Returns to Expenditure on Agricultural Extension Services:

Evidence from Literature

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CONCLUSION

In the post World War II period, there has been a relatively large commitment of financial and human resources in the establishment and operation of agricultural extension services worldwide. More recently, an increasing amount of concern has been expressed by policy makers about returns to this investment. The review of studies reported in this paper addresses itself to this question.

Inspite of the large scale investment in extension services, the reviewer found that there are relatively few studies available which directly measure the impact of extension on agricultural productivity. This points towards a need for an increased input of research resources in this area. Such an effort will improve the methodological sophistication which this research area currently seems to lack. Additionally, it will improve the accuracy of results.

Earlier studies of extension impact studied the combined effect of research and extension expenditures because of complementarities between them. Some of the research reviewed here measured the impact of extension and farmer's education (which substitutes extension up to certain levels) on farm productivity. The results of those studies which attempt to measure extension impact alone point largely in one direction, with minor variations, i.e., that investment in extension services brings significant and positive returns. As reported in the main body of the paper, the magnitude of returns varies from study to study. The returns to extension also seem to vary with the education of farmers, between crops, and farm enterprises as well as from one region to another.

Methodological shortcomings notwithstanding, there is enough evidence in the existing research to inform public policy that returns to investment in extension education are reasonable and compare favorably with returns to expenditures in other public services. Since free markets do not seem to fully satisfy farmers' information needs, government support for this activity is amply justified.

Returns to Expenditures on Agricultural Extension Services: Evidence from Literature

1 Introduction

Food and Agricultural Organization (FAO) 1988 Country Tables for Basic Data on Agricultural Sector indicate that, out of a total 1987 world population of 4,995 million, 3,769 million (75.5 percent) live in developing countries. Fifty-eight percent of the population of developing countries, according to these statistics, is classified as agricultural. Similarly, 61 percent of the labor force in developing countries is employed in agriculture.

Table 1

World Population and Labor Force Data in Millions (1987)

Particulars	World	Developing Countries Including Asian CPE	Less Developed Countries
Total Population	4,995	3,769	392
Agricultural Population	2,309	2,195	280
Total Labor Force	2,241	1,653	150
Agricultural Labor Force	1,071	1,015	108

FAO Economic and Social Policy Department, (1988). *1988 Country Tables*. Rome: p. 334-339.

For less developed countries, the proportion of population in agriculture and the proportion of agricultural labor force are much higher, being 71.4 percent and 72 percent respectively. These data signify the importance of agriculture and of the agricultural population in developing countries, especially in less developed countries. The high population growth rates (2.0 to 2.6 percent) projected for these areas and the newly created needs and aspirations of these populations present a tremendous challenge to agricultural development planners and practitioners involved in the application of science and technology to agricultural problems. It is assumed that agricultural development is the basis for future economic development in these countries.

1.1 Background and Nature of the Problem

The social organization of agriculture in developing countries is largely characterized by small family-operated farm units with varying arrangements for the ownership of resources and for work roles between men, women and youth. Income from complex agricultural enterprises and non-agricultural sources, where available, is combined to provide for family needs.

An important feature of this agricultural organization is the rural community with its distinctive social structure. The community provides the background for and influences the diffusion of information and technology necessary for fulfillment of needs, aspirations and interests of rural people. Further, the rural community provides a means for an individual's articulation to various regional and national structures. Similarly, national policies and structures find their expression through a downward articulation at the community level. One such structure, common to almost all non-socialist countries, is represented by the agricultural extension services charged with the responsibility of communicating useful information to the rural population and ensuring its application for increased productivity and an enhanced quality of rural life.

The FAO Agricultural Extension Reference Manual defines extension as "a service or a system which assists farm people, through educational procedures, in improving farming methods and techniques" (Swanson, 1984:1). The general aims of agricultural extension are to improve the quality of rural life and to raise levels of rural living through improved farm productivity and increased incomes. As an educational activity it entails a process or an essence (Mosher, 1958:5) common to all extension programs. Different extension programs combine various extension principles to focus on specific objectives at hand within a given socio-economic milieu. Consequently, the post World War II spread of agricultural extension to Third World countries has witnessed the development of diverse approaches to extension work. A considerable body of literature is available in the area of comparative extension education, beginning with Cornell University's (USA) Comparative Extension Program in 1956 to a variety of descriptive and analytical material of recent origin,[1] as a testimony to extension's diversity and differentiation.

Axinn discusses eight approaches to extension work in a recent unpublished document (Axinn, 1988). Similarly, Roling (1982), attempts to differentiate various extension approaches on the basis of specific criteria (objectives, target groups, offerings, methods and organization). The various approaches described in literature are not distinct modes of extension activity. The major difference between these approaches lies in the fact that some of them are better able to elaborate on and operationalize certain principles of extension, than the others. Also, some of these approaches are more widely practiced while others are not. For example, of Axinn's eight approaches, the General Agricultural Extension Approach, the Commodity Specialized Approach, the Training and Visit System and the Participatory Approach are the more commonly practiced approaches in the third world countries today.

The development of alternative approaches to extension work, as described above, is the result of a continuous search on the part of governments, aid agencies and extension administrators for more effective and relatively less resource-intensive systems of extension.

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1 For example, Cornell University Comparative Extension Publications, Nos. 1-16, and Comparative Extension Mimeo Releases, Nos. 1-6. Also, see deS Brunner, E.; Irwin T. Sanders and Douglas Ensminger, 1945. *Farmers of the World: The Development of Agriculture Extension.* New York: Columbia University Press; George Axinn and S. Thorat, 1972. *Modernizing World Agriculture: A Comparative Study of Agricultural Extension Education Systems.* New York: Praeger Publishers; B.R. Crouch and S. Chamala (eds.) 1981. *Extension Education and Rural Development,* 2 volumes. Chichester, England: John Wiley; G.E. Jones and M. Rolls (eds.), 1982. *Progress in Rural Extension and Community Development.* New York: John Wiley & Sons; G.E. Jones (ed.) 1986. *Investing in Rural Extension.* London: Elsevier Applied Science Publishers; William Rivera and Susan G. Schram (eds.) 1987. *Agricultural Extension Worldwide.* New York: Croom Helm, and several conference and workshop reports.

A somewhat negative judgment (Rice, 1974) on the accomplishments of extension services from professional sources has further contributed to concerns for cost effectiveness and related issues.[2] For example, World Bank's *World Development Report 1982* (p. 72) notes that "with some important exceptions the performance of extension services has been disappointing". Similarly, a recent FAO review of its programs concludes that:

> By and large, extension in developing countries is still inadequate. Its major shortcomings are weak organization, poor management, lack of operational funds, shortage of adequately trained staff, lack of incentives for field workers and extra duties assigned to them, ineffective methods and approaches and insufficient feedback from field workers to researcher (FAO, 1987: 177).

1.2 Extension Impact Considerations

Although publicly-funded agricultural extension services have existed for a relatively long time (longer in developed countries than in developing countries), it is generally agreed that systematic efforts to provide for comprehensive, in-depth evaluation of their impact are, comparatively speaking, more recent and few in number. Recently there has been an increasing concern with the performance of extension services both in the developed countries as well as in the developing countries. Such impetus for the evaluation of extension services comes from decision makers (including donors) concerned with the broad policy issues, administrators with responsibilities for program administration and resource allocation, and evaluators interested in improving the efficiency of program delivery. Warner and Christenson (1984:2) report that:

> in recent years there has been an increasing emphasis in evaluating the programmes of the Cooperative Extension Service (in the U.S.) for purposes of accountability and for gathering information in order to improve such programs.

1.3 Concerns with Cost-Effectiveness of Extension Services

The recent search for cost effective extension systems and strategies has been necessitated because of the ever-present constraints on extension budgets in the face of mounting problems of agricultural development and food production. These concerns arise out of an increasing trend toward strict accountability of public expenditure, in general, throughout the world; and specifically, in the face of mounting pressure for privatization (USAID, 1985) of extension services. Managers of public finance and planning agencies concerned with investment policy are finding it increasingly difficult to justify extension expenditures on the basis of weak and controversial evidence, from empirical studies, about the economic contribution of extension. Similarly, extension administrators and practitioners are voicing concerns about costs, cost effectiveness and resource outlays for extension services. For example, participants in a USAID-sponsored agricultural education workshop in Cameroon "discussed the inefficiencies and high recurrent costs of existing extension systems" in Africa "in the light of the urgent need for agricultural development and food production" (USAID, 1984:9). Evenson (1986:65) notes that "extension services, whether provided by private firms or public agencies, must produce economic benefits sufficient to justify their costs". The concern for cost effectiveness stems from the rational concern of those who are responsible for allocating scarce developmental resources. Some of the pressure seems to come from donor sources looking for best returns to their aid dollars. Pressure for cost effectiveness may also come as a result of criticism of certain approaches of extension. Such is the case with the Training and Visit System of extension

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2 A considerable body of opinion in extension literature points towards the ineffectiveness/effectiveness of extension services. A large part of this opinion is based on judgment and personal observation of individual specialists rather than on a causal analysis of the appropriate variable.

sponsored by the World Bank which has been under heavy pressure. Pickering (1986:21) representing the World Bank, for example, notes that "we are concerned with the high recurrent costs, in terms of human and other resources, of many extension services that we have helped and are helping to finance". Realizing the importance of investigating cost effectiveness, he goes on to say that "for this reason we are proposing to investigate the impact on efficiency of extension systems..." Similarly, Cernea et al. (1984), accept the fact that the Training and Visit System of extension is "certainly more costly than earlier approaches". They point out the "need to investigate this issue (of costs and returns) further".

The information presented above indicates that the recent debate has been focusing increasingly on the economic value of extension services in comparison to public expenditure on their establishment and operation. The policies, approaches and strategies which govern rural extension work are, therefore, under close economic scrutiny.

1.4 The Purpose of the Review

Responding to these concerns and other pressures national and international agencies such as the World Bank and FAO[3] have recently shown interest in exploring issues related to cost effectiveness of agricultural extension services. In view of these concerns, therefore, it is necessary to review the existing research evidence on this subject. Such information, if conclusive and positive might provide a basis for action in support of increased expenditure outlays on agricultural extension services.

For the sake of record it needs to be noted that a limited number of technical reviews of such literature by economists[4] do exist. The focus of such reviews is technical and methodological and they appear to have been undertaken from a disciplinary perspective. The present review aims to be up-to-date and somewhat less technical in orientation. It has a professional perspective. The purpose here is to present the material in such a way that it is useful to administrators and policy makers in the extension services.

1.5 The Limited Research Evidence

It is necessary, at the outset, to comment on the quantity and quality of research information available on this subject. An examination of various listings[5] of published material on extension education for agricultural development will indicate that considerable body of published information exists on various aspects of extension. This is an indication of the world-wide scope of extension involving considerable financial and human resources commitment.

It is true that research in extension has been going on at least for the last forty years. However, the major focus of a large body of extension studies has been on the operational aspects of extension. Such work has used descriptive and prescriptive methodologies. Agricultural extension is, relatively speaking, a young field of study struggling to become an academic field from its very practical and applied roots. It is estimated (Evenson, 1987:118) that world-wide expenditures on extension services are at least to the tune of 3.4 billion dollars annually involving close to 350,000 personnel. This indicates the nature of the size of extension enterprise world wide. In spite of this heavy commitment of resources there were relatively few studies of the

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3 Reference is made to a proposal by the Food and Agriculture Organization of the U.N. to hold a Global Consultation on cost effectiveness of extension services in developing countries at Rome in the fall of 1989.

4 See, for example, Lockheed et al. (1980), Orivel (1983) and Birkhaeuser et al., (1989).

5 See for example, Dhara S. Gill, *Preliminary Reference List*. Unpublished Document #2 prepared for the Proposed Global Consultation on Cost Effectiveness of Extension Services. Rome: FAO, Agricultural Education and Extension Service, 1988.

economic impact of agricultural extension up until 1970. More recently, during the 1970s and 1980s, interest in this subject has picked up and a limited number of studies have been undertaken to assess returns to expenditures on extension.[6] Studies reviewed here addressed diverse research objectives and were carried out under varying field conditions. The quality and reliability of data, therefore, might vary. This calls for a caution in interpretation of results.

2 Methodological Problems

2.1 Problem of Extension Objectives

The conditions for accountability require that investment policies be justified in terms of their relative ability to generate wealth. In this sense the cost effectiveness of extension services should only be considered on the basis of increased productivity of farmers, which could be attributed to extension teaching.

A part of the problem in this case, however, relates to the differential perceptions of the objectives of extension work. If agricultural extension work is viewed purely as an economic investment, as economists tend to view it, then the outcomes must be demonstrated in monetary and financial terms. However, if one views extension having both economic and non-economic objectives (equity, improved quality of life) as FAO and many national agencies define it, then the returns to extension work must necessarily be judged both on the basis of economic productivity as well as on its effectiveness in achieving non-economic objectives. The outcome of non-economic objectives cannot be judged properly without precise criteria and appropriate methodologies.

A search of literature on effectiveness of agricultural extension indicates that there is relatively little published empirical evidence which would allow a judgment on extension's achievements in terms of its socio-cultural objectives though efforts in this direction are already underway (Oakley, 1986:247). A majority of evidence on cost effectiveness, available at present, comes from studies in the economics of extension work and it attempts to measure benefits or returns to investment in extension in monetary terms using input-output and econometric methodologies.

2.2 Human Capital Formation: A Long Term Process

This specific approach to cost effectiveness of extension services has an economic perspective. The basic work in this field has historically been undertaken by the economists interested in the substantive area of human capital theory. Concerns of economists, with the impact of human capabilities on economic growth processes, are age- old. Economists such as Smith and Schumpeter saw human capabilities playing an important role in economic development through improved productivity and through the development of entrepreneurial skills. Contemporary economists, among them T.W. Schultz (1964, 1971, 1980), Gary Becker (1962) and others, have further clarified the concept of human capital and human resources. Problems of human resources development (Ginzberg, 1966) and its role in the development of nations and communities is increasingly assuming an important place in discussions of development issues (World Bank, 1982). This theoretical area is significant because extension education process enhances farmers' capabilities and improves the quality of human resources of agriculture. The process of knowledge acquisitions and skill development through extension education is cumulative in character, starting with the learning of simple concepts to a mastery of more complex phenomena related to the agricultural development process.

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6 In this study the terms extension education, extension, and agricultural extension/agricultural extension education are used interchangeably.

The cumulative and long term nature of the human resources development process (Schultz, 1987:13) however, creates methodological problems in the assessment of returns to investments in extension education. Studies based on short term perspective may not adequately be able to gauge the benefits derived from such an educational effort. It is assumed that the returns to investment in extension work will be much higher in the long term as compared to the measurements taken shortly after the process of extension education is initiated. In this respect studies measuring the impact of extension in short run will underestimate returns to extension investment.

2.3 Financial Data: Problems of Disaggregation

Detailed financial data about resource allocation to extension services is available in individual country budgets and other fiscal documents. FAO (1984), World Bank (1983), U.S. Department of Agriculture and other international agencies (Elias, 1981) regularly collect, analyze and disseminate data on public expenditures on agriculture. A large majority of such data, available internationally, are aggregate data presented either by country or by region. Depending on the professional interest of researchers, the tendency has been to use such aggregate data on extension services supplied to a region over time for the purpose of estimating effect on agricultural production. Because of its residual nature studies using aggregate data are potentially subject to estimation problems.

As reported in the following pages many of the earlier studies measuring extension impacts used combined data for financial expenditures on research and extension. The results of such studies suffer from potential biases in estimation due to aggregation. The more recent studies, including the one undertaken by the World Bank staff in India (Feder, Lau and Slade, 1987), based on a classical experimental design, do not have these problems, even though their shortcomings lie in other areas.

2.4 Problems of Farm-Level Studies

The farm level data used in measuring extension impact presents entirely different problems. One of these is the problem of farmer self selection. It is well known from diffusion of innovations research (Rogers and Shoemaker, 1971) that in every agricultural community there are farmers who more actively seek out information and extension advice than others. In such situations the extension contact variable becomes endogenous and the estimate of extension impact values on farmers' performance are upwardly inflated. In these cases better performance attributed to extension services would in fact be because of better farmers.

It is also well known that the extension information has a multiplier effect at the local level. Studies in North America and elsewhere indicate that about 18 to 20 percent of farmers are in contact with extension services at any given time. We also know that farmers use other farmers as sources of information for agricultural advice. In such cases the farmers receiving information from neighbours, friends and kinsmen may not attribute extension services for such information even though that information came to their informal contact from extension sources in the first place. In this situation the farmers in direct contact with extension may not produce more than the farmers who receive extension information second hand. If extension contact is used to discriminate productivity increase, in such situations there may not be any increase in productivity for farmers who have contacts with extension. The presence of inter-farmer communication, therefore, tends to cause an underestimation of extension effects on farm productivity.

Economists studying the impacts of extension on productivity have utilized various methodologies, some of them described by Feder and Slade (1986a) and by Birkhaeuser, Evenson and Feder (1989), to overcome the distortions caused by these peculiar problems of extension studies. Considering the fact that this is an evolving and new field of study and a relatively new area of research one cannot expect the degree of methodological sophistication characteristics of well established research areas. This may be the reason that the studies reported in this review show widely varying and uneven results.

3 Education, Extension and Farm Efficiency

Of more practical significance to the question at hand, are studies relating farmer education to agricultural productivity or income. This area of empirical research falls within the general area of 'Economics of Education.' Some of the earlier work in this field, and of significance to developing countries (Harbison and Myers, 1964), was influential in the legitimization of expenditures on education as investment expenditures. It countered the prevalent views which held that educational expenditures are to be considered as consumption items in the national budgets. Some of the more recent work (Psacharopoulous, 1987) in this area is concerned with efficiency and equity considerations of general educational expenditures.

3.1 Complementarities Between Education and Extension

The rationale for discussing formal education of farmers in a paper concerned with extension education, comes from the fact that the availability of formal educational opportunities and educational achievements of farmers has an impact on the conduct of extension work. Bowman argues (1976:221) that in talking about small farmers, formal education on the one hand and information (extension) on the other might usefully be considered along a continuum. One pole of this continuum may be labeled as the 'formation of competencies' and the other end might be labelled as 'transmission of information'. Basic competencies such as literacy, numeracy and general cognitive skills are best formed through schools or similar institutions. Information, on the other hand, (for example, on seeds, fertilizer and management practices, etc.), can best be transmitted through a variety of institutional and non- institutional frameworks including extension services. In this view the goals of information transfer services are perceived in narrowly economic terms. The development of competencies, however, can be expected to have not only an economic benefit in agriculture, but also in the improvement of other aspects of household life. Additionally, it encourages a critical self-reliance (Jamieson and Lau, 1982:3), an ultimate goal of extension education.

Formal educational achievement of farmers seems to provide a ground work on which extension work can be based. Moock (1981:239) in his studies of Western Kenya maize farmers found that in the acquisition of knowledge by farmers, the formal education (beyond three years) and extension contact "appear to be substitutes". He noted that "positive effect of extension contact is greater for those with less schooling than for those with more". Evenson (1986:84) similarly notes that farmers with lower education benefit more from extension services than those with higher education, for whom "the value of extension services decreases with the increase in the number of years of schooling". The data from these studies provide grounds for a strong case for enhanced public investment in extension services in the majority of the Third World countries where farmers' literacy rates are low and are likely to remain low in the coming decades.

The interrelationships between formal education and extension education are further emphasized by Schultz (1964:302) who notes that:

> when farm people are effectively literate, farm journals and press generally become important vehicles of information. Agricultural extension services can then also use bulletins, pamphlets and printed instructions which are, for many purposes, cheaper than meeting farmers based wholly on oral presentations.

Lockheed, Jamieson and Lau (1980:39) report similar interrelationships between education and extension, based on a literature survey of farmer education and farm productivity.

3.2 Education and Farm Productivity

T.W. Schultz's life long interest in the economic value of education and, more specifically, his interest in the impact of farmer education on farm productivity in transitional agriculture initially paved the way for further academic and research work in this area. For example, in *Transforming Traditional Agriculture*, he notes:

> Such clues as are now available all support the tentative judgment that primary schooling is a highly profitable investment. Even though only the benefits that accrue to those who acquire the schooling are taken into account, the rate of return appears to exceed by a wide margin the rate to investment in material capital. Shoup and associates estimate that the incremental return to primary schooling in Venezuela (grades one through six) is 130 per cent per annum based on the differences in the earnings of illiterate agricultural workers and of those who had completed six years of schooling (Schultz, 1964:204).

Although the economists did not begin to pay serious attention to this area of research until the seminal work of Schultz, there are earlier studies available on the impact of education on farm productivity. For example, Lockheed, Jamieson and Lau (1980:39) report that "Folks, as early as 1920, reported on studies showing a strong influence of education on agricultural productivity in Indiana, Missouri and New York" in the United States. Following Schultz's study, however, considerable literature in the field of economics of education developed dealing with the question of farmer education and farm efficiency. Subsequent studies, among others, by Caulkin (1976), and Sharma (1974) on Nepal; Chaudhri (1979), and Sidhu (1976) in India; Halim (1976) in the Philippines; Haller (1972) in Colombia; Harker (1973) in Japan; Jamieson and Lau (1982) in Korea, Malaysia and Thailand; Moock in Kenya (1981), Pachico and Ashby (1976) in Brazil; Wu (1977:699) in Taiwan; Yotopoulous (1967: 365) in Greece and Sadan, Nachmias and Bar-Lev (1976:445) in Israel have shed considerable light on this question.

Several attempts have recently been made to review this diverse, but limited, research literature which is of considerable interest to planning and agricultural development specialists. Lockheed, Jamieson and Lau (1980:60) reviewed the literature on farmer education and farm efficiency in 1980. They surveyed the findings of eighteen studies, conducted in developing countries concerning the extent to which the educational levels of small farmers effect their production efficiency. These eighteen studies included thirty-seven sets of farm data. They found that in six of these data sets education was found to have a negative (but statistically insignificant) effect, but in the remaining thirty-one data sets the effect was positive and usually statistically significant. Their overall conclusion was that "farm efficiency increases on an average by 7.4 percent as a result of farmers completing four additional years of education rather than none". They further state that "a number of studies showed evidence of a threshold number of years (four to six years) at which the effect of education became more pronounced". They contend that the effects of education were more likely to be positive in modernizing agricultural environments than in traditional ones. In this respect their results lend support to T. W. Schultz's hypothesis that the effectiveness of education is enhanced in the modernizing environments.

Jamieson and Lau (1982:8) conclude, based on the same data (eighteen studies and thirty-seven sets of farm data) that farm productivity increases on an average 7.4 percent as a result of farmers completing four years of education. They confirm that "several studies showed evidence that at a threshold number of years (four to six years) the effect of education becomes more pronounced". After having reviewed the evidence of farmer education and its impact on productivity they conclude that "the existing literature strongly suggests

that more educated farmers are more productive, particularly, as Schultz hypothesized, in modernizing agricultural environments". In their own studies in Korea, Malaysia and Thailand they reaffirm the findings of the previous studies on the impact of education on farm efficiency saying the effects are "positive, statistically significant and quantitatively important," (1982:8). They confirm that the "estimated rates of return are quite respectable". For example, in their studies they found the highest returns in Malaysia (25-40 percent), lowest in Korea (7-11 percent) and intermediate (i.e., 14-25%) for Thailand (1982:13). The same information is confirmed by Lockheed (1987:110) in 1987. Welch (1978:278) reviews considerable evidence related to farmers' education and farm productivity. His conclusions reaffirm what has been found to be true earlier in this Review that education contributes positively to farm efficiency. He goes further to suggest that:

> we now have evidence that the composition of activities within the household is sensitive to schooling to speculate that schooling is productive within the household as well. Further, there is little question that opportunities off the farm are enhanced by schooling.

4 Evaluating Extension Impact

4.1 Evaluation of Extension Operations and/or Outputs

In the evaluation of extension work there is considerable variation in what is considered as the necessary components of extension evaluation. Both in the developed countries as well as in developing countries extension evaluations have traditionally focussed on what is called 'program operations'. Such evaluations study what is accomplished by the extension services and how it is accomplished. These kinds of evaluations refer to an assessment of the amounts and kinds of program activities considered necessary for the achievement of program goals. Orivel (1983:14) refers to such evaluations as 'internal evaluations' of extension services often carried out by sociologists, education and communications experts. The mechanisms to carry out such evaluations often include in- house units such as the Offices of Extension Studies and other evaluation and monitoring units. Most well-organized extension services have these evaluation units attached, usually as staff functions, to the headquarters offices.

Internal evaluations usually seek to measure the effectiveness of methods employed to reach the clientele, the number of people participating in the program, staff training, quality of staff performance, extension's links with research and inputs supplies, etc. etc. Additionally, such evaluations often include receiving informal feedback as to the happiness and satisfaction of client groups with regard to agency's activities and events. In other words, these kinds of evaluations measure largely extension's inputs. These activities (or inputs) are considered necessary but not sufficient to ensure the desired outputs of extension work. As Warner and Christenson (1984:31) assert "there cannot be output without program operations, but operating a program does not guarantee there will be results".

4.2 Sociological or Economic Evaluation

Results of extension work can be measured in two ways, i.e., on the basis of sociological criteria or on the basis of economic returns. Economist Huffman (1878:969) complains that the "Federal Extension Service in the United States has taken a sociological approach (as in USDA, 1977) to the evaluation of extension's output". A balanced evaluation of extension must, therefore, take into account the desired outputs in terms of changed behaviors, but more concretely in terms of increased productivity and production, improved efficiency and larger income. The concerns with cost effectiveness of agricultural extension services stem from this rationale.

4.3 Measuring Returns to Research and/or Extension

The evaluation of economic outputs of extension work have historically been undertaken by agricultural economists. The earlier research in this tradition was on the assessment of returns to expenditures on agricultural research only (Griliches, 1958:419). As the complementary relationships between research and extension variables became clearer, the economists, involved in this type of research, began to study the combined impact of research and extension expenditures on farm productivity. Some of the earlier studies on the impact of extension, therefore, do not delineate the impact of extension by itself. More recently researchers have learned about the complementarities between the two activities. Extension is now seen (Araji et al, 1978:968) as augmenting the effectiveness of problem identification for research. The economists now view it as reducing the time lag between the development of new technology and its implementation and it is generally viewed as increasing the adoption rates of agricultural research results. With this realization the more recent studies have begun to focus on the impacts of extension on farm productivity by itself.[7] Now it is well understood that returns to public investment in research are significantly influenced by the time and rate of adoption of research results by farmers.

4.4 Impact of Research and Extension Combined

Agricultural economics research has clearly established the fact that returns to agricultural research and extension expenditures are significant. Araji et al. (1978:964) refer to aggregate evaluation of agricultural research and extension by T. W. Schultz which shows that "the value of inputs saved in 1950 (9.6 billion dollars) in the U.S. far exceeded the cost of research and extension ($7 billion) for the entire period of 1910-1950". Similarly, they refer to Petersen's analysis of the U.S. agriculture which shows that the cost of agricultural research and extension for the period 1910-1967 ($8.4 billion) is about one-third of the value of inputs saved in the year 1967 alone (25.9 billion dollars). Their own study of nine agricultural commodities (Araji et al., 1978:968) in western United States shows that the rates of return to public investment in combined research and extension programs in production agriculture range from 33 percent for sheep and rice to 104 percent for potatoes. In an effort to delineate the impacts of extension alone they state that "depending upon the commodity and the nature of the research program 25 percent to 60 percent of the expected returns to public investment in agricultural research will not be realized without extension involvement". Ruttan (1982:248) similarly reported high rates of return (110 percent) on investment in farm management and extension education work. Further, a U.S. study (Pandis, 1973) similarly noted that "research and extension was the most important reason for large gains in productivity in the U.S. agriculture".

Norton, Ganoza and Pomareda (1987:247) using ex-ante approach assess potential benefits of agricultural research and extension in Peru using data on five major agricultural commodities programs undertaken by the National Institute for Research and Promotion of Agriculture (INIPA). The rates of return on investment in research and extension for individual commodities "ranged as high as 80 percent and in no case less than 10 percent" according to the authors. They conclude that under a pivotal shift the aggregate benefits to Peru on investment to research and extension would be about 47 percent.

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7 Araji et al., (1978) point out (p. 964) that "previous evaluation studies have failed to estimate explicitly the impact of extension on the overall research effectiveness".

On the question of complementarity between research and extension, Evenson (1986:81) has found that in developed countries research and extension complement each other. According to him, in the U.S. "higher levels of research investment made extension productive and higher levels of extension investment made research more productive". In less developed countries, however, extension does not appear to complement national research, according to the evidence that Evenson presents.

4.5 Returns to Investment in Extension Alone

An exploration of the available literature on developing countries, relating extension expenditures to returns, indicates that most often reported work in this area is based on the same limited number of studies conducted during the 1970s. It has already been reported that Lockheed, Jamieson and Lau (1980:37-76) presented a literature survey on farmer education and farm productivity in 1980. In this survey data from eighteen studies from developing countries were reported. The total number of data sets in these studies was thirty-seven. All of these data sets were used for an analysis of formal education of farmers and its relationship to productivity on their farms, which has already been reported in this Review. Obviously, some of these studies had included data on formal education as well as on extension exposure. In fact, in the same literature survey, Lockheed et al. (1980:37-76) presented data on nonformal education (agricultural extension) and agricultural productivity using sixteen of the thirty-seven data sets for which information on extension educational variables was available. The results of their analysis are reported as follows:

> We have further hypothesized that exposure to extension or other nonformal agricultural education experience should have a positive effect on output. In Table 6 we summarize the analyses of 16 of our data sets for which information on nonformal education was provided. Of these studies, eight provided evidence that extension was significantly positively related to productivity, one provided evidence that extension was significantly negatively related to productivity, and the remaining seven showed no significant effect.
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> We also explored whether formal education and nonformal education acted as substitutes or complements. A few studies incorporated interaction terms between formal and nonformal education in their production function regressions. Most of the coefficients of interaction were positive, suggesting, therefore, a possible complementary relationship between the two forms of education, even though few of the coefficients were statistically significant (Lockheed et al., 1980:58-60).

Jamieson and Lau (1982) reviewed the same studies in their literature review for their book on *Farmer Education and Farm Efficiency* and repeated the conclusion of Lockheed et al., reported above, almost verbatim.

Wallace Huffman (1978:969-975) analyzed eleven studies from developing countries and the United States to present information on returns to investment in extension. The results of his analysis are reproduced in Table 2.

Evenson (1986:81) on the basis of data from nine studies (from the U.S. and developing countries) of extension impact, concludes that "these studies identified positive extension program impacts on farmer productivity". He reports another study (p. 81) from the United States using state level data for 1948-71 in which he found a "statistically significant extension impact on agricultural productivity". He estimated that in that study "a $1,000 increment to extension spending would cause $2,173 increment to farm output within a two year period".

Table 2

Returns to Extension

Study		Country (Data Set Year)	Type of Study	Conclusion
1.	Patrick and Kehrberg (1973)	Brazil-Eastern (1968)	Production function	Extension, number of direct contacts of farmers with extension agents during the study year, had positive but generally not statistically significant effects on value added in farm production.
2.	Evenson and Jha (1973)	India (1953-54 to 1970-71)	Productivity change	Extension, index of maturity of extension program, contributes significantly to agricultural productivity change only through interaction with research programs. Investment in extension programs yields a 15-20% social rate of return.
3.	Huffman (1974)	United States-Corn Belt (1959-64)	Allocative efficiency-production	Extension (days, average for 1958 and 1960, allocated to crops by agents doing primarily agricultural work) and education are substitutes in inducing optimal nitrogen fertilizer usage or hybrid corn. The marginal value of extension time on this one decision is estimated at $4.48 per hour of extension agent time allocated to crops or a social rate of return of 1.3%. Total social return from enhanced decision-making suggested to be in excess of 16%.
4.	Mohan and Evenson (1975)	India (1959-60 to 1970-71)	Productivity change	The Intensive Agricultural Districts Program (presence vs. absence) contributed to more rapid agricultural productivity change. The social rate of return realized on the investment was 15-20%.
5.	Huffman (1976a)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Extension, agent days allocated three years earlier to crops and livestock activities by agents doing primary agricultural work, contributes significantly to level of agricultural production. The marginal product of extension is $1,000-3,000 per day.
6.	Mooch (1976, 1978)	Kenya-Vihiga, (a western division) (1971)	Production function	An index of crop related extension contact with male and female farm operators during the last year contributes significantly to corn (maize) yields. Extension and education are substitutes in corn production; extension interacts positively with the rate of nitrogen fertilizer application on male operated farms (1978).
7.	Huffman (1976b)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Same as for Huffman (1976a) except marginal product of extension $1,000-2,500 per day.
8.	Halim (1977)	Philippines-Laguna Province (1963-68-73)	Production function	An index of extension contact with farms, derived by weighting frequency of contact over previous five years, contributes positively and significantly to agricultural production. Marginal products imply a "relatively high return of extension contact."
9.	Huffman (1977)	United States-Corn Belt (1959-64)	Allocative efficiency	Same as Huffman (1974) except marginal value of extension time on this one decision is estimated at $600 per day of extension agent time allocated to crops or a social rate of return of 110%.
10.	Evenson (1978)	United States (1949-71)	Productivity change	Extension, expenditures on applied farm management research and on applied agricultural engineering research are combined with expenditures on extension activity and deflated by number of commodity-subregions, interacts negatively with education and positively with applied research. The internal rate of return on extension expenditures is 110%.
11.	Huffman (1978)	United States, Iowa, North Carolina, Oklahoma (1964)	Production function	Extension is measured as days allocated to crops, livestock, and planning and managing farm businesses and as days allocated to the separate components. Emphasis is placed on holding factors constant that may be correlated with the extension variables. Marginal product of extension is sensitive to output mix (livestock vs. crop), ranging from very large to negative values. Crop extension performs better than other components.

Source: Wallace E. Huffman. 1978. "Assessing Returns to Agricultural Extension," *American Journal of Agricultural Economics*. Volume 60, No. 5, p. 973.

Francois Orivel's 1983 review of literature on the impact of agricultural extension is reported in Perraton et. al (1983). He reports that there are difficulties in judging the impact of extension because of timing of assessment as well as because of the problem of objectives. He reaffirms what has been said earlier that some effects of extension might be delayed. Second, he points out that some research workers are interested in agricultural efficiency and production while others might wish to consider effects of extension on equity. If these interests do not coincide with the particular extension effort being evaluated then there will be a problem of the relevance of that evaluation.

As reported earlier, he classifies the studies he reviewed into two main categories. One category of studies, according to him, concentrated on internal efficiency of extension services. The principle concern of this category of studies was "with interaction between the extension services and the farmers, with the obstacles to effective interaction, with the underlying philosophies and with the effectiveness of extension services in disseminating information" (p. 14).

He found that studies of internal efficiency of extension services, which he reviewed to be generally critical and their diagnosis "to be excessive". For example, they pointed out that the extension agents often contacted only the minority of farmers and tended to contact those who are richer and better educated.[8] He faults these studies for methodological problems and for using inappropriate and irrelevant criteria. Realizing the limitation of these studies, Orivel concludes that these evaluations do not address themselves to the external impacts of extension work and they have rarely attempted to measure its effect on yields and incomes.

To ascertain the economic impact of extension services Orivel reviews three types of studies in the second category. They include studies which use measures of internal rates of return, correlation at regional level, and comparisons of yields and microeconomic production functions. In the first two types of studies he points out problems of ascription of results to causes. Perraton supports this view when she reiterates (1983:iii and iv) that where yields are compared before and after the introduction of an extension service, or between regions with and without extension services, it is not possible to attribute yield increases specifically to extension services.[9] In spite of these problems and weaknesses in the methodology, however, Orivel concludes that most external studies of these two types still show positive results for extension.

His analysis of external efficiency includes twenty- one studies in the third type. These studies are based on the individual farm level data. These studies have appropriate data to make such an analysis possible, in his opinion. Nine of these studies, as reported by Orivel, show significant positive correlations between contact with extension and productivity, eight found positive but statistically insignificant relationships, three found negative but insignificant correlations and one found negative and significant relationship between extension and productivity. Orivel (1983:3) reports that:

> those researchers who use aggregate data find high social rates of return to investment in extension services and high correlations between extension services and agricultural productivity, but methods used tend to overestimate the specific impacts of extension services. Those (economists) who use farm level data in their studies obtain mixed results.

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8 These studies point out a number of reasons for these and other problems of extension services such as unfavorable ratios of extension agents to farmers, inadequate training of extension agents, their location which may make it difficult to visit farmers, their pay, and uncertainty about their role and the variety of functions they may be asked to perform.

9 Almost every study on this subject points out methodological problems faced by researchers in assessing extension's impact on productivity. For a more detailed treatment see Feder and Slade, (1986a) and Birkhaeuser et al., (1989).

Another set of studies exploring returns to extension work which have not received international attention was reported in the Indian Journal of Agricultural Economics in 1979. These papers were presented in a theme session, on "Economics of Investment in Organization of Extension Services in Agriculture", of the thirty-ninth annual conference of the Indian Society for Agricultural Economics in 1979. The overall results reported in these studies are similar to the ones which have already been reviewed in this paper. A brief summary of the results of these papers is presented in Table 3.

Table 3

Economic Return to Extension: Results of Indian Studies 1979

Study	Data Set and Year	Conclusions
Maji & Haque (1979)	1955-66 & 1975-76	Expenditures on agricultural extension significantly contributed to fertilizer consumption and the adoption of high yielding varieties. The marginal product of extension in terms of gross value of output increased substantially.
Ram & Sirohi (1979)	1974-75 & 1977-78	The results pertain to the impact of total extension project, which provided a ratio of 1:16.95 between expenditure and net returns. "In other words, one Rupee spent on extension work would give, in the same year, a net return of Rs. 17. The returns in the long run were expected to be still higher."
Rai & Panghal (1979)	1970-71 & 1978-79	Extension's contribution to agricultural production was second to irrigation. The marginal productivity of extension was positive in each district. Per Rupee returns to extension work were higher in rainfed areas and drought-prone regions as compared with assured irrigation regions.
Singh, Singh & Singh (1979)	1976-1979	An aggregate cost-benefit ration of 1:11 for extension in terms of selected agricultural inputs was found. Benefits of extension through the Block Structure are above the opportunity cost. As the rural society differentiates its structure from a more primitive form to modern, the returns to extension increase. Using a Path Diversion Curve the authors conclude that rates of return to investment in extension depend both on social and economic factors.
Jayaraman (1979)	1966-67 & 1976-77	Extension makes a positive contribution to agricultural production. "As regards extension services as increase in extension expenditure of one million Rupees, holding other things constant, would at the margin result in 12 point increase in aggregate production index."
Singh & Bhullar (1979)	1974-75	One percent increase in extension expenditure would lead to .18 percent increase in output. A rate of return equal to 19 percent.
Ray, Atteri, Sen & Mathur (1979)	1975-76	This study concerns the Training and Visit system of extension. Introduction of this approach has resulted in increasing the cultivated area under HYVs. The impact of this system is found to be more on small holdings as compared to the large.
Patel & Parmar (1979)	1976-77	The results of regression analysis indicate that investment in extension has played a significant role in increasing agricultural production only in the high productivity areas, while in the low productivity areas it has played an insignificant and negative role.

4.6 Returns to Investment in Training and Visit System of Extension

As reported earlier in this review the World Bank has been concerned (Pickering, 1986:21) with the cost effectiveness of the Training and Visit System of extension, which it sponsors through its loan programs. Towards a justification of the heavy expenditures of manpower and financial outlay on the Training and Visit System of Extension a study was undertaken in Haryana state of India and the results are reported in Feder,

Lau and Slade (1985), Feder and Slade (1986), and Feder, Lau and Slade (1987). These papers present results from the same study of the effect of Training and Visit System of extension on farm productivity. The researchers compared two adjacent areas in northwest India, one with Training and Visit System of extension and one with an older extension system. Farm level data were used in the comparisons. Their analysis showed that the Training and Visit System area had a wheat yield advantage of 9.3 percent after four years of extension work. The gain in yield attributed to the Training and Visit System is shown to imply "a return of at least 15 percent to the incremental investment in extension with high probability".

The authors conclude that the Training and Visit System of extension increases the number of contacts between farmers and extension workers. They say that "the proportion of farmers reached increases the longer the Training and Visit System operates". The benefits, according to the authors, "appear to result from an improvement of overall farm operations rather than from the induced use of more (and new) inputs". Specifically, the study suggests that "the increased availability of extension agents and their access to subject matter specialist (and thus the research establishment) contributed to the agent's effectiveness in helping farmers respond to local farming problems". They conclude that "the change in the extension system contributed much of the gain in the study area". The study was conducted in an area where the level of agricultural technology used was quite high and the farmers had already gone through the green revolution experience. They quote a review by Herdt and Capule (1983) which cites several studies showing that "extension can accelerate the spread of innovations such as high yielding varieties". Based on these observations they conclude that "the basic elements of a new and profitable technology may spread naturally but the spread of more complicated methods and the adaptation of technology to local circumstances will be significantly improved if farmers have access to specific and up to date advice". They observe that "where there are not enough good and well organized advisors, extension is likely to be much less effective". Finally, they conclude that "free markets do not fully satisfy farmers' information needs and that government support is justified".

4.7 The More Recent Evidence

The most recent review of studies on rates of return to extension investment has been completed by Birkhaeuser, Evenson and Feder (1989). They recycle the same studies which have already been reported on, more than once, in this Review, along with some additional evidence, in examining the impact of extension investments on farmers' knowledge, adoption and productivity improvement. The authors recognize the problems of limited numbers of basic studies, and reiterate the methodological problems involved in identification of extension effects. They conclude "that majority of studies ... show, at least for some of the versions presented, a significant and positive extension effect". They also point out the variability of results from different areas and on different crops. The estimates of rates of return on extension investment, as presented in their Review, vary from 14% to 500+%.

5 References

Ahmed, Ifikhar and Vernon W. Ruttan, (eds.). (1988). *Generation and Diffusion of Agricultural Innovations: The Role of Institutional Factors.* Brookfield, USA: Gower Publishing Company, Inc.

Araji, A. A., R. J. Sim and R. L. Gardner. (1978). "Return to Agricultural Research and Extension Programs: An Ex-ante Approach". *American Journal of Agricultural Economics*, 60, 5, 964-975.

Axinn, George H. (1988). *Guide on Alternative Extension Approaches.* Rome, Italy: FAO. Unpublished paper.

Becker, Gary S. (1962). "Human Capital: A Theoretical and Empirical Analysis." *Journal of Political Economy*, LXX, (August).

Birkhaeuser, Dean, Robert Evenson and Gershon Feder. (1989). *Economic Impact of Agricultural Extension: A Review.* New Haven: Yale University, Economic Growth Centre.

Bowman, Jean Mary. (1976). "Through Education to Earnings." *Proceedings of the National Academy of Education*, 13, p. 221-292.

Caulkin, P. (1976). *Shiva's Trident: The Effect of Improving Horticulture on Income, Employment and Nutrition.* Ithaca, NY: Unpublished Ph.D dissertation, Cornell University.

Cernea, Michael M., John K. Coulter and John F. A. Russell. (1984). *Agricultural Extension by Training and Visit: The Asian Experience.* Washington, D.C.: The World Bank.

Chaudhri, d. P. (1979). *Education, Innovation and Agricultural Development: A Case Study of North India 1961-72.* London: Croom Helm.

Elias, V. J. (1981). *Government Expenditures on Agriculture in Latin America.* Washington, D.C.: International Food Policy Research Report No. 50.

Evenson, Robert E. (1986). "The Economics of Extension." In *Investing in Rural Extension: Strategies and Goals*, G. E. Jones (ed.). London: Elsevier Applied Science Publishers.

Evenson, Robert E. (1987). "The IRAC's and their Impact on National Research and Extension Programs." In *Agricultural Extension Worldwide*, William Rivera and Susan Schram (eds.). New York: Croom Helm.

FAO. (1984). *Public Expenditures on Agriculture in Developing Countries 1978-82.* Rome, Italy.

FAO. (1987). *Review of Regular Programme 1986-87.* Rome, Italy.

FAO Economic and Social Policy Department. (1988). *1988 Country Tables: Basic Data on Agricultural Sector.* Rome, Italy.

Feder, Gershon, Lawrence Lau and Roger Slade. (1985). *The Impact of Agricultural Extension: A Case Study of Training and Visit System in Haryana, India.* Washington, D.C.: The World Bank, Staff Working Paper #756.

Feder, Gershon and Roger Slade. (1986). "The Impact of Agricultural Extension: The Training and Visit System in India." *Research Observer*, 1, 2. Washington, D.C.: The World Bank, 139-161.

Feder, Gershon and Roger Slade. (1986a). "Methodological Issues in the Evaluation of Extension Impact." *Investing in Extension*, G. E. Jones (ed.). London: Elsevier Applied Science Publishers.

Feder, Gershon, Lawrence Lau and Roger Slade. (1987). "Does Extension Pay? The Training and Visit System In Northwest India." *American Journal of Agricultural Economics*, 69, 3, 677-868.

Ginzberg, Eli. (1966). *The Development of Human Resources.* New York: McGraw Hill.

Griliches, Zvi. (1958). "Research Costs and Social Returns: Hybrid Corn and Related Innovations." *Journal of Political Economy* 66, 419-431.

Halim, Abdul. (1976). *The Economic Contribution of Schooling and Extension to Rice Production in the Province of Laguna, Republic of Philippines.* Los Banos: Unpublished Ph.D. dissertation, University of the Philippines.

Haller, Thomas. (1972). *Education and Rural Development in Colombia.* Lafayette, IN: Unpublished Ph.D. dissertation, Purdue University.

Harbison, F. and C. Myers. (1964). *Education, Manpower and Economic Growth.* New York: McGraw Hill Book Company.

Harker, Bruce R. (1973). "The Contribution of Schooling to Agricultural Modernization: An Empirical Analysis." In *Education and Rural Development*, P. Foster and J. R. Sheffield (eds.). London: Evans Brothers.

Herdt, R. W. and C. Capule. (1983). *Adoption, Spread and Production Impact of Modern Rice Varieties in Asia.* Los Banos: International Rice Research Institute.

Huffman, Wallace E. (1978). "Assessing Returns to Agricultural Extension." *American Journal of Agricultural Economics*, 60, 5 (December), 969-975.

Jamieson, Dean and Lawrence Lau. (1982). *Farmer Education and Farm Efficiency.* Baltimore: Johns Hopkins University Press.

Jayaraman, T. K. (1979). "Evaluation of Agricultural Extension in Mahi-Kadana Irrigation Project." *Indian Journal of Agricultural Economics*, 34, 4, 40-48.

Lockheed, M. E., Dean Jamieson and Lawrence Lau. (1980). "Farmer Education and Farm Efficiency: A Survey." *Economic Development and Cultural Change*, 29, 1, (October), 37-76.

Lockheed, M. E. (1987). "Farmer Education and Economic Performance," in *Economics of Education: Research and Studies*, G. Psaracharopoulous, (ed.) New York: Pergamon Press.

Maji, C. C. and T. Haque. (1979). "Efficiency of Extension in Technology Transfer and Income Generation Before and After the Green Revolution in India." *Indian Journal of Agricultural Economic,* 34, 4, 1-11.

Moock, Peter. (1981). "Education and Technical Efficiency in Small Farm Production," *Economic Development and Cultural Change,* 29, 4, (July), pp. 724-739.

Mosher, A.T. (1958). *Varieties of Extension Education and Community Development.* Ithaca, New York: Cornell University, Comparative Extension Publication No. 2.

Norton, G., V. G. Ganoza and C. Pomareda. (1987). "Potential Benefits of Agricultural Research and Extension in Peru." *American Journal of Agricultural Economics*, 69, 2, (May), 247-257.

Oakley, Peter. (1986). "The Monitoring and Evaluation of Nonmaterial Objectives of Extension," in *Investing in Extension*, G. E. Jones (ed.). London: Elsevier Applied Science Publishers.

Oram, P. A. (1981). *Recurrent Cost Problems of Agricultural Research and Extension in Developing Countries.* Washington, D.C.: International Food Policy Research Institute, Working Document No. 9.

Orivel, Francois. (1983). "Impact of Agricultural Extension Services: A Review of Literature," in *Basic Education and Agricultural Extension: Costs, Effects and Alternatives*, Hilary Perraton et al., (eds.). Washington, D.C.: The World Bank, Staff Working Paper 564.

Pachico, D. H. and J. A. Ashby. (1976). *Investment in Human Capital and Farm Production: Some Evidence From Brazil.* Ithaca, NY: Cornell University, unpublished manuscript.

Pandis, George A. (1973). *Energy, Natural Resources, and Research in Agriculture: Effects on Economic Growth and Productivity.* Extension International Exchange Issue No. 8, (February).

Patel, N. T. and D. S. Parmar. (1979). "Contribution of Extension Services to Agricultural Production." *Indian Journal of Agricultural Economic,* 34, 4, 49-54.

Perraton, Hilary. (1983). "Orthodox and Unconventional Approaches to Extension," In *Basic Education and Agricultural Extension*, Hilary Perraton et al., (eds.). Washington, D.C.: World Bank, Working Paper 564.

Pickering, D. C. (1986). "Discussion," in *Investing in Extension*, G. E. Jones (ed.). London: Elsevier Applied Science Publishers.

Psacharopoulous, G. 1987. *Economics of Education: Research and Studies.* New York: Pergamon Press.

Rai, K. N. and B. S. Panghal. (1979). "District Wise Return to Agricultural Extension in Haryana." *Indian Journal of Agricultural Economics,* 34, 4, 27-31.

Ram, G. S. and A. S. Sirohi. (1979). "An Economic Evaluation of Study of 'Operational Research Project' in Rural Delhi." *Indian Journal of Agricultural Economics,* 34, 4, 20- 26.

Ray, A. K., B. R. Atteri, A. C. Sen and P. N. Mathur. (1979). "Quantitative and Qualitative Impact of Training and Visit System on Different Groups of Farmers." *Indian Journal of Agricultural Economics,* 34, 4, 11-20.

Rice, E. B. (1974). *Extension in the Andes: An Evaluation of Official U.S. Assistance to Agricultural Extension Services in Central and South America.* Cambridge: MIT Press.

Rivera, William and Susan G. Schram (eds.). (1987). *Agricultural Extension Worldwide.* New York: Croom Helm.

Roling, Niels. (1982). "Alternative Approaches to Extension." In *Progress in Rural Extension and Community Development*, G. E. Jones and M. Rolls. Chichester, London: John Wiley.

Rogers, E. M. and F.F. Shoemaker. 1971. *The Communication of Innovations.* New York: The Free Press.

Ruttan, V. W. (1982). *Agricultural Research Policy*. Minneapolis: University of Minnesota Press.

Sadan, Erza, C. Nachmias and G. Bar-Lev. (1976). "Education and Economic Development of Occidental and Oriental Family Farm Operators." *World Development*, 4, 445-455.

Schultz, T. W. (1964). *Transforming Traditional Agriculture.* New Haven: Yale University Press.

Schultz, T. W. (1971). *Investment in Human Capital.* New York: Free Press.

Schultz, T. W. (1980). *Investing in People: Economics of Population Quality.* Berkeley: University of California Press.

Schultz, T. W. (1987). "Education and Population Quality," in *Economics of Education*, George Psacharopolous, (ed.). New York: Pergamon Press.

Sharma, S. R. (1974). *Technical Efficiency in Traditional Agriculture: An Econometric Analysis of Rupandehi District of Nepal.* Australian National University, Unpublished Master's thesis.

Sidhu, S. S. (1976). "Production Value of Education in Agricultural Development. Minneapolis: Staff Paper, Department of Economics and Applied Economics, University of Minnesota.

Singh, A. J. and B. S. Bhullar. (1979). "A Study into the Nature and Impact of Agricultural Extension in Punjab State." *Indian Journal of Agricultural Economics*, 34, 4, 35-39.

Singh, Daulat, R. I. Singh and V. K. Singh. (1979). "Returns from Investment in Extension Service in Agriculture." *Indian Journal of Agricultural Economics*, 34, 4, 31- 35.

Swanson, Burton E. (1984). *Agricultural Extension: A Reference Manual.* Rome, Italy: FAO.

U.S. Agency for International Development. (1984). *Proceedings of the Agricultural Education Workshop, Yaounde, Cameroon, 22-27 July.* Washington, D.C.

U.S. Agency for International Development. (1985). *Stimulating Private Sector Extension.* Washington, D.C.

U.S. Department of Agriculture. (1981). *World Indices of Agricultural and Food Production.* Washington, D.C.

U. S. Department of Agriculture. (1977). *Analyzing: Impacts of Extension Programs.* Washington, D.C.: ESC-575, July.

Warner, Paul D. and James Christenson. (1984). *The Cooperative Extension Service: A National Assessment.* Boulder: Westview Press.

Welch, Finis. (1978). "The Role of Investments in Human Capital in Agriculture." In *Distortions of Agricultural Incentives*, T. W. Schultz, (ed.). Bloomington, IN: Indiana University Press.

World Bank. (1982). *World Development Report 1982.* Washington, D.C.

World Bank. (1983). *Strengthening Research and Extension: The World Bank Experience.* Washington, D.C.: World Bank, Report No. 4684.

Wu, Craig. (1977). "Education and Farm Production: The Case of Taiwan." *American Journal of Agricultural Economics,* 59, November, 699-709.

Yotopolous, P. A. (1967). "The Greek Farmer and the Use of His Resources." *Balkan Studies*, 8, 365-386.