Feature — Science and Technology

Folk-culture in Transfer of Technology

by Abdur Razzaque

'A song of the living sweetmeat' is an innovative folk-musical narrative with the drama of rural life sandwiched in it. It centres around a life tormented with despondency and scepticism in a land, where human existence has seriously been endangered due to alarming contraction in nature's benevolence. The ultimate objective of this cultural enterprise is, therefore, to bring about a ray of new hope and dream in that fast eroding system of life. The immediate goal of this endeavour is to generate awareness of the urgency of proper maintenance of soil characteristics. In fact, it endeavours to advocate and popularise the application of biofertiliser technology so that the organic matters available in the soil can proliferate in a desired manner and, thus, they can add to the fertility of the soil, which is considered as the best of all mothers by the rural folk of this region.

As the rural folk is the sole target of this cultural enterprise, it strictly adheres to the style of our folk-cultural tradition, which has a high credibility in the eyes of the villagers. It is, in fact, their legitimate possession and it forms an intrinsic part of their life. It is here, where they can have their authentic voice of their own in terms of their understanding, experience and conscience and in this way they can build a secure sense of identity, an essential component for effective participation in their own development and change processes. So their languages, beliefs, idioms, music and images have been given due preferences in the composition and presentation of this innovative folk-musical drama.

Its dramatic part has been presented in a folk-musical coating, demanding the rhythm of music in the dialogues uttered by various characters of the drama. Therefore, they communicate in a language couched in poetic metre. We know, the measured utterances of a metrical composition add heavenly wings to the language we use in our day-to-day life and it is, thus, elevated to a sort of classical grandeur. Besides, it plays a significant role in understanding of the subject-matter and memorising its essence for a longer period.

In the salutation part of the narrative, the traditional 'Bayati' or the chronicler takes us to a land of rippling rivers with shining sun in the blue sky and a vast plane covered with deep patches of green, a symbol of mirth and vitality. Terming the golden Bangladesh as a sustaining source of endless possibilities and potentials, the chronicler very rightly gives stress on the optimal utilisation of her basic resources, namely, the man, land and water resources that abound in rural areas. But, he says, the people here are always not very careful in the balanced use of chemical fertilisers that results in the fast deterioration of the chemical and bio-physical properties of soil and, thus, accelerating the process of environmental degradation. Moreover, the price increases of chemical fertiliser go beyond the reach of the small farmers. Nevertheless, in a land-hungry country like ours, they are to rely heavily on the use of chemical fertiliser for higher yield of food grains.

The Bayati making his traditional presentation of folk-musical narrative in 'A song of the living sweetmeat.'

In this context, a small farmer Abu Miah leaves for the nearby town to purchase chemical fertilisers for himself. But he fails to procure the needed quantity of fertilisers for sky-kissing price. In utter despair he comes back and stares helplessly at the green paddy field turning yellowish, sitting on the ridge of his small plot of land. And with the lamenting Abu, the drama moves on.

There enters Budhai, a simpleton young fellow and a neighbour of Abu. They talk on sudden price-hike of fertilisers only to find no way out. At this point, Munshi, a religious teacher of the village makes his appearance and advises them to have patience. To have confidence in the omnipotent Allah, who can help overcome all dangers and calamities. Can turn the lifeless desert into a smiling greenery within the twinkling of an eye. Abu and Budhai fervently seek blessings from Allah.

As soon as the religious leader leaves, the sight of Budhai falls on the field worker (FW), a village level change agent who is on his way to a demonstration farm to deliver the packets of biofertiliser carrying in a bag. Budhai draws the attention of the man and when he comes towards them with a hanging bag in one of his shoulders, Budhai asserts naively that those in the bag of FW must be the packets of fresh sweetmeats. The FW replies him jokingly that those are nothing but the packets of living sweetmeat. However, Abu learns from the field worker that his land has been suffering from severe nutrient deficiencies because of indiscriminate application of chemical fertilisers and successive culture of monotype of crops. The FW says, the nitrogen which is abundant in the atmosphere we live in, is the most deficient nutrient that limits crop production in our country and the urea is largely used to offset this loss of soil nutrient. He further states that the researchers have been working on biological nitrogen fixation (BNF) technology and have developed quite a good number of biofertiliser inoculants for various leguminous crops, viz, lentil, chickpea, mungbean, blackgram, pea, pigeonpea, grass pea, cowpea, soybean, *Sesbania* and groundnut. They have yielded encouraging results in the meanwhile.

The FW shows them the packets of biofertiliser consisting of Rhizobium bacteria mixed in peat soil and explains the benefit of its use in land including the methods of applications. The fertiliser dealer, a profiteering businessman, who made his appearance during the course of their discussion, pleads the favour of the FW for issuing him a business licence of biofertiliser. However, as he learns that it requires special care which his shop cannot ensure, he feels rather discouraged.

But the message of biofertiliser brings a new hope in the mind of the rural poor and specially Abu and Budhai, it comes as the message of human liberation.

Here ends the dramatic part of the narrative. The chronicler furnishes us further information on the small family of Abu with his wife and a daughter and a clear happiness is discernible there because of his timely application of biofertiliser and rotational cropping pattern. And happily concludes the *Bayati*:

Sugar, honey and manda are sweet indeed, but
the sweetness of mother's smile is without
an equal.
It's water by which we quench our thirst, when thirsty.
It's biofertiliser, the living sweetmeat of the soil
by which are properly nourished the soil nutrients.

It is, therefore, evident that the biofertiliser inoculum has allegorically been named as the living sweetmeat for the soil. This folk-cultural medium was used for on-farm transfer of biofertiliser technology developed by a team of scientists under the leadership of Dr. AM Sattar, Principal Scientific Officer of Bangladesh Institute of Nuclear Agriculture (BINA). Initially, the folk-cultural presentation was videoed and used in farmers' training programmes as teaching materials that generated much interest among the trainees.

The present folk-cultural experimentation has been grounded on our glorious folk-cultural heritage and, in a creative manner, it has paid respect to peasants' culture, taking their frame of mind into consideration so as to sharpen their sense of dignity while handing over new technology to them. It ought to be remembered that dignity is a fundamental requirement for effective action toward development.

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The Field Worker explaining the importance of biofertiliser technology to Abu, a small farmer, Budhai, a simpleton village fellow and the Fertiliser Dealer in 'A song of the living sweetmeat.'

Energy-Rich Sludge Successfully Recycled

THE disposal of sludge, the residual semi-solid matter generated by sewage treatment, is a universal problem which has been tackled with less than satisfactory solutions.

In the past, sludge has been used as landfill, discharged to the ocean or incinerated without any attempt at resource recovery. However, sludge, like treated waste water, is a resource that can and should be recycled.

Sludge is rich in nutrients and energy, though it contains also most of the undesirable components that are discharged to the sewer, such as heavy metals, industrial organic chemicals, pesticides, herbicides and insecticides.

Such material is not destroyed in the sewage-treatment process and accumulates in the sludge, as do pathogenic organisms. An effective sludge-recycling process must be able to handle these undesirable components in an environmentally acceptable manner.

Oil from sludge (OFS) technology is one process that provides an environmentally sound, cost-effective sludge-recycling system. It is a system that Enersludge Australasia has used effectively in a series of trials at Sydney's Malabar sewage-treatment plant.

The technology has been under development and demonstration for the past 10 years in both Australia and Canada and has been short-listed by the Sydney Water Board for Management of Sydney's sludge.

In essence, the technology mimics nature in making oil. The starting material (sludge) is a microbial and organic-rich substrate, just like the substrate used by nature to make oil. Unlike nature, however the technology does not need high pressures to convert the sludge to oil and the process operates at only moderate temperature.

In the first stage of the OFS converter dried sludge is heated to 450 degrees celsius in the absence of oxygen at atmospheric pressure. Under these conditions, roughly half the sludge solids are vapourised to complex long-chain organic compounds, predominantly carboxylic acids and proteins.

In the second stage these vapours come into contact with the solid residue (char) from the first stage, where vapour-phase catalysed reactions convert the complex molecules to saturated hydrocarbons.

Finally, these vapours are condensed to oil and water, which are separated in a centrifuge. Some of the organics (light fractions) remain as a gas, called non-condensable gas or NCG.

The oil product contains about half the energy originally available in the sludge. This oil is very similar to a medium fuel oil as far as energy density and other parametres are concerned. Extensive testing has shown it can be used as a fuel for industrial kilns, boilers or furnaces. From a combustion viewpoint, it can be used in purpose-designed engines (diesel) to generated electricity.

Charcoal has an energy content similar to lignite. The remaining two products, gas and water, also have fuel value. The gas contains carbon monoxide and hydrogen as combustible constituents and the water contains low-molecular-weight carboxylic acids.

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In essence, the OFS converter recovers all of the sludge energy in the four products. This high-energy efficiency is one of the principal advantages of the OFS technology.

The energy efficiency is further enhanced by use of the conversion by-products (char, gas and water) to provide the energy required to dry the sludge. These by-products are fed to a hot gas generator (HGG) which produces the hot air needed for sludge drying.

The HGG is a fluid-bed furnace designed to meet the needs of the OFS process in an environmentally sensitive manner. The gas finally is cleaned using modern air-pollution-control equipment, before being discharged to the atmosphere.

Two end-products from the process are oil and ash. The ash is an ideal substitute for sand and can replace the fine aggregate in most concrete mixes. No waste products are produced by the process.

An integrated OFS plant comprises sludge drying, conversion energy recovery and gas cleaning.

Sludge from the treatment plant is first mechanically dried using centrifuges or filters to produce a "cake" containing roughly 35 per cent solids and 65 per cent water.

The sludge produced at the treatment plant normally contains about 95 per cent water.

The sludge cake (a shovellable solid) is then thermally dried to produce a granular or pelletised product of at least 95 per cent solids. This dried sludge is then fed to the OFS converter as described above.

The OFS technology not only offers total sludge recycling, but does so with numerous environmental benefits, including complete destruction of pathogens, eliminating any health concerns. The heavy metals in the sludge are captured in the ash product.

Furthermore, these metals are converted to oxides and silicates in the HGG and, therefore, are no longer teachable for transport up the food chain.

Pesticides, herbicides, insecticides and industrial organochlorine compounds such as PCBs and hexachlorobenzene (HCB) that accumulate in sludge are destroyed in the OFS converter.

Under the highly reducing conditions in the converter (hydrogen-rich atmosphere) these organochlorine compounds are catalytically dechlorinated. For example, HCB is converted to benzene and hydrochloric acid. This is a very significant advantage of OFS technology compared with thermal sludge processes such as incineration.

Of major importance is the fact that since no organochlorines are fed to the HGG, this system can operate at a lower temperature to minimise heavy-metal emissions.

By contrast, an incinerator must provide conditions to both destroy organochlorines (high temperature) and minimise heavy-metal emissions (low temperatures), clearly conflicting requirements.

Since the OFS technology captures half the sludge carbon in the oil product, which is used to replace indigenous fossil fuels, carbon dioxide emissions from an OFS plant are only half that of other thermal processes, such as incineration.

The OFS technology, providing 100 per cent recycling of sludge produces no waste products that require landfill disposal.

Australian Science and Technology Newsletter

Wood Substitutes Emerging

by T V Padma

FACED with shrinking forest reserves and spiralling demand for wood in some core sectors, scientists have launched a massive hunt for wood substitutes that can cut down the use of timber in construction.

The Central Building Research Institute at Roorkee has taken a lead with the development of several alternatives for wood in buildings, which were discussed at a two-day national symposium at Roorkee in December.

While the cost of these alternatives is comparable to that of timber, they serve the main purpose of saving timber, Dr S K Mishra CBRI director, told PTI. If found to be commercially viable they can save up to 30 per cent timber, he said.

"We are not working on substitutes for decorative uses of wood, but concentrating only on alternatives for semi-structural and building components," he said, adding that some of these technologies would be ready by next year.

Timber is used in buildings for a horde of structures: piles posts, lintel, doors, windows, frames, trusses and shutters. It is also used in flooring, ceiling, panelling and partition walls and ends up contributing to almost 15 per cent of the total cost of the buildings.

The draft housing policy for the Eighth Five Year Plan envisages nearly 21.8 million dwelling units by 1995, which would require almost 4.84 million cubic metres of wood. With the current availability estimated at 2.32 million cubic metres, the need for substitutes is becoming imperative.

Alternative wood substitutes fall into three main categories — ferrocement substitutes, fibre-reinforced composites and polymers.

Ferrocement is a versatile material that can replace timber, steel concrete and even baked clay products. A composite made of wire mesh, sand and cement ferrocement possess unique qualities of strength and serviceability and can be used to directly replace not only timber components but also concrete walls, columns, and in roofing and flooring.

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A second and recent trend is to develop composites using industrial wood wastes and residues and natural fibres in inorganic matrices like gypsum, portland cement and other cements.

Wood composites are being promoted the world over to reduce consumption of industrial wood. These composites can be manufactured using small girth wood, fast growing species wood, low-grade wood and wood residues available from saw mills and other industries. Wood based composites presently manufactured in India are plywood, block boards, particle and fibre boards.

Cement bonded particle boards consist essentially of a mixture of fibrous wood particles (typically chips and shavings) and portland cement or other cement with equivalent properties, to which fillers and pigments may be added.

Cement bonded particle boards and wood fibres reinforced cement sheets are commercially available abroad and have been found to be cheaper than good quality timber. They are being used for various applications such as panelling, partitioning, cladding, false ceilings and wall lining.

There has been a growing interest in incorporating natural vegetable fibres like sisal, coir, bamboo, bagasse and jute in the cement matrix. Sisal and other natural fibres reinforced concrete corrugated roofing sheets are used in Australia and some African countries while sheets reinforced with jute and bamboos fibre are being used in Bangladesh, and with coconut in the Philippines Thailand and Indonesia.

The Indian Jute Research Institute has developed jute reinforced composites as a wood substitute. A prototype model of these panels fixed with steel sections is giving promising results in a six-year outdoor exposure study, although the cost is proving to be slightly more than that of timber.

Also on the anvil are particle boards from jute sticks, a waste product obtained during jute cultivation to the tune of 4 million tonnes. The boards, prepared from dry jute sticks, flakes or powder coat with resin binders and casted into shape in heated metal plates under high temperature and pressure, are fire resistant, termite and water resistant, scientists report.

Considerable work has been done at the Regional Research Laboratory, Trivandrum, on lignocellulosic fibre polymer composites, with a recent coir-polymer system emerging as a potential substitute.

Bambooply boards, formed by pressing bamboo mats at high temperature and pressure, are an elegant and strong panelling material. Resistant to boiling water and termites, these boards can also be used in furniture, panelling, false ceilings and partitioning. The strength of bambooply can be improved by putting veneer between the bamboo mats.

Rice husk boards developed by the Indian Plywood Industries Research Institute, Bangalore, have 18 per cent silica and, therefore, not attacked by termites, wood boring insects, wood decaying organisms or rodents. An added advantage is that they do not catch fire immediately but only smoulder slowly when ignited.

Another viable alternative is gypsum boards, consisting of a gypsum plaster core with or without fibre, encased in and firmly bonded to strong durable paper liners. India has 1249 million tonnes of natural gypsum and 4 million tonnes of phospho gypsum obtained as a byproduct from the phosphate fertiliser industry.

Particle boards and glass reinforced gypsum composites can be used as an alternative to wood because of their inherent wood-like properties such as ease cutting, nailing, screwing, chisseling and sawing.

In the field of polymer substitutes showing considerable promise is an interpenetrating polymer network by blending a high-performance polyurethane (PU) polymer with a low-cost phenolic rigid foam.

Developed scientists at the Indian Institute of Chemical Technology (IICT), Hyderabad, have developed. The researchers developed the substitute using cashew nut shell liquid and castor oil as raw materials.

The institute is trying to cut down costs in the area of door and frames. It first developed frames from magnesium oxychoride cement and sawdust, which although economical, suffered from a major drawback: they were not water-resistant.

The scientists then turned to frames made from saw dust, using organic resins as binders, which were found to have the same density, and flexural and compressive strength as normal wood, and reasonably good nail, screw- and paint-holding properties.

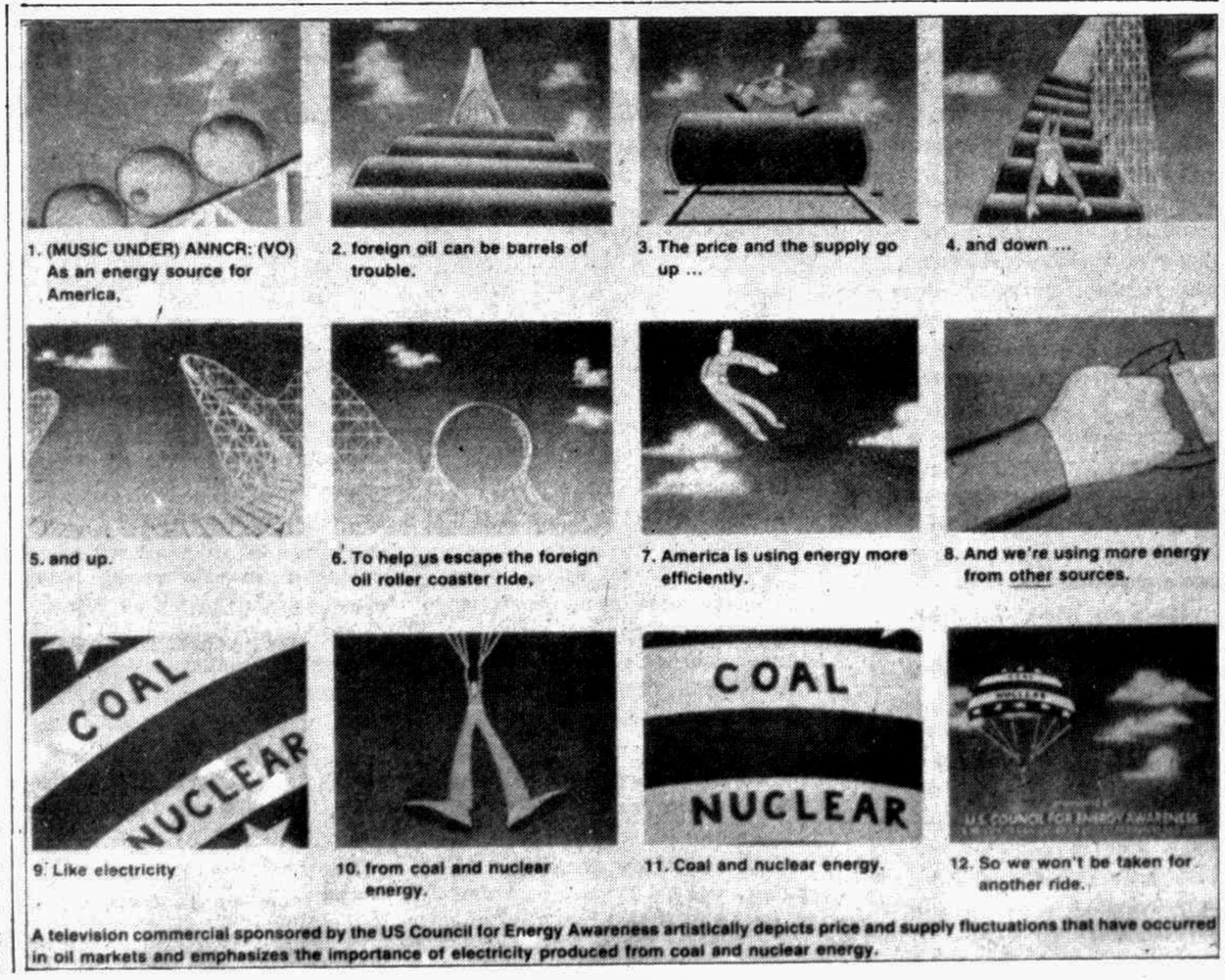
The quality of these frames was markedly improved after lamination with plywood or sunmica. The lamination, which does not require any extra binder also protects the core material from water and weather changes, according to a report by CBRI scientist Dr Y Singh, which was presented at the symposium.

CBRI is now working on an even more wood-saving concept — use no frames at all. For low-cost housing, its scientists have developed substitute panels which can be fixed directly into the walls with the aid of bolts and screws.

The institute has also identified about 400 secondary species of wood, such as mango and eucalyptus, which can be used for building construction without affecting the quality in any way, Dr H C Mital, assistant director at CBRI, told PTI.

Scientists of the Regional Research Laboratory, Bhopal, advocate the use of red mud, and industrial waste available in large quantities in India as a filler in polyester resin. Flat sheets prepared from composites of red mud in polyester resin could be used as switch board and as strips for electrical fittings.

— PTI Science Service



A television commercial sponsored by the US Council for Energy Awareness artistically depicts price and supply fluctuations that have occurred in oil markets and emphasizes the importance of electricity produced from coal and nuclear energy.