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SOME NOTES ON EDUCATION AND AGRICULTURE WITH
SUGGESTIONS FOR RESEARCH

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Some Notes on Education and Agriculture with
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Current discussions of agricultural and economic development often cite education as a key (or the key) variable stimulating development. The paper presents a conceptual model of education with specific reference to the agricultural sector. Knowledge is classified in four categories based on the transferability of this knowledge between occupations and relevance of this knowledge over time. Educational activities are classified in three types based on the attitude of the individual and the evaluation made of his learning. Then, the various categories of knowledge are associated with the types of educational activities which are the source of this information. In the second section, education's role in agricultural development is examined. The third section suggests some areas of research in the economics of education in the agricultural sector which appear to have implications for agricultural and general economic policy.

Concepts and Definitions of Education

Education is the process or activity by which new knowledge is transmitted to or acquired by an individual. Schools are one type of institution engaged in educational activities, but educational activities are also performed by the family, church, armed services, on-the-job training, extension individual study, the

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communication/diffusion media and by other means.^{1/} Although new knowledge may be acquired by an individual in a variety of ways, this education is not effective unless it leads to a change in the future behavioral patterns of the individual.

The knowledge transmitted by most educational activities is multi-dimensional. A part of the total knowledge acquired by an individual may be purely a consumption good having no influence on productivity of an individual. Another portion of the total knowledge acquired by an individual can, at least potentially, increase the individual's productivity. For economic development of agriculture, it is the latter subset of total knowledge which is of immediate importance.

The knowledge which can potentially increase the productivity of an individual can be called "development knowledge" or "economically useful knowledge".^{2/} The process of transmitting developmental knowledge can be considered developmental education.

In part, developmental knowledge consists of facts and relationships between facts. However, for the agricultural sector, an important portion of developmental knowledge is ability to analyze facts and perform the synthesis required for decision-making to make use of facts and relationships between facts.

What constitutes developmental knowledge for an individual depends upon a variety of factors. The position occupied by an individual is of great importance. Developmental knowledge for a farm laborer is largely irrelevant for an office worker and vice-versa.^{3/} Even within agriculture, the economically useful know-

^{1/} For a classification of various education-producing activities see Machlup, Fritz; The Production and Distribution of knowledge in the United States, Princeton, Princeton University Press, 1962.

^{2/} Wharton, Clifton R., Jr., "Education and Agricultural Growth: The Role of Education in Early-Stage Agriculture", in C. Arnold Anderson and Mary Jean Bowman, eds., Education and Economic Development, Chicago, Aldine Publishing Company, 1965, pp.203-205.

^{3/} The organization of school curriculum usually recognizes this, and various programs are developed for people with different occupational objectives. In grade schools most pupils study similar material, but in secondary schools business courses, vocational agriculture, industrial arts and other programs are used. On-the-job training is often used by businesses to supplement school programs.

ledge required for one type of farming differs in part from that required by another type. The society and its level of development within which an individual exists also influences the type of information that is economically useful. For example, knowledge of motors is of little value in an agriculture using animal power, but as the process of development proceeds, the knowledge of motors may become developmental knowledge.

Economic development is a dynamic process and because of the changes which occur during the process, at least part of what constitutes developmental knowledge for an individual, can change during his lifetime. In some cases, economic development will require the acquisition of new knowledge in the form of new facts and new relationships between facts. However, it is more likely that as the process of economic development proceeds an individual must not only acquire new knowledge, but also must replace what was once economically useful knowledge with information which is relevant to the current situation. This is particularly true with respect to facts, however, knowledge of how to analyze and synthesize facts for effective decision-making should not require major modification. Although difficult to define, developmental knowledge is a useful concept in that it focuses attention on the subset of total knowledge that is economically useful. As more information regarding the process of economic and agricultural development is obtained, it may be possible to design educational activities which will transmit the maximum amount of economically useful information to various groups of individuals.

Categories of Knowledge

Conceptually for the agricultural sector, developmental or economically useful knowledge can be subdivided into categories of "societal knowledge", "basic knowledge", "scientific knowledge" and "applied knowledge." This subdivision is based on the transferability of the knowledge between occupations and the stability of the relevance of this knowledge over time within agriculture. This subdivision of economically useful knowledge also permits the association of particular categories of knowledge with various types of educational activities that are the source of this category of knowledge.

"Societal knowledge" is defined to include much of an individual's early experience such as language skills, learning to

communicate with other individuals, basic social conventions, and knowledge necessary for an individual to function within collective society. These components of societal knowledge are a very stable portion of developmental knowledge both for the individual over time and for occupations within agriculture. Some aspects of societal knowledge such as the adaptation to rural living may be less stable when considering possibilities of migration to an urban environment, but within a particular country much of societal knowledge is the same regardless of occupation.

"Basic knowledge" consists primarily of reading, writing, and arithmetic skills or what can be considered basic literacy. This category of knowledge, when acquired by an individual, facilitates the communication of new knowledge and increases the efficiency of other educational activities. Literacy has been considered similar to social overhead capital in the sense that both make their contribution to increased productivity in an indirect manner.^{4/} Basic knowledge is a component of development knowledge for all occupations within the agricultural sector and is readily transferable to non-agricultural occupations. While the abilities associated with basic knowledge are useful over the lifetime of an individual, they can be lost through the failure of an individual to utilize the skills associated with this category of knowledge.

"Scientific knowledge" is the third category of development knowledge. In large part, this category consists of knowledge and understanding of the principles which govern phenomenon with which an individual is associated. For example, this would include basic awareness of the nutritional needs of plants and animals. Many different levels of knowledge and understanding of scientific principles are possible. This creates difficulty in defining scientific knowledge in the framework of developmental knowledge. At one extreme, scientific knowledge may border on applied knowledge, while at the other, detailed understanding of scientific principles

^{4/} The concept of basic knowledge as defined here closely parallels the subset of general education, basic education, used by Wharton, Op. cit., p. 203.

may not be economically useful in a particular occupation. The level of understanding and skills required are likely to vary with the stage of agricultural development, thus, scientific knowledge can be more transitory than societal or basic knowledge. The skills required by individuals in various agricultural occupations based on scientific principles differ, reducing the transferability of skills based on scientific knowledge within agriculture. The transferability of skills based on scientific knowledge useful in agriculture to nonagricultural occupations may be very low.

"Applied knowledge" refers to the skills and knowledge acquired by an individual which are specifically applicable to a given occupation or type of employment. In the agricultural sector, examples of applied knowledge would be specifically recommended crop and livestock practices such as varieties, fertilizer applications, plant populations, insect and weed control programs, feeding rations and animal health programs. Also included are the manual skills required to perform particular agricultural tasks. By definition, the transferability of much of the applied knowledge is low among various types of agricultural enterprises and extremely low with respect to nonagricultural occupations. In a dynamic, developing agricultural sector, much applied knowledge is very transitory. As research advances, the recommended practices change and the applied knowledge of an individual becomes out-dated. In a traditional agriculture this information is more stable over time, but it is still highly specific to a particular occupation.

Types of Educational Activities

Educational activities can be classified into three classes. In all cases the material may be organized to communicate information to the individual, however, the distinction between classes is based on the attitude of the individual and the evaluation made of his learning. Formal educational activities include those activities where the individual is actively or deliberately seeking to acquire knowledge, there is some emphasis on individual's formal education, and a systematic evaluation of his learning is made. In semi-formal educational activities the individual is making a deliberate effort to acquire knowledge, but there is little or no evaluation made of the individual's learning. Informal educational activities neither involve deliberate action on the part of the

individual, nor is any evaluation made of his learning.^{5/} Neither semi-formal nor informal educational activities place much emphasis on former training or prerequisites.

Formal educational activities are those of the type normally considered as schooling. Primary and secondary schooling are examples of formal educational activities, as is college or university-level education. Secondary schooling may include academic, vocational, or technical training. Adult education is another type of formal educational activity.

Semi-formal educational activities include agricultural extension and community development work. Training in the area of religion could also be included in the area of semi-formal educational activities. In these cases, although a formal organization is transmitting information in an organized educational activity and the individual is actively seeking knowledge, little or no evaluation is made of the individual's learning.

Informal educational activities include most of the personal experience of an individual. A major part of an individual's informal educational activities occur in his contact with his family and friends. This is an important part of "the socialization process by which each society transmits its culture to the new generation."^{6/} Also included is an individual's contact with the salesman and advertising of business firms, radio, television, movies, newspapers, magazines and contact with other communication/diffusion media. For informal education activities, the distinguishing characteristics are the essentially inactive role of the individual in seeking this knowledge and the lack of evaluation of his learning.

On-the-job training poses some difficulties in classification. Occurring in an industrial situation, it often has the characteristics of a formal or semi-formal educational activity.

5/ Wharton, op. cit., p. 204 divides educational activities into formal and informal education based on the organization for the purpose of transmitting educational material and attitude of the individual, but he does not consider what evaluation of learning is made.

6/ Wharton, Clifton R., Jr., The Role of Farmer Education in Agricultural Growth, New York, Agricultural Development Council, Dec., 1963, p. 2.

However, the situation in the agricultural sector is different. Much of the agricultural training of farm-reared children is performed by the parents in an environment of informal educational activity. Some knowledge in agriculture is acquired by trial and error, but formal on-the-job training is rare in agriculture unless associated with a formal educational activity such as secondary vocational agriculture schools.

Association of Categories of Knowledge with Types of Educational Activities

In part, it is possible to associate the various categories of development knowledge with the types of educational activities which are the source of this category of knowledge. This association is by no means perfect, and the association of a particular type of educational activity with a particular category of knowledge does not preclude the possibility that the educational activity transmits knowledge classified in other categories. The possibility also exists that a particular type of educational activity does not, because of a variety of factors, transmit any developmental knowledge.

Societal knowledge, the knowledge necessary for an individual to function in society, is largely the result of informal educational activities. In particular, the family has an important role in transmitting this type of information. Contacts with friends and society are also of importance. Formal educational activities supplement the knowledge supplied by the family, as do later personal experiences, but the family is the primary source of societal knowledge.

Basic knowledge, which is largely synonymous with basic literacy is largely developed in the primary schools or specially designed adult education programs.^{7/} To be effective and prevent

^{7/} In Brazil, adult education programs exist to teach basic literacy and elementary technical and vocational training. For a report of these activities see the Diagnóstico Preliminar-Educação (II), Plano Decenal de Desenvolvimento Econômico e Social, Escritório de Pesquisa Econômica Aplicada - EPEA, Rio de Janeiro, Sept. 1965.

the loss of these basic skills, they must continue to be used. Other institutions, such as the family, may substitute for primary school and adult education, but this information is almost always transmitted in a formal manner, whether or not the framework of formal educational activities is used.

Scientific knowledge, is largely transmitted by formal educational activities. In particular, secondary and university education transmit this knowledge or at least have the potential for transmitting this category of knowledge, if the curriculum is properly designed. Technical and vocational training are also formal educational activities which transmit scientific knowledge to individuals. Semi-formal educational activities such as agricultural extension can also transmit scientific knowledge to farmers, particularly those scientific principles necessary for a farmer's decision-making. Although it appears that agriculture as an applied science cannot be taught at the primary level, the educational materials can be made more applicable to rural situations.^{8/} In some instances, primary education can be used to impart agricultural technology in addition to providing basic literacy.^{9/}

^{8/} Wharton, Clifton R., Jr., "Education and Agricultural Growth...", op. cit., p. 210 presents arithmetic problems similar to these faced in everyday consumption and production. Although not teaching economics, these examples do show how to perform necessary economic calculation.

^{9/} Winters, R. W.; "An Interdisciplinary Approach to Development", unpublished paper for Agricultural Economics 616, Spring, 1966 at Purdue University presented the following example of dual-purpose educational material.

"I am hungry.
 I eat when I am hungry
 I am weak when I do not eat.
 I cannot work when I am weak.
 Rice is also hungry.
 Rice cannot get enough food from mother earth.
 Rice needs food to work.
 We feed rice so it can work harder.
 Rice food returns to mother earth what is taken away.
 Rice food is called 'fertilizer'."

Applied knowledge, the skills and knowledge useful to a particular occupation, is developed in a variety of ways. In traditional agriculture, where applied knowledge is relatively static, an individual acquires this knowledge largely through contact with the family and informal on-the-job training. These sources of applied knowledge are important in all phases of the development process, but as economic development proceeds, other sources of applied knowledge also become important. Both informal and semi-formal education have a large potential role. Extension education can become an important source of applied knowledge as the development process proceeds. Informal educational activities such as contact with business firm representatives and others are also important. The communication/diffusion media of newspapers, magazines and radio can also be important sources of applied knowledge for farmers.

Education's Role in Agricultural Development

Educational activities make complex and varied contributions to economic, social, and political aspects of agricultural development. These contributions in various aspects of agricultural development are mutually reinforcing and often "people's development of understanding and skill in one area enhances their potential for advancement in others."^{10/} Educational activities make their contributions to agricultural development not only through the actions of farmers, but also through the actions of non-farmers serving farmers directly or indirectly, farm leaders and those who make policies affecting the agricultural sector. This note is primarily concerned with contributions to agricultural development that educational activities make through farmers.^{11/}

^{10/} Montgomery, George, "Education and Training for Agricultural Development" in Herman M. Southworth and Bruce F. Johnston, eds., Agricultural Development and Economic Growth, Ithaca, Cornell University Press, 1967, p. 148

^{11/} The effects of educational activities and their contributions to agricultural development nonfarmers is developed by Wharton, "Education and Agricultural Growth...", op.cit.

Schultz^{12/} indicates that educational activities benefit the individual and society with respect to present consumption, future consumption and future producer capabilities. The present and future consumption aspects of educational activities increase well-being in the present and future, but do not appear as measured economic development, in the sense of increased productivity and per capita income. Increased producer capabilities and the associated increase in productivity of individuals may result in measured economic development in the sense of increased per capita incomes.

Developmental educational activities can have three major influences on farmers and their families which contribute to agricultural development by increasing agricultural productivity. These influences are motivating the farmer to change, improving the farmer's ability to perform the managerial function, and providing factual knowledge necessary for decision-making.^{13/}

Formal and semi-formal educational activities may have an important role in motivating farmers to change by widening the scope of understanding and making more apparent possibility of change. Education exposes an individual to value systems other than his own and increases his inquisitiveness and desire for more knowledge. Thus the groundwork is laid for self-discovery and self-improvement, which is an important aspect in the transformation of agriculture. Extension activities, such as variety trials and fertilizer demonstration plots, show the farmer that different cultural practices can be used. The acquisition of literacy permits him to use sources of information which would be unavailable to the illiterate. Basically, educational activities through the introduction of new ideas can raise the level of aspirations and provide the means by which an individual acts to achieve his new level of aspirations.

12/ Schultz, Theodore, W., The Economic Value of Education, New York, Columbia University Press, 1963, pp. 38-39

13/ These contributions of educational activities are highly production oriented, but for the farmer the development knowledge is reflected primarily in production.

Educational activities may also act to improve a farmer's ability to perform the managerial function. In static, traditional agriculture many decisions are determined and conditioned by ritual and custom and the farmer has little need to choose among alternatives or adapt them to changing conditions. As agriculture becomes more market-oriented, prices become more important and the selection of enterprises and practices also increase in importance.

The modernization of agriculture with the new inputs and new forms of inputs which are available require a modification of decision-making on the part of the farmer. Much of the decision-making in traditional agriculture relies heavily upon historical precedent, like common law. Modernization of agriculture requires farmers to rely more on logical inference in their decision-making. In many situations, historical precedents are not available and the farmer must depend more or less on "scientific reasoning" for effective decision-making. Farmers in modernized, market-oriented agriculture are not necessarily more efficient in the allocation of resources, but they must be more aware of overall economic conditions than the traditional subsistence-level farmer. The basic and scientific knowledge provided by educational activities should be useful to the farmer in performing the increased managerial function of decision-making.

Educational activities can also make a contribution to agricultural development by providing the farmer with needed factual information or by equipping him to seek this information for himself. Farmers in modernized agriculture need factual information about new technologies available, prices of inputs and outputs to make rational decisions. Agricultural extension activity is one mechanism to provide farmers with information of new practices and developments resulting from the advance of agricultural research. Informal educational activities are also important sources of applied knowledge which spread the adoption of new technology.^{14/} Formal educational activities transmitting basic and scientific knowledge are important because they permit a farmer to utilize a wider range of sources of factual information; they can also

^{14/} Informal educational activities such as advertising and salesmen are an important means of the diffusion of new technologies developed by the private sector.

provide the background necessary to make an interpretation and evaluation of the information.^{15/}

In addition to economic benefits of education which are reflected in production, education may have other benefits for the individual. Literacy allows the use of additional sources of information and achievement of greater understanding of the world. Education may increase an individual's self-respect and his respect and position within the community. Being educated, he may be able to participate in the political process or to become a community leader. Although these "skills" may not be marketable, they may help an individual discover and enjoy a better life, thereby contributing to his psychic income.

Educational activities in the agricultural sector which increase output may also yield substantial economic returns to society. Increases in agricultural output may permit the agricultural sector to make substantial net contributions to overall economic development. Larger supplies of agricultural products often mean that prices are lower and the real income of consumers is increased. Possible improvements in the nutritional level of the population may have considerable impact on the general level of health and productivity. Larger foreign exchange earnings may be generated by sales of increased agricultural output or foreign exchange diverted from importation of food to importation of needed capital goods. Increased farm incomes enlarge the market for non-agricultural products and may be a stimulant to the development of the domestic non-agricultural sector.

Other societal benefits of educational activities may be demonstrated as higher incomes or reduced costs. Some examples of the economic returns to society are the reduction in cost of diffusing information, made possible with widespread literacy and the interaction of individuals in production where an increase in the productivity of one person increases the productivity of others. Educated individuals in specific positions may have an economic impact on others. For example, a research worker may be instrumental in alleviating a particular problem in the agricultural

^{15/} Mellor, John W., op. cit., p. 346-349

sector and the returns to his actions accrue to all of society, not solely to his individual.^{16/}

Another benefit of educational activities which has implications for the individual and society is that associated with the more equal distribution of income which may accompany an increase in the educational level of a population. Some of this effect may appear in those benefits discussed above for the individual and society, but there may be an additional societal benefit such as reduced interclass tension which may accompany a more equal distribution of income.

In the long-run, perhaps one of the most important benefits of education in rural areas is the preparation of rural children for non-farm employment. It is hypothesized that formal schooling may have a major impact on mobility of rural labor by providing them with skills which can be used in the non-farm sector. Given the great rural-urban migration which has occurred and will probably continue to occur, education in rural areas may benefit not only those leaving the agricultural sector by facilitating their entrance in the urban labor market but also work to increase the incomes of those remaining in the agricultural sector by promoting out-migration.

Some Suggestion for Research

Three underlying factors lead to concern with empirical aspects of education and agricultural development. First is the hypothesis that education has a major role in general economic and agricultural development. Second, education is not a homogeneous process, nor is the product of the educational system homogeneous. Investments in many types of educational activities such as primary school, general secondary school, technical and vocational training, adult education and extension activities could be made. However, the returns to investments in various types of educational activities are likely to differ in various sectors and within the same sector over time. The third factor,

^{16/} For a more detailed discussion of the social returns to educational activities see, Weisbrod, Burton A., "Education and Investment in Human Capital", Journal of Political Economy, Vol. LXX, No 5, Part 2, Supplement, October, 1962.

that of resource allocation, is linked to those above. Not only must decisions regarding allocation of resources among educational activities be made, but resources must be allocated between education and other types of development investments such as roads, research, credit, fertilizer, land reform and others. The suggested research issues revolve around the economics of education, but other research is necessary to provide information as a basis for an efficient allocation of resources among development investments.

In the agricultural sector, three types of educational activities, formal schooling, vocational and technical training, and extension have particular relevance from the viewpoint of public policy. These three educational activities can be most directly influenced by the public sector and which, because of the knowledge they transmit, have the greatest possibilities of influencing agricultural development within a reasonable planning horizon. Although many of the research issues are similar for all of these activities, because of the special characteristics of each, some of the research issues are different.

The following part outlines some of the research issues which appear to have important policy implications.

A - Formal Schooling

1. What is the impact of formal schooling on agricultural production and productivity?

a) At the level of the individual farmer, a previous study^{17/} suggested no economic payoff to investments in formal schooling in four areas, while there was a payoff in the most developed area studied. This study also indicated that private costs of schooling were high, implying it difficult for many children to attend school. This raises questions as to

- 1) What is the complementary between formal schooling and other development investments?
- 2) What are alternative ways of financing education?

^{17/} Patrick, George F., "Education and Agricultural Development in Eastern Brazil" Unpublished Ph. D. thesis, Purdue University, 1970.

- b) Another relevant question pertains to the payoff in agricultural output and productivity of primary versus secondary school education for the individual and society.
- c) As indicated previously, increases in agricultural output can contribute to overall development. These contributions may not be reflected by increases in farmers' incomes. Thus, the product market effects of increases in formal schooling or other activities should be examined. One hypothesis is that education does not have a payoff for the individual because increases in agricultural output lower farm prices. However, lower prices of agricultural products can mean higher real incomes for consumers such that it is to the advantage of society to promote education by subsidizing formal schooling.

2. What is formal schooling's effect on labor mobility?

There is substantial rural-urban and rural-rural migration in Brazil.

- a) Does schooling increase mobility?
- b) What are the private and social costs and returns of migration?
- c) What is the impact of outmigration on those remaining in agriculture?
- d) Does schooling lead to job and geographic mobility within rural areas?

3. What is formal schooling's impact on the functional distribution of income?

4. What are the other economic and noneconomic contributions to agricultural development and how are they distributed between the individual and society?

B - Vocational or Technical training

Vocational or technical agricultural training could be made an optional part of the secondary school curriculum in rural areas. Brazil also has a few specialized secondary schools that are agriculturally oriented (ensino agrícola). It may be possible

to obtain information from previous students of these schools to study the following:

1. What is its impact on agricultural production and productivity and the economic payoff for the individual and society?
2. Does it make labor more mobile?
3. Do the people with technical training become farmers or do they work in agriculturally related industries making their contribution to agricultural development indirectly?

C - Agricultural Extension

1. What is its impact on agricultural production and productivity?

- a) A previous study^{18/} suggests that, although not statistically significant, the payoff to production-oriented extension activities is high in four of the five areas studied. However, there is a tendency for the payoff to decline as the level of development of the area considered increases. This tendency and the overall impact of extension should be studied in other areas.
- b) It has been suggested that the tendency for the payoff to decline may be due to the relatively small output of agricultural research in Brazil. A study of the information transmitted by extension would shed some light on this hypothesis.

2. What are the spillover effects of extension activities?

Extension activities have a high degree of public support while many of the immediate returns accrue to the individual receiving assistance. One of the arguments cited for the public support of extension activities is its demonstration effect which spills over to other farmers, but the size of this effect is unknown.

3. What is the private and social payoff of the non-production oriented activities of the extension service?

18/ Patrick, op. cit.

Here the home and community development projects of extension would be evaluated in terms of their contribution to development and, if possible, by quantifying the costs and returns.

4. What are the objectives of the extension service?

Unlike other educational activities, the objectives of the extension service are subject to revision and programs are continually evaluated. Although these objectives may be largely politically determined, it is possible to evaluate the effectiveness of the extension service's program under various specified sets of objectives and its potential contribution to agricultural development.