2.16 Technology From the People: Managing Appropriate Technology Innovation in a Changing World

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Why does so much R&D aimed at producing technology to help the poor in developing countries end in failure? Formal R&D often fails to deliver the goods because it is out of touch with the needs and aspirations of the poor, and because it is not making use of one of the greatest innovation resources - the knowledge and experience of poor producers, who need to be viewed as its clients or customers. Many of the R&D success stories of Western industry (the Boeing 747, Scotch tape, and one third of all IBM software, to name a few) owe much to customer ideas and to managers getting clients involved in the technology development process. Poor people are neither ignorant, backward, nor helpless regarding technology and the process of technological change. They are no more mystified by machines and products from industrialised countries than are many people from those countries themselves. Artisans' knowledge of how available raw materials can be most effectively used often is superior to engineers'.

People's Technology

Technological development in most countries is dominated by imports of products and machinery from outside and often hinders people's innovation. It puts formally trained scientists and engineers in front, and artisans and other 'informal' innovators at the back. Such policies lead to poor people losing control over their local resources and over the decision making that affects their future. Paradoxically, this situation can stimulate the development of people's technology. Even if government actions stifle local innovators, the worsening plight of the marginalised groups provides a greater motivation to innovate. Unlike research scientists, who innovate to satisfy their professional aspirations, people's technology innovators do so to survive. Increased poverty can encourage the growth of people's technologies.

Imported technologies are often 'parachuted' into a country in a fixed package; their hardware and skills needs are set before their arrival and may bear little relation to local skills and experiences. People's technologies, on the other hand, develop and diffuse slowly and steadily through a trial-and-error process. They rely on close communication between users and producers to identify the changes required to improve them. They develop in a way that retains and builds upon local skills, and closely reflect the priorities of local people. They spread, however, only with great difficulty. Local innovation is not recognised by the formal scientific and industrial community and growth occurs in a 'horizontal' pattern across groups of poor people, but prevailing social, political and institutional structures place barriers against this sort of interaction. The full potential of these technologies is, therefore, seldom realised.

Local Innovators and the Ignored Technological Revolution

From the perspective of large and extensive 'technology transfer' projects, the history of technology in developing countries is a tale full of problems and short on progress. However, from the perspective of poor people and the technologies they employ in daily life, recent history shows many dramatic innovations. Africa often is singled out as the region most resistant to technological change, but it is in Africa that some of the most rapid and remarkable changes have occurred at the grassroots level.

* Tanzanians were forbidden to grow coffee until the 1930s. Today, local smallholders account for both the majority of coffee production and the majority of coffee processing of both arabica and robusta beans. The small-scale processing equipment is virtually all locally made. Far from being intimidated by foreign crops and technology, Tanzanian farmers absorbed it at an impressive speed. By comparison, the Scandinavian nations took far longer to adopt the machinery and processes of the English industrial revolution!

* The 1980s brought a crisis to Sierra Leone's salt supplies, made up largely of rocksalt imports from Senegal. When foreign exchange grew scarce, imports dropped. A development agency tried and failed to introduce solar salt manufacturing (through open pan evaporation). Local salt producers, extracting salt from filtering brine-rich salts, saved the day. They improved their techniques and expanded their output; today they provide 40% of national supplies - and their production and market share continue to grow.

Asia is seen as less of a technological 'problem child', but some of its poorest countries and regions often are derided in much the same manner as Africa. Yet the cases from the poorest parts of Asia demonstrate innovations that rival those from now richer areas, in terms of their transformation of life at grassroots level.

* Nepal is one of the world's poorest and most technologically 'backward' countries. In the 1950s it had virtually no local engineering capacity. Today it has at least 12 private companies designing and installing hundreds of micro-hydro schemes, which provide mechanical and electrical power for crop processing and other rural needs. These small firms are literally lighting up the countryside and transforming rural women's lives by reducing the time and drudgery of crop processing tasks. The firms are nurturing local engineering knowledge and skills that support other initiatives, such as large-scale electrification projects and the growth of new manufacturing industries. Nepali companies now export turbines and other micro-hydro system components to other Asian countries and to Europe.

* Blacksmiths in Bangladesh have attracted little public attention, but they account for 5% of the country's gross output, 9% of its value added, and 11% of total manufacturing GDP. The 10,000 blacksmithing enterprises are a major source of off-farm employment in a nation with an estimated 65 million landless poor. Blacksmiths also help in import substitution, producing spare parts for power tillers and tractors that otherwise have to be imported - at twice the cost.

One of the most widely researched and reported areas of energy technology in development is that of stoves for the poor. Scientific institutions and aid agencies have invested much time and effort in this cause, and a certain degree of success has been achieved in urban areas. However, few improved stoves reach rural households, where cooking fuel and kitchen environment problems hit hardest.

* In Zimbabwe a metal grate cooking system, consisting of a metal grate provided by metalworking artisans and a hearth and windscreen constructed by women users in the kitchens, can be found in the vast majority of rural homes. This system has evolved over time as cooking practices, and cooking pots in particular, have changed. It owes virtually nothing to formal research and development, and remains unreported in stoves literature - but it is the innovation upon which most rural Zimbabwean food preparation depends. The grate system provides a versatile and energy-efficient way of using firewood to cook local dishes.

Recognition and Collaboration

Technologies arising from laboratories have a support system to nurture their introduction and development. People's technologies generally have no such help. Poor people are not recognised as sources of new technology, so their initiatives are rarely examined, much less promoted. Yet cases where such recognition has taken place show great potential for collaboration between scientists, policy makers and local innovators.

* The development of the local micro-hydro industry in Nepal accelerated rapidly after the National Electricity Authority repealed a ban on private electricity generation for small mills, and even more rapidly after the government's Agricultural Development Bank offered capital subsidies for mill upgrading. Local fabricators and foreign hydro experts have cooperated in experiments on new component designs and production techniques to reduce costs further, making the benefits of micro-hydro innovations affordable to poorer mill owners and communities.

* In Gujurat, India, staff from a local engineering research institution encouraged local artisans to persevere with attempts to produce multi-purpose, animal-drawn farm implements, and helped to persuade the government to include this type of tool in its farm equipment subsidy scheme. The multi-purpose tool bar has become one of the most popular new implements in the state. It has saved farmers time and has increased yields by enabling greater control over fertiliser application. New manufacturers have set up in rural areas to produce the toolbar. Agricultural labourers, increasingly displaced by tractors and other large-scale machinery, retain their jobs on farms using the tool bar.

Small enterprises, particularly production enterprises, play an important role in developing countries' economies. They provide a large proportion of manufacturing employment and GDP. For women, and landless and other disadvantaged groups, small-scale off-farm production often represents their sole means of generating income. There are many technologies for small-scale production that could help poor producers and a considerable body of knowledge and experience exists - but it will remain a diffuse and largely inaccessible resource for both producers and scientists, as long as communication between these groups remains poor.

The world knows of Leonardo da Vinci, Louis Pasteur and Thomas Edison and the impact they have made on human life. Few have heard of Nigeria's Ologbon Ori (cassava processing equipment) or Nepal's Akkal Man Nakarmi (turbines and other hydro-mill equipment), but they and others like them are playing a similar role for their people. Compiling information on such local innovators helps us to understand their skills, potential and obstacles and to help them to do it better. Recognising the contributions and the potential of people's technology opens the door to cooperation, in which local experience can combine with scientific knowledge to tackle small-scale production problems. In Kerala, the new state 5 Year Plan has allocated resources for artisan fishermen to work with the Central Marine Fisheries Institute in the continued development of the former's artificial reef designs. In Nigeria, some polytechnics are including training sessions with metalworking artisans in their curricula, to provide students with a broader spectrum of ideas and methods in their technological education. Tanzania's TASTA award programme builds bridges between its R&D institutions and small producers. Hopefully, these small steps are a sign of things to come.

Science-led innovation is a relatively new phenomenon in the industrialised countries. In the great upsurge of innovation called the Industrial Revolution, new technologies arose when a number of critical factors came together at one time - needs, markets, new materials, scientific discoveries and the practical experimentation of individuals who were, in the main, not trained scientists (Trevithick, Darby, Boulton, Watt). In developing countries, people's research is driven by that same need to engineer practical solutions that drove the pioneers of the Industrial Revolution.

* In the 1960s and 70s the Appropriate Technology Development Association in Lucknow, India, under the late M K Garg was instrumental in developing practical small-scale industrial technologies for the production of white crystal sugar, Portland cement, whiteware pottery and cotton yarn. Much of the innovation was arrived at by a process Garg called 'action research'; in a situation where scientific skills were scarce, it was cheaper and quicker physically to try out alternative solutions than to develop them on paper. The additional value of learning through doing enriched the skills of that organisation.

Pragmatic action research may sometimes follow blind alleys and miss better solutions that are based upon somewhat different principles. This is where injections of expert assistance may help.

* In the case of ATDA's mini cement plant, early work on the upgrading of the raw material was not yielding results. A brief mineralogical study by the British Geological Survey using an expensive and sophisticated Beta Probe Analyser diagnosed the problem and enabled the work to continue in a more productive direction.

Science-based R&D institutions should study locally-based R&D processes and support them by giving access to their facilities and skills to solve problems identified by local innovators, rather than trying to export ready made solutions over their fences. One of the best examples of this sort of institutional behaviour is the work of the Technology Consultancy Centre in Ghana, where it has assisted this integration by moving away from its university campus base to found R&D support facilities (called Intermediate Technology Transfer Units) in the midst of informal manufacturing areas around the country.

The 'Tinker, Tiller, Technical Change' Project

In 1988 ITDG decided to help in building bridges between R&D institutions and artisan innovators by assembling a group of 17 researchers from 14 countries to examine successful people's technologies in a project named 'Tinker, Tiller, Technical Change'. Their work has not only provided the findings presented in this paper, but has also helped ITDG to re-examine its own role in technology development and dissemination.

The 'Tinker, Tiller' investigators each selected a technology from his/her country and carried out detailed field studies of its evolution, its social and economic importance, and its limitations. At the same time they met with colleagues in their regions to learn how the factors supporting and hindering locally developed stoves compared with those affecting building materials, and those affecting food processing machinery. Having carried out their field work, the 'Tinker, Tiller' group met together to see how people's technology in Asia differed from that in Africa and in Latin America. They shared their work with representatives of donor agencies, non-government agencies and research institutions at a seminar in London in 1989. Books in English and Spanish containing their full studies and regional analyses have been published.

The researchers have not been content to stop at this point. The Latin America group, all of whom come from R&D organisations (all NGOs), are organising personnel exchanges to try out alternative technology development strategies. In Asia a project called 'Do it Herself' is examining the contribution of women to innovation; women are the majority producers in many small enterprise sectors. As Rosabeth Kanter, one of the world's leading thinkers on the management of industry writes, 'the problem before us is not to invent more tools, but to use the ones we have'.

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