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*Changes in Human Capital, Technology, and Institutions:  
Implications for Policy and Research*

The economic environment facing agriculture in much of the world during the past 15 years has been described as being turbulent (Schuh; Rausser *et al.*; Fishel and Kenney). The plenary, invited, contributed and poster papers and discussions at these meetings have focused upon many issues that relate to the theme, 'Changes in Human Capital, Technology, and Institutions'. My purpose is (1) to highlight issues that were underemphasised under this theme and (2) to present implications for future research and policy. Part (1) is included because a number of important issues received very little attention in these meetings.

ISSUES THAT WERE UNDEREMPHASISED

In this section, issues that were underemphasised are discussed for each of the following areas (a) human capital for agriculture, (b) research and technology, and (c) institutions.

*Human capital for agriculture*

Investments in human capital (schooling, information, immigration and health) change the quality of human time and skills for decision-making. A large body of evidence shows that these investments have important effects in agriculture, households and labour markets, especially when the economic environment is dynamic (Schultz 1975; Welch 1978; Jamison and Lau 1982). This focus was missing from the contents of the conference.

In a technically and economically dynamic agriculture, farmers' schooling and agricultural extension have been shown to have relatively large marginal products in market economies. Productivity arises from farmers' enhanced allocative efficiency – ability to perceive, interpret and take appropriate action in response to new information. Allocative ability is important in market economies when farmers must make decisions on adopting new technologies and on the input and output mix when relative prices change (Huffman 1974, 1985). Related to this issue is

\*Daniel Sumner and Gary Williams provided helpful suggestions, while Ulf Renborg encouraged a provocative format.

a possible threshold number of years of schooling that must be attained (e.g., 4–6 years or permanent literacy) before schooling has a significant effect on allocative ability. Also, does schooling enhance farmers' abilities to deal with greater uncertainty of a turbulent world? Finally, are farmers' schooling and agricultural extension substitutes for enhancing allocative efficiency of farmers? In centrally planned economies, and in China, very little is known about the effects of farmers' schooling on decisions and productivity of agriculture. With the exception of Chaudhri's paper, the importance of allocative ability of farmers in a dynamic environment received minimal attention in this conference.<sup>1</sup> I think this is a major oversight.

Schooling of adult farm household members (males and females) has been shown to affect their time allocation and household off-farm income. In an unstable agricultural environment, farm households can diversify their sources of income and reduce income uncertainty by having off-farm income, especially nonfarm wage and salary income, or by engaging in non-farm enterprises (Pollard and Meyer). The correlation of changes in non-farm wage rates and farm prices seems likely to be relatively low. Schooling has been shown to increase the probability of farmers' off-farm work (Huffman 1980; Huffman and Lange 1984; Rosenzweig 1980; Sumner 1982) and, in developed countries, to raise the wage rate received (Huffman and Lange 1984, Sumner 1982). Suh, Osburn, and Price (1982) also find that higher schooling levels of farmers increases their probability of off-farm work. Less evidence exists on the determinants of womens' participation in off-farm work. Other papers in these meetings that consider non-farm income of farm household members (e.g., Pollard and Meyer; Mukhopadhyay) do not focus on the human capital component.

Schooling for rural people enhances occupational and geographical mobility. With sustained economic growth or a turbulent world, labour market conditions for particular types of labour or skills can be expected to change. Occupational mobility is required to prevent a serious poverty problem in rural areas. With occupational mobility, some able individuals may be gainfully employed locally, but others will need to move to a different location. Schooling for males and females is critical for making this transition. Furthermore, Psacharopoulous (1981, 1984) has summarised a large number of studies showing high social rates of return to investment in elementary schooling and contributions of education to economic growth.

Significant increases in expected length of life in many developing and developed countries have occurred over the past 15–30 years. This change has been labelled the life-span revolution by some (Ram and Schultz 1979). The production of good health is centred in the household, but we know very little about this production process. Infant mortality is negatively related to mother's schooling, and child health is positively related. Very little is known about the link between food or nutrient consumption and good health, including energy levels, number of days worked, and life expectancy.

Increased life expectancy of individuals also has implications for optimal schooling levels and other resource allocations of farm and non-farm households during their lifetimes. The 'new home economics' provides a useful framework for considering household production of health and other human capital components (Nerlove 1974; Michael and Becker 1973; Becker 1981). Cloud employs this framework for considering the productivity of human capital investments in women.

The potential for agricultural extension is enhanced in a dynamic agriculture. In almost all cases, when the economic and technical agricultural environment is changing, the demand for information increases. The econometric evidence for productivity of agricultural extension is strongest in the United States and weaker in developing countries (Huffman 1978). The organisation of extension, ties to productive indigenous agricultural research, and goodwill with farmers seem to be important factors for determining the productivity of agricultural extension. These are important human capital issues that deserve attention by agricultural economists.

### *Research and technology*

Advances in knowledge are both the source of some of the changes in the technical environment facing agriculture and one source of solutions to problems encountered by agriculture in a turbulent world. Recent advances in biological sciences and computer technology provide potential for enhanced agricultural productivity and growth.

Little attention was given at these meetings to the issue of how to organise research so that agricultural sciences efficiently incorporate advances in basic knowledge. How do we quickly integrate advances in general sciences into applied agricultural sciences and agricultural technology? How do we set incentives for older scientists to stay up to date when rapid advances in knowledge occur? Longmire and Winkelman do raise the important issue of what should guide the allocation or reallocation of public agricultural research funds (e.g., comparative advantage, social rate of return). This is a very important issue for determining the social contribution of public agricultural research (Schultz 1983).

The efficient organisation of the international transfer of new biological technology is an important issue. The private sector seems to be more heavily involved in biotechnology than in the green revolution (Fishel and Kenney). This suggests that the mechanism for transfer may be different. Also, how should scientists be allocated internationally? Developing countries face strong competition for good agricultural scientists with developed countries and with international companies. Successful international borrowing of agricultural technology (by developing countries) requires an ongoing research enterprise and high-quality scientific talent (Evenson and Kislev 1973; Ruttan 1982, pp. 173-8). Very little agricultural technology is directly transferable internationally or between regions within a country.

The productivity of public agricultural research seems likely to be affected by the organisation and methods of financing public agricultural research. The establishment of successful agricultural research systems is a long-term process. The willingness of countries to fund public agricultural research differs considerably around the world (Judd, Boyce, and Evenson) and the reasons for these differences are largely unexplored. What is an efficient organisation of research for dealing with problems in a turbulent world? What role should farmers and other groups play in the decision-making process and in the funding process? Also, how can multiple disciplines be efficiently employed? Large problems need the expertise of several disciplines. However, multidisciplinary teams that look for problems to solve seem likely to be unsuccessful.

### *Institutions*

In a turbulent and changing world, it is useful to consider institutions to be adaptable. Olson and Schmitt have presented papers at this conference dealing with new theories of public choice where public policy is endogenously determined.<sup>2</sup> (Also, see Becker 1983 and Peltzman 1976.) Theories of competitive pressure groups provide a framework for showing how minority groups in a population can have strong political influence. They must be relatively efficient at exerting political pressure. The new public choice provides a promising framework for explaining national agricultural trade and other policies. There is, however, relatively little econometric evidence to show the usefulness. Exceptions are von Witzke; Rausser and Freebairn; Guttman; Huffman and Miranowski; Huffman and McNulty. Can the models of the new public choices explain changes over time in the policies applied to agriculture in terms of changes in parameters that affect the distribution of benefits-costs of these policies among affected groups (see Gardner 1983)?

Alternative farm policies for dealing with a turbulent world economy have distributional implications. Some of these effects have been considered by Just and Zilberman (1984) but others include the distribution of benefits among farmers who have different managerial abilities, the incentive for managerial skill development in the future, and the long-term incentives for nonhuman capital investments.

## IMPLICATIONS FOR RESEARCH

Based upon the state of knowledge in these broad areas of human capital, technology and institutions, I am suggesting a relatively small set of research implications. These are research issues that I think are relatively important across developing and developed countries. First, I am making an appeal for high-quality econometric research. I have detected a reluctance by authors of papers at this conference to put forward new theories of behaviour and econometric evidence to test their theories.

The only way that we can advance in our knowledge of the behaviour of agents and institutions is to provide sound econometric tests of competing theories. My specific suggestions for research are:

1. Identify the relative importance of farmers' schooling and experience, public extension and private information on farmers' abilities to adapt to a turbulent economic environment.
2. Identify the determinants of public funding for government farm programmes, agricultural research, agricultural extension and schooling for rural people.
3. Investigate effects of alternative farm programmes to deal with a turbulent world (a) on human capital attracted to agriculture and (b) on incentives for long-term capital investments in agriculture.
4. Investigate the determinants of part-time farming and implications for farm household welfare.

These ideas provide a starting point. The hard work of turning them into meaningful research projects and programmes is left to you.

### IMPLICATIONS FOR POLICY

I am somewhat reluctant boldly to suggest policy implications for representatives from such a diverse set of countries. For a wide range of countries, the following policy implications do, however, seem to be relevant:

1. Permanent literacy should be established for rural populations in developing countries.
2. Average schooling completion levels of rural and urban populations should be equalised.
3. National agricultural research systems, especially in developing countries, should establish incentives to attract and keep at least a few high-quality agricultural scientists.
4. A country's trade, exchange rate and domestic food policies should not be permitted to preclude benefits from agricultural research.
5. Public agricultural extension should emphasise distribution of timely and new information and should not directly be associated with politics.

In conclusion, I think that human capital for farm people is a high priority when one considers the ability to adapt efficiently to changes in the economic environment associated with a turbulent world.

### NOTES

<sup>1</sup>Although several papers in this Conference focused on farmers' adoption of new technology, none emphasised the role of farmers' schooling or agricultural extension.

<sup>2</sup>Berlan's concept of institutional transformation is descriptive. It does not contain a framework that yields testable propositions.

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