

TECHNOLOGY AND COMMUNITY DEVELOPMENT BCD 216

LECTURE 4

INNOVATIONS AND COMMUNITY (CONT'D)

Point to ponder:

What do the following have in common?

Improving the water quality of the Kuang River, which flows through the city of Lamphun in northern Thailand, by treating domestic wastewater using a contact aeration process; a residential training facility which is energy self-sufficient as a result of harnessing both traditional and modern means of tapping renewable sources of energy, and of energy conservation, to offer modern amenities such as lighting, air conditioning, cooking, and laundry at substantially reduced costs; use of computer software to create long term future scenarios of the Langat Basin, Malaysia, by making policy choices and exploring the environmental, social, and economic consequences of the decisions, including the complexities and tradeoffs of sustainability; implementation of a regional knowledge management system for ESTs; implementing the advice of international consultants to construct coastal defence structures in order to arrest the erosion of the coastline adjacent to a major urban area, and deterioration in the quality of the sandy beaches, the result being a series of problems such as erosion of neighbouring areas, water quality problems and disruption of the ecological balance in the areas with coastal structures; and The uptake and application of environmental management systems (EMS) by local government authorities in China.

The above are examples of technology transfer. In some cases uptake was successful; in other cases noted above it resulted in failure. The examples serve to highlight the diversity and complexities of technology transfer. But there is one common view of technology transfer – successful transfer of appropriate technologies is essential to facilitating national and community development and enhancing sustainability, especially in developing countries and countries with economies in transition.

Case Study of Technology Transfer: *Brazil's sugarcane-based ethanol industry*

Brazil's ethanol industry started in the 1930s. With more sugar than it could use, the Government directed that sugarcane be used for ethanol production and made the addition of ethanol to gasoline a mandatory automobile fuel. As a result of the international oil crisis in 1973 that doubled Brazil's expenditure on oil imports, the industry made significant progress. With the

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need to consider alternative sources of energy to decrease its dependency and spending on fossil fuels, the Government launched the National Alcohol Programme (Pro-Álcool) in 1975 to increase ethanol production as a substitute for gasoline. It invested in increasing agricultural production, modernizing and expanding distilleries, and establishing new production plants. It also introduced subsidies to lower prices and reduced taxes for ethanol producers.

Over the next 15 years, production of ethanol increased from 0.6 billion liters in 1975 to 11 billion liters in 1990. During the first phase of the programme in 1975–1978, one part of ethanol was added to four parts of gasoline and there was an additional processing stage to remove water from the fuel. By 1979, production had been streamlined to focus on hydrous ethanol (containing six per cent water) that could be used in cars fuelled entirely by ethanol. At the programme's peak in 1986–1989, 90 per cent of all new vehicles sold in the domestic market were ethanol-fuelled.

Behind the success of the programme there were important scientific and technological advances in agriculture and industry. The production of 40 tons of sugarcane per hectare was more than doubled through investments in research and improvements sponsored together by the Government and the private sector. Using traditional breeding techniques, researchers produced varieties adapted to different soil and climate conditions, with shorter production cycles, better yields, and tolerance to water scarcity and pests (such as the devastating fungus that caused sugarcane rust in the 1980s). New grinding systems were developed and the fermentation process adapted to use different microorganisms and enzymes to produce more ethanol at a faster pace. The Sugarcane Technology Centre, a privately-funded research institute in São Paulo, was key to improving ethanol production technology, having invested about US\$ 20 million per year in research at the peak of the programme. Researchers at the Centre and other institutions also found ways to use sugarcane fibre residue, known as bagasse, to produce energy, building on existing methods of burning bagasse to power steam turbines for electricity generation and using the remaining heat from the turbines for the distillation process. They developed cauldrons operating at greater pressure so that more energy could be produced, allowing many ethanol plants to become self-powered. This contributed significantly to keeping ethanol production costs low.

The infrastructure developed and advances made enabled the programme to survive a turbulent period at the end of the 1980s, when the Government cut public investment after a drop in the

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price of oil. Although this had a short-term impact, demand remained high and almost five million ethanol-fuelled cars were in circulation by the 1990s.

Today, Brazil is the second biggest producer of ethanol in the world (20 billion litres) after USA (24 billion litres). Close to 80 per cent of this is for the domestic market; the fuel used in 45 per cent of Brazilian vehicles is ethanol. Part of the demand is due to the success of flex-fuel cars, which can run on gasoline, ethanol or a mixture of both. The cars were developed by engineers at Bosch, a German company, in São Paulo and released in 2003. The engine works differently depending on the quantity of oxygen produced by the type of fuel burned, which is measured by a sensor. Flex-fuel cars renewed consumer interest in ethanol and intensified demand for this biofuel. According to Brazil's National Association of Vehicle Manufacturers, ANFAVEA, 85 per cent of cars — some four million vehicles — sold in Brazil today are flex-fuel. The success of flex-fuel and the need to reduce CO₂ emissions have inspired a search for new applications of ethanol. Researchers at the Delphi Technology Centre in São Paulo have developed a fuel system for motorcycles that can also use ethanol–gasoline blends in any proportion. The first ethanol-powered bus, developed at University of São Paulo, has been undergoing road tests since December 2007 to assess its economic viability. The Brazilian aviation company, EMBRAER, has had an ethanol-fuelled agriculture monoplane in use since 2004.

As a result of poor harvests in key producing countries and a fast-growing demand for grains and other crops used for biofuels (among other reasons), world agricultural prices rose sharply during the 2006-2008 period. The price boom was led by maize and wheat but high market volatility was observed for most food and feed commodities. However, the Brazilian biofuel industry is based on sugarcane conversion which is considered a very efficient process. Furthermore, the Brazilian biofuel industry uses the extensive land available in that country with only a small fraction of the arable land being used for ethanol production.

With international demand for renewable sources on the rise, Brazil has many challenges to face if it is to continue at the forefront of the ethanol market. One major challenge is to increase its already significant production without further negative environmental or social impacts.

Producing ethanol from sugarcane bagasse and straw would be a step in the right direction. These components are rich in cellulose and turning these into ethanol would allow the entire sugarcane biomass to be used with no wastage. One tonne of bagasse can produce 186 litres of ethanol. But there are doubts about the economic viability of the current process, which requires

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more water and produces more polluting byproducts like liquid vinasse. Large production of ethanol, however, is no guarantee of market superiority for Brazil nor of success of the ethanol industry internationally.

Brazil is offering its expertise to nations worldwide, especially to developing countries that could produce biofuels but still depend on oil. Brazil also hopes to expand its ethanol market. Many countries have already shown an interest in the trade. In 2008, Brazil signed agreements with countries in Africa, the Caribbean and Latin America. Most of these agreements involve the transfer of Brazil's ethanol production technology. For example, in Benin, Brazil will use its expertise to help develop production capacity and, in Angola, Angolan and Brazilian oil companies are planning a facility to produce sugar, bioenergy and ethanol from sugarcane. This facility is designed to produce million tonnes of sugar, 50 million litres of alcohol and 140 megawatts of electricity per year. Construction was scheduled to begin in 2008 and the joint venture involves an investment of US\$ 200 million. The sugar, ethanol and power produced by this project are expected to cover domestic demand rather than exports, due to shortages of these commodities in Angola.