are relatively more developed. Among these regions North America and Oceania have had the highest investment in agricultural research. Incidentally the "New World" also happens to be the region which has one of the most developed agricultures. Generally the investment in agricultural research has expanded quite rapidly, with Asia realizing the highest rate of expansion but not necessarily a high level of research intensity.

It is no chance that about 25 percent of the total expenditure on agricultural research in North America and Oceania and slightly more than 10 percent in Western Europe is provided by the industrial sector. In the agriculture of these countries farm inputs originating in the industrial sector play an important role and thus farm sector provides market for industrial products. The available evidence also suggests that the percentage share in the agriculturally related scientific research has increased in all the regions except the Eastern Europe and the USSR where it has gone down from 27 percent in 1951 to 17.2 percent in 1972.

The authors' organization of the research and extension expenditure as a percentage of the value of the agricultural products by regions reveals that

public sector expenditure on extension programs has expanded relatively more rapidly in low income countries whereas research programs have expanded more in the developed regions. The developed countries are much more research intensive than the low income countries whereas the low income countries appear to be more extension oriented. If quality differences in research and extension are taken into account, the difference between the research intensity of the developed countries and low income countries would be further widened. Also the extension intensity of developing countries may not look real. The authors argue that allocation of funds between agricultural extension and research indicates that the policy makers in developing countries think extension resources to be highly substitutable for research in their quest for improved agriculture.

The data on research expenditure per man year of scientists suggest that prices of scientist's skills may be 3 to 4 times higher in the highest income countries than those of low income countries. Nevertheless, most of these differences stem from huge quality variation and different definition of scientists in different countries. The data adjusted for these variations reveal uniformity in expenditure levels.

The authors' contention that variation in skill levels of extension workers of different countries is small and, because of large differences in expenditure per extension worker, the real price of extension services does vary considerably is debatable. If we compare the quality of training and services provided by the extension workers we would find a huge gap that separates the extension services of different countries. Extension worker's skills are low priced relative to research skills in low income countries. This primarily reflects differences in the ability to produce these skills at low cost. Most of the low income countries can train extension workers in their local institutions and have few institutions capable of producing the more demanding scientific skills and thus have to rely upon the expensive institutions of the developed countries for the training of their research personnel.

The organization of research and extension expenditure data according to climatic regions reveals wider differences in research investment intensity than those obtained in per capita income grouping and grouping by regions. The authors rightly point out that the low level of real research investment in the major developing country climate zones, particularly in the tropical and desert zones, is partly responsible for the backwardness of the agricultural sector in these regions. The sub-tropical zones enjoying more productive agriculture have paid more attention to their research and extension programs.

Since gains from private research in agriculture cannot be monopolized the support of agricultural research, as a matter of necessity, has been mainly from the public sector. This is especially true for the low income countries. The conventional agricultural research conducted in recognized agricultural research institutes has been highly commodity oriented. The developing countries, which were colonies of the European countries, had established research stations oriented to specific export commodities with the result that little productivity gains were realized in these countries with the exception of the export crops sector; whereas the high income countries who had a well

established research institution system were realizing rapid productivity gains in their agricultural sector. The authors' presentation of data on agricultural research and extension expenditures reveals that USA, USSR and Japan accounted for almost 45 percent of the world's total expenditure on these activities in 1974. Recently the low income countries have also expanded their investment in research activities and the ratio of investment in the agricultural research to the investment in all scientific research has shown an upward trend. The authors emphasize that the available evidence does not bear out, the often cited complaint, that agricultural research systems in the low income countries are oriented towards the pure sciences.

The authors' comparison of research and extension intensities in terms of expenditure on these activities as a proportion of the value of agricultural product by sub-regions and per capita income groupings, confirms their earlier findings that high income countries and more developed regions have invested relatively higher proportion of their agricultural incomes in research and the low income countries in extension activities. The authors rightly observe that the degree of substitutability between extension and research has been highly overestimated by the policy makers in the developing countries. It has not been a prudent policy to pursue an aggressive extension program while neglecting the difficult task of building research capabilities. It appears that policy makers in developing countries, hard pressed for quick results, could not overcome the temptation of adopting short cut measures via extension programs since a long gestation period accompanied by uncertainty characterizes research activities.

International aid has played an important role in providing research facilities in the low income countries and accounted for 40 to 50 percent of the total investment in agricultural research, in the low income countries, during 1950s. However its share had declined to about 20 percent of the national investment by 1971. The authors point out that this decline was partially due to the phasing out of aid programs and partially because of the relatively rapid growth in investment by the national agencies. The authors also note that in some cases host countries asked the foreign advisors to leave. A great deal of this retrenchment was justified on the grounds of poor performance by advisers and research scientists whose skills and long since atrophied. Moreover, the emerging system of international research centres during 1960s, enjoying good reputation because of their role in green revolution technology, supplanted the old system.

The distinguishing feature of the international research centres, supported by the Consultative Group on International Agricultural Research (CGIAR), is their focus on one or at the most a limited number of commodities. The commodity emphasis has enabled these institutes to employ a thorough going inter-disciplinary approach to research. However, the authors note that organization history of the institutes suggests that over the longer period the institutions with heavier emphasis on scientific disciplines have proved to be more successful. The International Institutions at present lack these ties to the mother disciplines. The authors correctly suggest that if the international centres have to maintain their edge over the national systems they would have to develop these links.

The data presented on agricultural research in the private sector, though not comprehensive enough to permit a thorough analysis, nevertheless, suggest

that inventive activity has been greatly influenced by the size of the potential market. The cyclic nature of the inventive activity suggests that as some countries exhaust inventive potential in a particular field the other countries have emerged as leaders. The low income countries have not benefited much from the invention-oriented research in agriculture and an understanding of the factors influencing the inventive activity would provide a better basis for future policy guidelines.

The authors' review of research productivity studies shows that agricultural research investment has yielded a very high rate of return in almost all the situations and investments have been far below optimal levels. The available evidence suggests normal rate of return for extension investments, however.

The authors argue that the evidence presented by them casts serious doubts on the "Induced Innovation Institutional Change" hypothesis of Hayami and Ruttan. Had the public sector investment been guided by the perceived economic returns, it is unlikely that investment in agricultural research would have been far below the optimal level. Studies on technology diffusion specification based on geoclimatic factors point out that developing countries are unlikely to appropriate a large share of the benefits produced as a consequence of their research investment. Nevertheless, the review of various studies does suggest that research programs in developing countries offer great potential for productivity gains.

It is well known that developing countries' agricultural programs have had an extension bias. The authors substantiate this with the help of empirical data. Despite the extension bias, the agricultural programs in the low income countries have not been very successful in raising the productivity. It is clear that without adequate backing from organized research, provision of modern farm inputs, and adequate training facilities the extension services by themselves could not revolutionize the agriculture.

An important lesson that emerges from this study is that if the developing countries are serious about their agricultural development they must develop and strengthen their research institution and strike a proper balance in their allocation of funds for agricultural research and extension. But for the help of international centers in evolving new seeds (extension services played an important role in the rapid diffusion of these seeds) the developing countries, agricultural sector would not have realized the productivity gains that were realized recently.

The authors have done a useful service to the planners, policy makers and researchers in compiling the valuable information on agricultural research and extension programs from all over the world in one place.

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