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Is research a global public good?

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Research, and in particular biological research, today is very likely to be patented and thus may not benefit the poor in the developing countries. It is no longer a public good. This conflicts with the initial objective of biological or agricultural research to contribute to food security and poverty alleviation. This situation calls for new initiatives to fund public research in general and national and international agricultural research systems in particular.

Public goods have two characteristics: First, the consumption of the good by an individual does not detract from that of another; and, second, it is impossible or at least very difficult to exclude anybody from consuming the good. Most knowledge derived from research fulfills the first condition: whether or not I know something does not detract from the ability of others to have the same knowledge. However, generators of knowledge, e.g., research institutions, or distributors of knowledge, e.g., scientific journals or newspapers, may attempt to limit access to specific knowledge to those who are willing to pay. Thus, the second condition may not be fulfilled, although the Internet makes it more difficult to limit knowledge dissemination to those who are willing to pay.

Furthermore, while those who are not willing to pay may be excluded from access to new knowledge initially, it is very difficult for the original owner of the knowledge to get around the fact that the knowledge flows from the initial buyers to others, precisely because the initial buyers do not use up the knowledge. Also, once the knowledge is obtained, whether it was purchased or obtained for free, it can be used over and over again without paying the original owner. New knowledge about agronomic practices would be an example of such knowledge. Some knowledge is only of interest locally or nationally, e.g. optimal planting time for teff in a particular region of Ethiopia, while other types of knowledge are of interest and benefit globally, for example, knowledge about international economic trends and certain health, food, and agricultural issues including knowledge from certain kinds of agricultural research.

Are computer chips and improved seed public goods?

Filling the bowls for all and preserving the biodiversity is the initial basic objective of international agricultural research.

Knowledge may be embodied in physical technology such as computer chips or improved seed. Is such technology a public good? It depends. If the use of the technology by one person precludes its use by another or if certain individuals or groups can be prohibited from obtaining benefits from the technology, the technology is not a pure public good. Thus, neither computer chips patented by Intel nor Round Up Ready soybean seed patented by Monsanto are public goods. Each of the companies has exclusive rights to the technology protected by patent laws. The intellectual property rights are clearly defined. However, enforcement of these

rights is likely to be much more difficult in the case of biological technology such as improved seed, because, contrary to computer chips, seeds multiply and the farmer may use his own seed in future planting without paying the original owner, e.g. Monsanto. Although farmers may enter into contracts with seed companies agreeing not to use their own seed, such contracts are difficult to enforce. Therefore, while the benefits to society, including farmers and consumers, may be large, private corporations may be unable to capture enough of these benefits to warrant investment in the research needed to develop the technology.

The importance of property rights

The development of hybrid seed helps the seed company recuperate the research and development costs because, contrary to open-pollinated seed, farmers need to buy new seed every season to maintain the improved traits of the original seed. The much discussed terminator gene, if ever commercialized, would be another way for the seed company to assure that the farmer buy new seed every season because his production is sterile. While the notion that the seed produced by the farmer is sterile is ethically unacceptable, at least for small farmers in developing countries, because of the associated risks and dependency, a more ethical approach involving the ability to turn on specific new traits in a seed is currently being developed. Using such an approach, farmers would have the choice of buying the chemicals needed to activate the improved traits embodied in the seed, e.g. insect resistance, or plant the seed with the original traits. Farmers who choose not to buy the chemicals would presumably be no worse off than before trying the improved seed.

But even if the private research agency could enforce property rights, for example through hybrid seed or built-in gene switches such as those mentioned above, research investments by the private sector would be less than socially optimal. The reason is that groups other than farmers, e.g. consumers, would benefit through lower prices. Since the private research agency does not have the right to tax consumers, the benefits derived by the farmers will set limits for how much the agency can capture. Therefore, relying on the private sector for agricultural research is likely to result in under investment from the point of view of society.

The importance of basic research

Continued public funding of basic agricultural research is essential for continued technology development.

So far, the discussion has focused on applied research leading to knowledge and technology of direct utility for farmers. But applied research depends on the availability of results from basic research, the latter being more likely to be a public good. Private research agencies including the large life science corporations have benefited greatly from past university and other public sector research. Will the public continue to invest in such basic research? If not, will the private sector provide the funding and will that imply that results from basic research be more likely to be patented? Recent partnerships between life science corporations and universities indicate that the former recognize the importance of continued basic science, even if they have to cover at least some of the cost and even if they are not assured exclusive rights to the resulting knowledge. However, continued public funding of basic sciences underpinning the development of improved agricultural technology is essential for continued technology development.

Implications for poor countries and poor people

What does all this mean for small farmers and poor consumers in developing countries? First of all, a great deal of evidence shows very severe under-investment in agricultural research in developing countries. The economic returns from past agricultural research for developing countries are very high and the potential benefits from additional research by far exceed the expected costs. Private sector research relevant to small farmers in developing countries is very limited even in the larger middle-income countries. It is almost non-existent in the poorer developing countries, including most of the African countries. The public goods nature of the technology needed by small farmers in developing countries along with lack of rural infrastructure, lack of access to credit among farmers and traders, and poorly functioning markets for seed, fertilizers, and agricultural output account for the limited private investment. Furthermore, although early adopters of new technology may gain, most of the economic gains are likely to be captured by consumers through price decreases resulting from productivity gains and expanded domestic supply.

As countries liberalize trade, the domestic price decreases

As countries liberalize trade, the domestic price decreases may be less and farmers may capture a larger share of the benefits. Furthermore, consumers in other countries may benefit. In the case of small countries producing for effectively functioning export markets, the producers may capture almost all of the benefits. In such cases, producer groups may be willing to pay for productivity-increasing research and the private sector may be able to capture sufficient economic gains to warrant the research. Coffee producers in Colombia, who are mostly small farmers, and producer levies on export commodities in Australia, are illustrations. However, for most food commodities in most developing countries, a large share of the benefits from productivity-increasing research will accrue to consumers. The social gains may be large but private research agencies will not be able to capture a large enough share to justify the research. Furthermore, gains to society from improved management of natural resources may not be captured by the private research agency.

The importance of publicly funded research

The intellectual property rights of improved seeds may cause conflicts between private companies and farmers, who will use their own seed in future planting and not be willing to pay the owner of the originally patented seed.

Such a situation calls for publicly funded agricultural research. Strong national agricultural research systems (NARS) focused on solving problems facing poor farmers and consumers are likely to make major contributions to both efficiency and equity goals. These contributions would be significantly enhanced if the NARS have access to results from international research aimed at the creation of knowledge and technology relevant to many countries, i.e. global public goods, such as that currently produced by the centers sponsored by the Consultative Group on International Agricultural Research (CGIAR). The impact of NARS may also be enhanced through innovative partnerships with private sector research agencies in which non-exclusive rights to processes and traits are transferred from the patent holder to NARS for restricted use in research to develop technology for eco-regions and commodities of little or no commercial interest to the patent holder. The private research agency holding the patents would, in turn expect to improve public relations and develop new markets as poor farmers who benefit from the technology become customers. The former would be of particular interest to the large life science companies suffering from bad publicity related to genetically modified seed. The CGIAR might be an appropriate broker and participant in such partnerships.

Strong national agricultural research systems are needed to solve the problem of food security.

As globalization proceeds, benefits from agricultural research applied in one location would be more widely distributed. With fully liberalized trade, the benefits from, say, productivity increasing technology applied to maize farming in Uganda resulting in reduced maize import or expanded export would no long be limited to Ugandan consumers. Outside Uganda, maize consumers and consumers of livestock fed with maize could benefit. This justifies a sharing of research costs across country border.

Is agricultural research a public good?

As illustrated above, agricultural research is neither a pure private nor a pure public good. However, the public goods characteristics of much agricultural research, particularly that needed by small farmers and poor consumers in developing countries, together with poorly functioning markets in most developing countries results in very limited investment by the private sector in agricultural research. Low priorities for agricultural development and improved food security among many developing country governments along with lack of knowledge about how powerful agricultural research can be to achieve economic growth and

reduced poverty and many governments' short planning horizon relative to the time lag between the investment in agricultural research and the resulting benefits are the main reasons for the serious under-investment of public funds.

Failure by the public sector to expand investment in agricultural research will result in lost opportunities for increased economic growth and reduced poverty and food insecurity. This, unfortunately, is the current prognosis for most developing countries.
