DOSSIER: SCIENCE & TECHNOLOGY

A case in point

The transfer of technology, nationally and internationally, is as important as research. In fact, for small industries it may be more important, as the answers to most of their technical problems are already known. To facilitate the application of this knowledge, IDRC has funded TECHNONET Asia, a network of 11 organizations in 9 countries that aims at improving the quality and efficiency of production in small and medium scale industries through the transfer of technical information and the provision of industrial extension services.

How the services provided by TECHNONET aid these industries can readily be seen by the following example, reported in a recent issue of *TECHNONET Asia Newsletter*.

Phoenix Silk Mills, set up in the Bangladesh Small and Cottage Industries Corporation (BSCIC) Industrial Estate in Dacca, went into operation in January 1976. Equipped with modern preparatory machinery and equipment and power looms, the factory produced grey cloth for *saree* and plain cloth for ribbon using synthetic yarns and cellulosic fibres such as nylon and polyester. The cost of the product was very high, however, and could not compete with printed and imported fabrics.

The company approached BSCIC, a member organization of TECHNONET, for assistance. Mr Shah Alam Chowdhury, the estate manager and textile expert and a graduate of INDEXTRAC, the industrial extension training course offered by TECHNONET, visited the factory. He found that the factory had no finishing equipment and produced fabrics for which the demand was poor and the price low.

He therefore suggested that the company experimentally open a screen printing section for printing their plain fabric, and he provided them with the necessary technical know-how as well as a supply of designs from BSCIC, free of charge. The experiment proved successful and the company has now started a full-scale printing section, which also handles fabrics from other local manufacturers.

Following his advice, modifications were also made to the layout of machinery and equipment. As a result, the efficiency and profitability of the company have been greatly improved and plans are now being made for further expansion.

A leafy paradox for science

Gunnar Poulsen

The capital of Ethiopia at Addis Ababa owes its existence to a tree. The tree owes its existence to the shrewdness and determination of the Ethiopian peasant farmer.

Between those two facts lies a history of development that could serve as a lesson for those who believe that adapting science and technology to meet the needs of rural people is a job that can only be managed by "experts".

In efforts to halt environmental destruction, and provide fuel and building material, forestry departments in Africa have been producing millions of tree seedlings for distribution to villages at subsidized prices, or even free of charge, hoping to encourage individuals and communities to plant more trees. They have met with little success. An outstanding (and upstanding) exception is Ethiopia, where an estimated 50-100,000 hectares of Eucalyptus plantations have been established. Almost all of this vast rural afforestation was accomplished before Ethiopia had elaborated its professional forestry service, by illiterate peasants using methods that would make a "properly trained" forester cringe.

Cattle rearing and crop farming, dating back nearly 3,000 years in Ethiopia, placed the country's once great forests in competition with agriculture for arable lands. The pressure on land was greatest around the cities. When all the land within "donkey and mule reach" of the city had been denuded, and erosion and water shortages began to take their toll, inhabitants moved to where the forest was still intact. The capital of Ethiopia was shifted several times over the course of history in this fashion. The fact that Addis Ababa finally became the permanent capital city, and not just another itinerant government waystation, may be due in large part to the introduction of the Eucalyptus tree in 1905. An assured supply of wood, and the protection of water supplies and land brought the wandering city to a halt.

Scattered specimens of large trees of a number of species seem to indicate that some trial-and-error experimentation was carried out before deciding on the species that seemed best adapted to local conditions and requirements. Present day Ethiopian farmers know and plant only two species. Above 2000 metres sea level, they use *E. globulus*, and at lower altitudes, *E. camaldulensis*. *E. camaldulensis* is grown not only under arid conditions where its tolerance makes it a seemingly obvious choice, but also in areas where the annual rainfall exceeds 1000 mm. Growing this tree in heavy rainfall areas confounds most scientists, who would opt for other species known to thrive and produce straighter stems under such conditions.

The explanation is very simple. The two species of choice, better than any other, combine a good adaptability to climate and soil with the necessary toughness that enable them to survive the peculiar planting techniques applied by Ethiopian farmers. It's all wrong scientifically — but it works and serves the need.

Ethiopian farmers rarely obtain potted nursery stock from government supported nurseries; instead, they grow the Eucalyptus plants themselves or buy them from an enterprising neighbour. Nursery beds are carefully prepared, tended, and protected from harsh sunlight, rainfall, and wind. At the end of about a year, the seedlings will be approximately 0.75 metres high, very slender and with few side branches, the result of crowded growth on the seedbed. The ground where the seedlings are to be planted is worked, usually by hand, to provide a loose soil structure that is well aerated and drained. Having prepared the area for planting, the farmer waits for ideal weather conditions: a cloudy day with no wind, preferably with a slight drizzle falling.

The plants are lifted from the nursery bed by means of a small forked hoe, damaging the delicate root systems as little as possible. The long slender stems are not pruned back, nor stripped of any leaves. The farmer simply bundles the plants together as they are and carries them to the planting area. From a scientific perspective, the plants are doomed. The root/shoot ratio is too low, and further threatened by the unavoidable damage suffered during lifting and transportation. A professional forester would not expect that the more or less mutilated root system would be able to sustain the evapotranspiration of the long stem. And the

Photo: Gilles Lessard

trees are planted very close together, with a density of between 40-100,000 seedlings per hectare. For the professional forester, even 10,000 seedlings per hectare is too dense.

And if one visits an Ethiopian farm plantation a couple of days after planting, it would seem that the scientist is right. The topshoots of the plants are hanging down limply and some of the leaves are beginning to wither. Surprisingly, however, as many as one-quarter of the plants survive the rough treatment — sometimes even half. The farmers expect these losses. If the final result of their efforts is a plantation containing 10-25,000 plants per hectare, they are pleased.

The dense plantation will close canopy within a few months, eliminating the problem of severe grass competition and making weeding unnecessary. And if the trees remain small and slender, so much the better — they yield a product much in demand. Small wood dimensions are a major component of rural Ethiopian houses, which are of a mud-plastered wattle type, and are also used in considerable quantities in the erection of non-wire fences. The farmers' dense stands will yield these products first in abundance, and later also produce the larger dimensions, marketed as fuelwood and building poles.

In the neighbourhood of Addis Ababa, considerable areas of level farmland have been reforested with Eucalyptus within the last 20 years because the owners have found that they can make more income from the trees than from wheat or barley crops. Thus the tradition of 3,000 years is reversed.

Rural afforestation is a success in Ethiopia because techniques have developed that match local conditions, including the psychology, educational level, and resources of those applying them. The lesson of the Eucalyptus is plain: science or technology must be measured against the real human needs that they are meant to serve.

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Beyond the pill

David Spurgeon

Two new contraceptives now undergoing field trials show promise for family planning programs in developing countries. Both are examples of how modern medical technology can be designed to respond to personal and cultural needs in this most intimate area of health care.

The devices were described to the October meeting of the IDRC Board of Governors by Dr Elof Johansson, Dr Wayne Bardin, and Dr Anibal Faundes, world experts in contraceptive technology who sit on the Population Council's International Committee for Contraceptive Research (ICCR). Dr Bardin is chairman of the ICCR, Dr Johansson is head of the department of obstetrics and gynecology at the University of Uppsala, Sweden, and Dr Faundes is professor of obstetrics at the University of Campinas, Brazil.

The contraceptives are the subdermal implant and the vaginal ring. Both contain steroids that are released over a period of time to enter the body's bloodstream and block ovulation.

The subdermal implant is a small tube containing norgestrel, a component of the birth control pill that contains no estrogen and thus avoids most of the pill's side effects. It is placed under the skin (usually on the inside of the forearm) by means of a hollow needle containing a plunger. The contraceptive effects of the implant could last for as long as five years.

The vaginal ring is made of plastic, is somewhat smaller in diameter than the commonly-used diaphragm, and can be inserted and removed easily by the woman herself. The ring's contraceptive effect lasts approximately six months.

When the vaginal ring is removed, vaginal bleeding occurs, just as it does when a woman stops taking the contraceptive pill. Many women may want to remove the ring once a month to produce a kind of menstrual bleeding, Dr Johansson said in an interview, because women have been conditioned to believe that such bleeding is a natural function and therefore necessary.

However, Dr Johansson added that it is not really necessary to remove the vaginal ring and thus cause vaginal bleeding: the ring could be left in during the whole six months, in which case only what is called "breakthrough bleeding" or even none at all would occur.

Vaginal bleeding is the primary problem with the subdermal implants because it is completely unpredictable. If it persists, however, the implant can always be removed. And even when women with the implant do bleed, the total volume of blood lost is less than occurs with a normal menstrual cycle — an advantage for Third World women because they are often borderline anemics.

These new contraceptives have other distinct advantages for use in the Third World. The implants are put in place by injection, similar to injections of antibiotics and other medications. This is a form of medication thoroughly approved of by Third World peoples, whereas Western peoples are primarily pill-oriented.

The ring uses natural estrogen, which does not get broken down while being absorbed, as it would by the liver if this steroid were taken orally. And being a natural steroid, it does not cause the wide range of side effects the synthetic steroid causes.

Obviously, distribution of the vaginal ring poses more of a problem in the Third World than does the subdermal implant, because the effects of the ring last only six months compared to the implants' five years. But the ring has other advantages: its use is under the complete control of the woman, who can remove it when desired — even during intercourse if she or her partner prefer (although it does not interfere with intercourse). The individual cannot take an overdose of steroid, and there is no great risk of side effects. Theoretically, the ring could quite safely be sold in grocery stores, without prescription.

Large-scale field testing is still necessary for both new contraceptives, however. An international study is going on in eight centres comparing two different sizes of vaginal ring with low-dose contraceptive pills. These are being carried out in Brazil, Chile, the Dominican Republic, Nigeria, India, Denmark, Sweden, and the United States. Testing is also underway to determine whether the device will cause local reactions in the vagina.