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COMMENTS ON "AN INDUCED INNOVATION INTERPRETATION OF TECHNICAL CHANGE IN AGRICULTURE IN DEVELOPED COUNTRIES" PRESENTED BY VERNON W. RUTTAN

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I found the Ruttan paper a useful synthesis of the current state of the theory of induced innovation and the empirical evidence bearing on this theory. It is especially useful for those, like myself, who have not followed the considerable research in this area since the original interpretation by Hayami and Ruttan in the early 1970's.

Nonetheless, there are a number of important weaknesses in the theory and its empirical testing for explaining technological change as endogenous in the historical process of agricultural development in the developed countries.

First and most importantly, as Ruttan notes, the induced innovation model has been, by and large, used to explain the direction of technological change. However, for technological change to be really endogenous in agricultural development theory, we must be able to explain the rate of technological change. To do this, requires an understanding of both the factors which affect the level of resources invested in agricultural research and factors determining the productivity of these research investments.

Second, it is curious that a model based on micro-economic theory has been largely tested using national and international level statistics from developed countries. Some good micro-level case studies of specific innovations are needed to document the actual processes that lead to an innovation responding to a change in factor prices. These might be cases

from historic events. For example, in Australia a mechanical wheat harvester was developed in response to a severe rural labor shortage when gold was discovered and rural workers left to work in the gold fields. Or specific cross-sectional data might be used to further understand the innovation process. For example, why have many Europeans countries, emphasized development of high yielding wheat varieties with little attention to disease resistance and which therefore require applications of fungicides. Meanwhile the U.S. and many other countries have successfully developed disease resistant wheat varieties. Finally, there is a need to study the innovation process in relation to characteristics of innovating institutions. I would expect different behaviour with respect to mechanical and chemical innovations which are largely developed by the private sector, including by farmers themselves, and biological plant breeding innovations which have been largely the product of the public sector.

I turn now to the limitations of using the induced innovation model for agricultural research management and policy in developing countries. Clearly, factor price distortions in developing countries have important effects on resource allocation. The fact that these distortions may have long-run effects through biases in agricultural technology generation, strengthens the argument for reducing these distortions to the extent possible. However, factor price distortions do represent the interests of particular groups of the population and are unlikely to go away. Unlike Ruttan, I

believe research decision makers must and should take into account these price distortions in allocating resources. I agree that it is not possible to introduce a technology that is socially desirable but not profitable to farmers without a change in the relevant prices. However, it is possible to screen out those research opportunities that would, because of factor price distortions, be quite profitable to farmers, or at least some farmers, but which do not make economic sense from the national viewpoint. I am thinking here, for example, of screening out research on varieties suitable for mechanical harvesting in a situation where mechanical harvesting would only be profitable to farmers because of factor price distortions.

We should also remember that prices are usually not a good guide for evaluating the income distribution objectives of agricultural research. In fact, prices reflect underlying pattern of asset distribution. In Mexico for example, agricultural research to develop protein sources might emphasize beans if we are primarily interested in low income consumers. Left to Market forces, more research might be done on sorghum for livestock feed to produce animal protein for middle or high income consumers. These considerations should be weighed in making decisions on the allocation of research resources. At present, a major limitation on this type of analysis is the lack of adequate social science capacity in most agricultural research institutions.

Finally, I agree with Ruttan that greater attention needs to be given to interaction between farmers, scientists and research administrators to ensure that technologies are better focussed on the needs of the client, the

farmer. We at CIMMYT have advocated a descentralized adaptive or onfarm research effort as a mechanism for facilitating this interaction. Information aggregated over area specific onfarm research programs can then be used to orient more basic research programs operating at the provincial or national level. However, for the proper functioning of such a system, research managers must provide incentives to researchers to work on real world problems. Unfortunately, few research systems measure research success by the rate and extent of adoption of technologies being released by the system.

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