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BRIDGING THE GAP BETWEEN RESEARCH AND APPLICATIONS IN THE THIRD WORLD

by

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This is a discussion paper presented at the UNIDO Expert Group Meeting on "Applications of Biotechnology to Food Processing in Africa", held in Ibadan, Nigeria during December 16 - 20, 1991.

BRIDGING THE GAP BETWEEN RESEARCH AND APPLICATIONS IN THE THIRD WORLD

Introduction.

The move of biotechnology and related know-how from laboratory to the applied sectors of industry, agriculture and health takes place but rarely in developing countries. On the one hand, mechanisms that would facilitate such transfer either does not exist or is poorly developed in these countries. On the other hand, economic, legal, and social barriers prevent such mechanisms from being developed. During the time I have available I will try to accomplish three objectives. First, using the findings from a study I did in 1988, and from observations since that time, I will briefly discuss the generic reasons that prevent the transfer of biotechnology within developing countries. Second, I will suggest measures that should be taken by governments to overcome these problems. Third, I will review the assistance international agencies, especially UNIDO, can provide that promotes in and between developing countries.

I. The Problem of Transferring Biotechnology in Developing Countries.

In 1988 I undertook a project on behalf of the United Nations University to assess the technical assistance provided by four major United Nations (UN) agencies to developing countries in the field of biotechnology.(932) The unexpected major finding from that study was that practically all technical assistance being provided was aimed at building up the research capabilities of developing countries; very little, if any, assistance went to industry or agriculture. Further, the agencies made only a rare attempt to make certain that the research they supported generated findings or results useful to the applied sector. In other words, biotechnology, which by definition implies application, was not being deployed to solve the pressing problems of developing countries, nor to boost their economic development.

At first glance, it would seem that the UN agencies were seriously remiss in how they directed their scarce resources. An in-depth analysis of the situation existing in the case countries of Egypt, Thailand and Venezuela indicated more fundamental and complex reasons for how international agencies provided technical assistance. Four interconnected reasons predominate:

First, scientists, and their professional societies, are well-organized to voice their demands. Their collective voice becomes doubly powerful when they can make a persuasive case; in this instance, the necessity of building a strong scientific base without which biotechnology cannot grow and progress. Also, the fact that scientists are government employees in developing countries enables their spokespersons to have direct access to the decision and policy makers who represent their countries at international agencies. In effect, when assistance is sought from international agencies, scientists being unified and well-represented, are in an excellent position to voice their requests.

Second, conversely, no bioscience-based industry exists as such in developing countries. Further, firms dependent on fermentation production methods that in industrialized countries are well placed to adopt biotechnology, such as pharmaceutical plants, do not exist in the Third World -- so-called pharmaceutical plants in developing countries are usually subsidiaries of multi-national companies that have only a packaging function. This means that there are few spokespersons, and no industry interest group, to present the views or demands of those in the applied sectors to either national governments or international agencies.

Third, by far most developing countries lack effective mechanisms for transferring results and findings from the research laboratories to those who might be in a position to use them in industry or agriculture. Referring to Figure 1, universities and other public research institutes do not have units that take on applied research or applied research and developent (R&D); neither does industrial firms have such units. Further, specialized technology transfer offices so common in major research universities in the US and other industrialized countries are nowhere to be found in the Third World, neither does industries possess technology acquisition departments whose job it is to ferret out useful applications from research done at public and private universities. This situation dictates that the best intention of international agencies to fund research having specified applied objectives will come to naught, since there is no way for the results to reach those who may apply them.

Fourth, adding adversity to this already distressing situation is the poor entrepreneurial environment existing in developing countries; i.e., science-based entrepreneurship was discouraged due to poorly designed or outdated tax laws, intellectual property laws, and other legal barriers that punish business success while making no allowance for risk taking. In addition, powerful social disincentives exist that block scientists from taking on applied research or associating with industry. Simultaneously, industrialists face formidable bureaucratic barriers when they attempt to contract for directed research at university laboratories or to engage local scientists as consultants to solve problems or improve processes. As a result, they find it easier and quicker to buy required technology or expertise from US, English, Japanese, Taiwanese and other foreign sources.

I will now draw on personal experience to illustrate the difference in technology transfer between a industrialized nation (USA) and a developing country (Ecuador). At present I am performing an assessment of the status of marine biotechnology in the US. Simultaneously, I have evaluated some project proposals in Latin America for possible UNIDO assistance. One of them concerned marine biotechnology in Ecuador.

In the US, professor Miriam Polne-Fuller working at the University of California at Santa Barbara, has been performing basic research on the interrelationship between a certain marine amoeba and giant kelp for over six years. While doing so, she obeserved that the amoeba was able to digest the very tough alga leaves. Intrigued, she wondered if this amoeba also had the ability to digest manmade substances, such as plastic. Laboratory investigation indicated that the amoeba was indeed able to break down several types of manmade polymers, albeit at low effieciency. Polne-Fuller then spent the next year developing the organism, using classical breeding and selection techniques, until she had a fairly efficient strain. At that time, she informed the University's technology transfer office about her findings and it began the process to patent the organism. The technology transfer office also prepared a statement for its monthly newsletter describing the experiment and findings. The newsletter is routinely sent out to companies throughout the US.

The technology transfer office at Occidental Petroleum Company read the notice and immediately recognized its importance for the company, which is one of the largest manufacturer of certain plastics in the US. The importance lies with the fact that more and more American states are adopting legislation that promotes or orders recycling of plastics in the community and the manufacture of packaging that is biodegradable. So Occidental contacted the university's tech transfer office, and it acted to bring the researcher together with the company. After negotiations, the company agreed to fund applied research to develop an amoeba useful to industry. As the first step, the university and company researchers will work jointly to develop radioactive polymers, so the anabolic process of the amoeba can be clarified. No such probes exist today, so this is a new departure for both sides. In any case, if further progress is made, the company will take over the development process and if commercialization is achieved, the university will receive royalties. According to University policy, about 70% of proceeds are returned to Dr. Polne-Fuller's laboratory.

An alternative scenario, and one that is perhaps more common in the US, is that the researcher would have formed her own company and sought to raise funds via forming a general or limited partnership with entrepreneurs or making private or public offerings of stock. The small start-up company may also seek funds from the state or from on of the federal agencies. On the state level, for example, the State of Maryland has an innovative program called Maryland Industrial Partnerships, which funds cooperative research between universities and companies at a maximum of $ 50,000 per year for three years. In addition, some universities, such as the University of Maryland, have established so-called incubators, where a small science or technology-based company may rent space for offices and laboratories at exceedingly favorable rates and access university resources, such as computer centers, data bases, library and expert assistance. On the federal level, all major agencies, including the National Science Foundation, the Department of Agriculture, the Department of Defense, etc., must set aside 5% of the funds they use to support research and development for so-called small business innovative research, which in effect supports research and development by companies having fewer than 500 employees.

Now to return to the researcher in Ecuador. This scientists, who holds a regular appointment at the Catholic University in Quito, has been researching diseases that afflict shrimp aquaculture in that country. You should know that Ecuador is now the second largest producer of aquacultured shrimp in the world.

The most serious constraint to its aquaculture industry is disease.

When I visited this scientist's laboratory in September, he had been working on a vaccine that would protect shrimp from certain marine vibrios. He had recently been able to show a strong protective reaction by shrimp that had been administered the vaccince. At this point, he has a product that seems promising. But, he has been unable to find the funds to develop it further. The aquaculture industry in Ecuador is not willing to provide funds, even though it would seem to be in its interest to do so, because it does not see a short-term gain from this research, neither does companies receive any credit in the form of tax breaks or other incentives, for funding this research. Private persons and companies are not interested because they perceive this project as being risky, and they would not receive any tax credit or other financial incentive if the venture failed. On the other hand, if the venture was successful, the profits would be taxed at about 60%. And the government has no program that promotes small industry. In the end, this researcher's only possibility seems to be to try to raise funds from international sources. However, he has no contacts with international business or international agencies and would, in any case, lack the business expertise to be able to negotiate an equitable contract. The likelyhood is high that a business in Taiwan or Korea, where shrimp aquaculture is very big, would contract with him to develop a product, but would in the end swindle him.

II. Overcoming Barriers to Technology Transfer.

Overcoming barriers to technology transfer takes cooperative, complimentary actions from the two parties directly involved in the transfer, the technology producer and the technology user, as well as the government. However, the government's responsibility in this regard is crucial, so I begin with a discussion of its role.

A. Government and Technology Transfer.

A government may encourage technology transfer by direct and indirect means. The direct means have been analyzed and discussed at many fora and in many articles, so I will only briefly mention them here:

Strengthening the research base. Universities in developing countries are mostly supported by governments; researchers are mostly government employees. As is well known, public universities are underfunded and researchers are grossly underpaid. A significant strengthening of reseach can only come about if governments take the hard decisions to divert scarce funds from other programs in order to strengthen research. In a time of severe budgetary contstaints this is not likely to happen; nevertheless, this is what is required before a country can gain from a science-based industry such as biotechnology industry.

Make funds available for small business initiatives. After the scientist-inventor has had a good idea and has been verified it as commmercially promising in the laboratory, a point is reached where funds for further development is required, but these funds are exceedinly difficult to raise since investors will perceive the venture at this early stage as being too risky. A government is probably the only source in most developing countries for this kind of funding; if it is not available, the venture dies.

B. Technology Producer.

The major indigenous technology producers in the developing countries are universities and public scientific or technical institutes. It is imperative that they establish technology transfer units. Often, this will mean that universities will have to break out of the mold set perhaps hundreds of years ago, that of the academic ivory tower. Universities are changing everywhere, even the ancient universities of Europe that were once the model for the academic ivory tower. One reason for this change is that the scientific research done at these universities can no longer be designated as basic, in contrast to applied research done by industry. In biotechnology especially, findings from so-called basic research can have almost immediate applied implications. For example, when a researcher clarifies the molecular control in a cell that produces a protein, he or she is at the same time mapping out a production process that is of interest to industry. Unless the researcher, and the university employing that researcher, is willing to forego a possibly significant financial reward, the university must track the research being done at its laboratories and assess its applied impacts.

Of course, models already exist for such outreach activities. In particular, most countries agricultural research institutes have outreach programs that introduce the fruits of their research to farmers. Agricultural outreach programs have been remarkably successful in most parts of the Third World, witness the incredibly rapid spread of the green revolution. Why not try to emulate the success of agricultural outreach programs in other applied areas?

C. Technology User.