Status of Biogas Plants in Different Countries of the World

by M A Gofran

BIOGAS had been known to many countries for centuries particularly in the phenomenon of marsh gas. Allessandro Volta first associated origin of the burning gas with decomposition of organic materials. In Come of northern Italy, one day he noticed in some lakes and ponds that by disturbing sediments of decomposed organic materials huge number of bubbles rose to the water surface. He carefully collected the gas from the bubbles and found its combustion nature. On 14th November 1776, he wrote a letter to his friend describing his new invention. In early 1805, Humphrey Divvy observed presence of biogas in farm yard manure. William Henry between 1803-1806 identified this inflammable gas to be methane. In 1875, Popoff discovered microbial origin of methane which was supported by Tappainer in 1882. Pastier found that optimum temperature for biogas production is 35 C. Gain, a student of Pastier, successfully recorded in 1883 production of biogas from animal dung. In 1895, night soil based biogas was collected and used in street lighting in England. A good number of biogas plants were constructed in European countries during this period up to 1900 AD. Sohangen in 1901 gave more details about microbial action in a biogas fermentation process. Some scientists notably Buswell, Barker, Van Nail and Omelianski had good contribution in anaerobic digestion. In 1914, a Dutch scientist used straw board waste for methane production. During the First World War (1914-18), biogas technology extended all over Europe. Fuel crisis compelled to give more attention to biogas technology. During Second World War, biogas technology got highest priority. In Germany, many trucks and lorries were run using biogas. They used to maintain optimum temperature by artificial heating arrangement, which increased gas production cost. French scientists constructed many plants in France and French-occupied Africa.

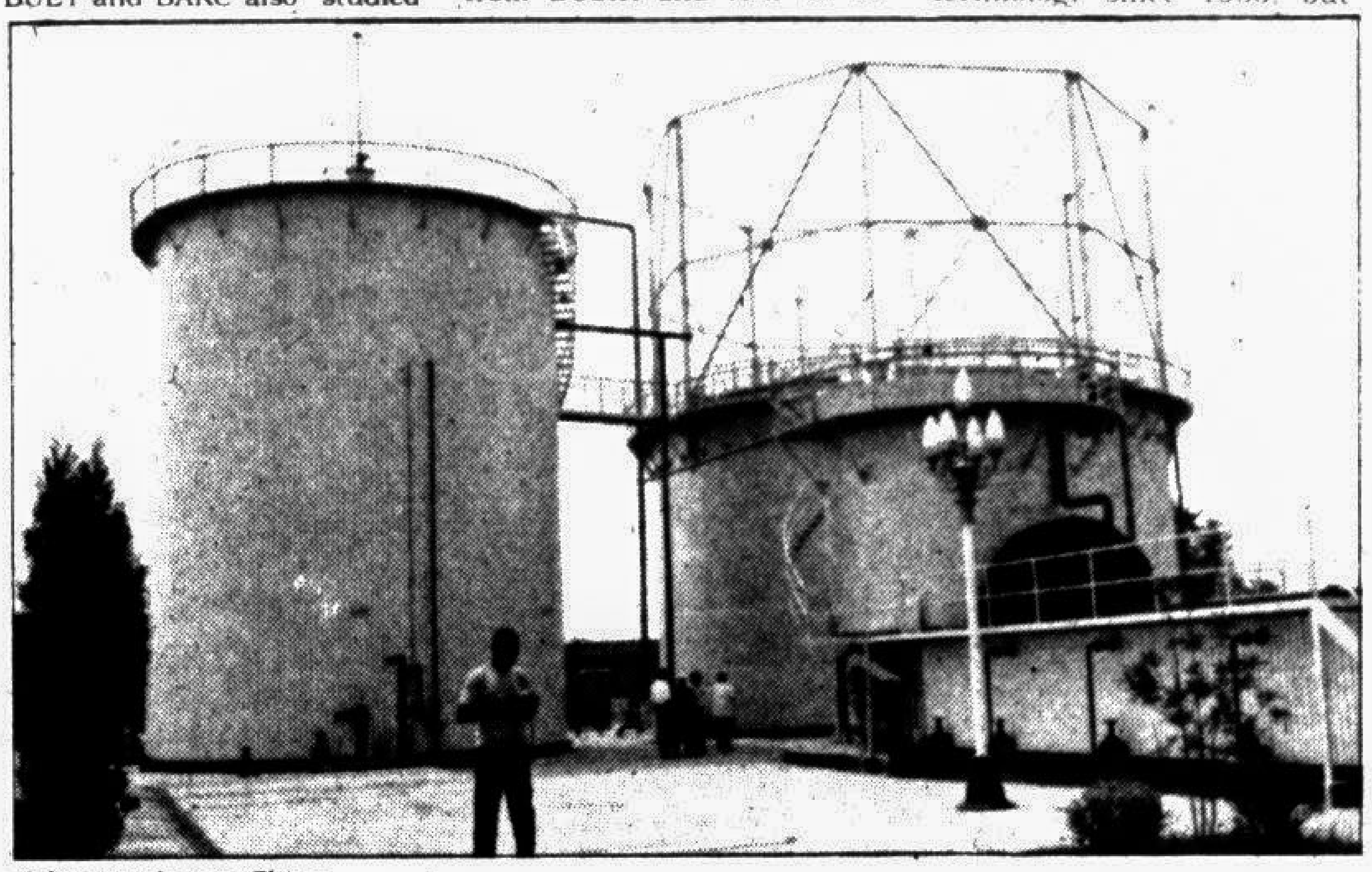
In the European countries, it is difficult to maintain required temperature in the digester due to cold weather. As a result, gas production rate is less. For this reason, the practice of biogas technology was almost stopped for many years in Europe. During 1970s, they again gave attention to this technology. By this time, 140 plants were constructed in Italy, 136 plants in Germany, 131 plants in France, 73 plants in UK, 65 plants in Netherlands, 63 plants in Spain, 76 plants in Belgium and 33 plants in Portugal. Out of these, there were large size plants also. In Germany, they constructed one plant of the size of 7250 m3. Among the large size plants, 8 Nos were of 2000 m3 size, 35 Nos of 1000-2000 m3 size, 39 Nos of 500-1000 m3 size, 203 Nos of 100-500 m3 size and 89 Nos of 50-100 m3 size.

Biogas technology though started in Europe, it spread all over the world. Continuous extraction of natural gas, limitation of natural resource compelled man to think of alternative energy. Biogas technology is, therefore, getting priority. A brief description of the research and development of biogas technology in other countries is addressed in this article.

Bangladesh

The first biogas plant was constructed in Mymensingh Agricultural University by Dr M A Karim in 1972. Before that, this technology was not known in Bangladesh. The plant was floating dome-type and the size was 3 m3. Some more plants were constructed in Mymensingh during that time. In 1974, one plant was constructed in Bangladesh Academy for Rural Development (BARD), Comilla. Bangladesh Council for Scientific and Industrial Research (BCSIR) constructed one plant in 1976. BADC, BUET and BARC also studied on this technology and constructed some demonstration plants. In order to extend biogas technology, a department named Environmental Pollution Control Department (EPCD) was established in 1980. BCSIR provided training to the engineers of this organization. By 1984, they constructed 109 floating dome-type and 110 fixed dome-type biogas plants in different districts. During this period, 92 plants were constructed by their departmental engineers at the initiative Siraj Uddin, the then Chairman BSCIC. BCSIR through different NGOs and directly by their scientists has so far constructed about 250 floating dome-type and 35 fixed dome-type biogas plants. DANIDA has so far constructed 10 biogas plants. Some NGOs and private individuals constructed about 100 plants of different types.

Local Government Engineering Department (LGED), at the initiative of its Chief Engineer, Quamrul Islam Siddique, started study, research, development and extension of biogas technology since 1985. LGED constructed the first biogas plant in Kurigram in 1986 and arranged a seminar there. About 300 engineers, scientists and interested persons attended the seminar. LGED constructed first Chinese-type fixed-dome model biogas plant in Karimpur village of PS Begumgonj, Noakhali in June 1992. LGED constructed the first biogas plant from night soil in Faridpur Muslim Mission in 1992, biogas plant from water hyacinth in Madaripur in 1993, biogas plant from poultry droppings in Utter Khan, Dhaka in 1994 and garbage-based biogas plant in 10 towns in 1994. Up to the end of 1994, LGED constructed about 200 biogas plants out of which eight are floating dome-type and the rest are Chinese model fixed dome-type. Among the plants, 73 are based on night soil, one based on water hyacinth, two based on poultry droppings, 23 based on garbage and the rest are based on cowdung. To provide technical support to the beneficiaries, LGED trained up 70 of its engineers on biogas technology with assistance from BCSIR and four of its engineers in China.



A biogas plant in China

China

China started research on biogas technology since the end of 1920s. During this period, 49 pilot plants were constructed in Sichuan. Besides cooking, gas was used to run six lamp stations and one six kw generator. 200 technicians were trained. But this was not cost effective as life of the plants was short. In 1958, Chairman Mao included biogas technology in the national programme and gave importance on the extension of biogas technology. During 1960s, many demonstration plants were constructed. In 1970, a massive biogas development programme was to resolve the problem of energy shortage in the rural areas. By 1978, the number of biogas digester increased to 7 million with 5 million in Sichuan alone. But the life of these plants were not more than 3-4 years. In March 1979, an international seminar was held to sum up the experience gained and formulate national policy for future development. Eighteen countries participated in the seminar. This led to some changes in the institutional framework and improvement in the management.

Based on the recommendations of the seminar Chengdu Biogas Research Institute was established in 1979. In 1981, following an agreement with United Nations Development Programme (UNDP) it was renamed as Biogas Research and Training Centre for Asia and Pacific (BRTC) and started short training course for developing countries from 1982. At present there are 252 scientists in BRTC researching on biogas technology. They developed very economic and efficient models of biogas digester, which is popularly known as Chinese model fixed-dome biogas plant. In China, there are now about ten million biogas plants, out of which 50,000 are Red Mud Plastic 6-10 m3 size and 10,000 medium and large size. Some of these are of 1000 m3 to 5000 m3 size. Cowdung, pig waste, human excreta, poultry droppings, city garbage, agriculture and industrial waste are used as raw materials.

Nepal

Nepal is dealing with biogas technology since 1955, but could not show any notable achievement. In 1977, one NGO, named Gabber Gas Company (GGC) was established with the aim to disseminate biogas technology. GGC, with the support from Nepal Government, constructed many family size demonstration plants which could draw attention of all. Subsequently government took a massive programme for constructing biogas plants giving subsidy through GGC. At present, there are about 20,000 biogas plants in Nepal. Government of Nepal set a target to construct 50,000 more plants by the year 2000. To implement biogas extension programme, there are now 15 Companies like GGC.

The size of the plants completed so far are from 4 m3 to 50 m3. Elephant dung, cow dung, night soil etc. are the main raw materials for digester. Gas is used for cooking, lighting and producing electricity. Government gives subsidy of Rs 7000/- to Rs 10,000/- per plant for remote area and 25% subsidy for other areas.

India

In India research and study on biogas started in 1900 AD, when the first biogas plant was constructed in Homeless Lepers Asylum in Matunga, Bombay. But it did not work well. As a result, further development stopped for a long time. In 1937, scientists of Indian Agricultural Research Institute (IARI) took up study on sewage treatment through anaerobic digestion in Deader, Bombay. They collected gas and used to run a five ton garbage truck. Slurry was used as fertilizer. In 1939, Dr S V Desai of IARI constructed a cow dung based biogas plant in Delhi, which led to the development of design of floating dome-type biogas plant. Dr Y N Kotwal and Broker of Deader plant proved that urine accelerates gas production. Jashbhai Patel developed an economically viable model named Gram Lakshmi model in 1951 in Gujarat. Following this model, more than 200 plants were constructed in different places of India. But these plants did not work successfully. In 1961, Khadi Village Industries Commission (KVIC) included biogas in its programme and developed a model named Gram Lakshmi III. KVIC adopted this model successfully and started a Directorate named Directorate of Gobar Gas. They constructed some large size biogas plants also such as, Karim Nagar (125m3), Delhi Dairy Corporation (350m3). In 1961, Gobar Gas Research Station started in Ajitmal. In 1976, fixed dome-type Janata model was developed by them. This model got popularity due to its durability, economy and efficiency. By 1980, one lac plants were constructed by KVIC, State Govt and AFPRO. India's National Project on Biogas Development (NPBD) for mass diffusion of biogas technology was launched in 1981 following a multi-agency and multi-model approach. In 1982, biogas technology became part of the twenty point programme. There is a nodal agency at the top, the Department of Non-conventional Energy Sources (DNES) established in September 1982 within the Ministry of Energy, which is responsible for the coordination, implementation and R&D of family size and community biogas digesters. At state level, there is 'Biogas cell' who supports and coordinates 25 nodal departments and agencies dealing with biogas technology. They are mainly KVIC and AFPRO. The scientists of AFPRO developed a new fixed dome model biogas plant in 1984 called 'Deen Bandhu' which could draw attention of the beneficiaries.

Thailand

In Thailand, National Energy Administration (NEA) is responsible for coordination of all biogas activities, policy formulation, R&D work, administering subsidy etc. Some agencies like Department of Agriculture Extension, Department of Public Health, Department of Social Welfare are dealing with biogas extension programme. At present, 3000 family size, five farm size (100m3-2000m3), 12 large biogas plants (3000m3) are in operation in Thailand.

Pakistan

The first biogas plant in Pakistan was installed in 1974 which led to construction of 100 demonstration plants in different educational institutions. At the directives of President, a National Biogas Extension Programme at a cost of Rs 33.00 million was launched in 1980-81.

Modern development is mainly based on energy. Population growth has accelerated energy need. As a result extraction of natural gas, oil and coal is increasing alarmingly especially in developing countries. This is the time to explore alternative energy sources.

The writer is Project Director, Slum Improvement Project, Local Govt Engineering Department.

Lead Pollution: An Environmental Concern

by Md Shah Alam

THE automobiles exhaust lead (pb) in addition to NO(nitrogen and oxygen containing gases) and other gases. The lead emitted from the exhaust of motor vehicles is an environmental problem. It pollutes the atmosphere, soil, water etc. Pollution of environment with lead is a global problem. Lead alkyl additives used in gasoline to increase the anti-knocking property, which combusted and emitted into the atmosphere can be responsible for high concentrations of lead in roadside soil, vegetations, air, water and plants.

The increased level of lead near roadside environment is mainly due to the combustion of leaded gasoline used by the automobiles. Bangladesh is a developing country and to satisfy the growing need of the population, the number of vehicles are also increasing rapidly. Presently, there are approximately 2,50,000 motor vehicles in Bangladesh, of which 65 per cent run on leaded gasoline. In Bangladesh, every year about 75 tons of tetraethyl lead and ethylene dichloride and ethylene dibromide are used for blending with gasoline.

A group of researchers under the supervision of Prof Syed Safiullah and Prof Jasim Uddin Ahmad of Chemistry Department of Jahangirnagar University conducted some study to determine the levels of lead pollution in the roadside plant and soil of a section of Dhaka-Aricha, one of the most busy highways of Bangladesh.

The results obtained from the study shows that the average lead concentration in the rural area of the highway is 12.85 ppm for the washed samples and 22.79 for the unwashed samples, but for the urban section of the highway the respective values are 32.09 and 58.10 ppm. The average lead concentration of 4.85 ppm and 6.86 ppm for washed and unwashed samples of the treeleaves respectively are obtained for 1 kilometer off the roadside samples and for two kilometers off the roadside samples the concentrations for washed and unwashed samples are 3.06 and 4.04 ppm respectively. It is obvious that the lead concentration of the samples away from the highway are much lower compared to the lead concentration in the vicinity of the highway. This indicates a substantial external deposition of lead on tree leaves near the highway and it is considerably less away from the roadside. The average lead concentration of the washed and unwashed samples in the urban sector of the highway is 32.09 and 58.10 ppm respectively. These values are more than double in comparison to the lead concentration of the washed and unwashed samples of the rural sector (12.85 and 22.79 ppm respectively).

The results obtained for the soil samples shows that, in the vicinity of the road, the average lead concentration of the surface layer is 51.33 ppm, nearly 1.4 times greater than concentration of the samples of one kilometer away from the highway and 1.6 times greater than the concentration of the samples of two kilometers away from the highway. The average lead concentration of the 6-12 inch deep layer in the vicinity of the highway is 45.32, one kilometer away from the highway is 32.94 ppm and 26.66 ppm at two kilometers away from the highway. It has been found that the lead concentrations of samples away from the highway are lower compared to the lead concentration of the samples in the vicinity of the highway. It is also found that the concentration of the lead in soil samples gradually decreases from the surface layer to the different deep layers. The higher level of lead in urban highways can be ascribed by the difference in the density of gasoline based vehicles in the metropolitan area and the rural highway.

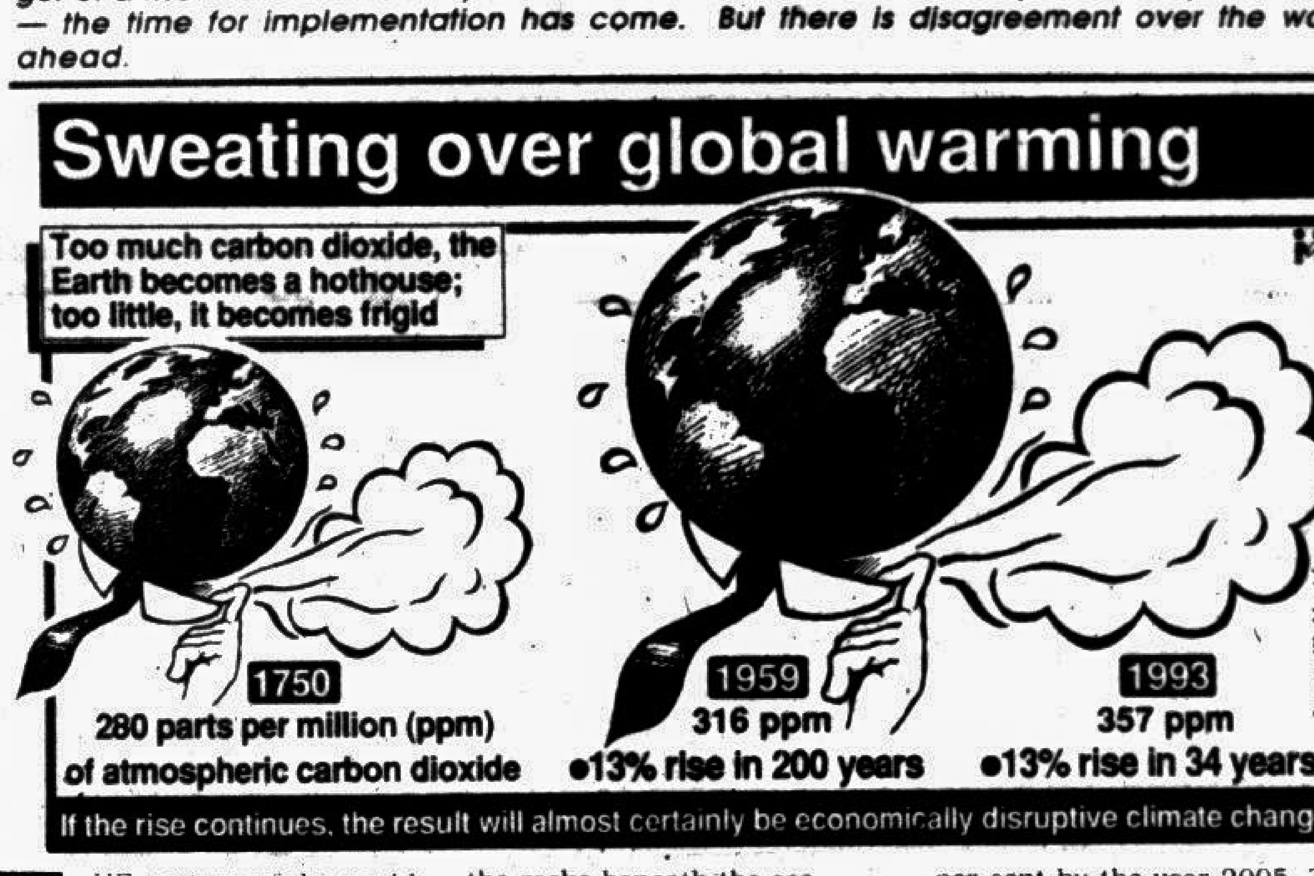
There are some noticeable variation in the lead level from one tree species to another. The lead contamination in washed leaves of Sal is the least and for the Black-berry is the highest. It is clear from the study that the lead contamination of soil is higher in surface layers and hence for the trees whose roots and sub-roots spread in the surface layers, the intake of lead is more compared to those trees whose roots and sub-roots penetrate deep into the soil. Moreover, the intake of lead by tree species whose principal root has gone to the deep layer and branch roots or sub-roots spread in the surface layers of the soil is also quite high.

Comparison of lead pollution with the cases of some of the industrialised countries, the cases of lead pollution of Bangladesh is not alarming as yet. However, if no steps are taken for introducing lead-free motor fuel and if the present rate in the increases of motor vehicular traffic continues then serious health hazards may occur due to lead pollution in the vicinity of the motor highways and busy city roads.

Climate Change Debate Comes to the Boil

by Fred Pearce

Almost three years after the "Earth Summit" approved an agreement to tackle the danger of a rise in the Earth's temperature — which could cause widespread disruption to life — the time for implementation has come. But there is disagreement over the way ahead.



THE nations of the world gather in Berlin in March to decide what to do about global warming. Having signed the Climate Change Convention in a blaze of green fervour at the "Earth Summit" in mid-1992, they are now faced with implementing its provisions.

The Convention was arguably the only tangible success of the Summit. But in the following months, environmental issues have slipped down the political agenda. "If the Summit were held now, they would not sign such a convention," says leading British environmentalist Jonathan Porritt.

But the central commitment of the convention remains — that industrialised nations should return emissions of carbon dioxide, the principal cause of global warming, to 1990 levels by the year 2000.

Carbon dioxide comes mostly from burning fossil fuels such as coal, oil and natural gas. Global emissions of the gas are approaching 6 billion tonnes a year, more than half of it from North America and Europe. The commitment to stabilising emissions should not be difficult for industrialised countries. Most have reduced their emissions over the past 20 years, as heavy industry has declined and fuel efficiency improved. The countries of eastern and central Europe have made reductions of 20-40 per cent since 1990 as old, inefficient communist factories have closed.

Elsewhere, modest measures will meet the target. Britain, for instance, is switching from burning coal and oil in power stations, towards natural gas, and making small investments in wind power.

Norway, which wants to develop reserves of North Sea gas rich in carbon dioxide for sale to its European neighbours, has found a way to do it. The country plans to use a chemical process to remove carbon dioxide from the natural gas as it is pumped to the surface, and will then inject it back in the rocks beneath the sea.

Even so, southern European countries are increasing emissions. European Commission staff in Brussels concede privately that the European Union as a whole may not meet its stabilisation target.

And it turns out there are loopholes in the targets. Emissions from aircraft, the fastest-rising source of carbon dioxide, will not be covered by the convention, because they are difficult to ascribe to an individual nation.

All this begs the question of what will happen after the year 2000. Much tougher measures are essential after that date, says the Convention's chief scientific adviser, Sir John Houghton. And negotiations on them must begin in Berlin.

Carbon dioxide stays in the atmosphere for a century or more. If we carry on emitting as much as we do today, it will continue to accumulate, slowly warming the planet. Article 32 of the Convention lays down as its central objective "to achieve the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

To be sure of meeting that objective, says Houghton, requires cuts in global emissions of up to 60 per cent. If we go on as we are, the amount of carbon dioxide in the atmosphere will have doubled within a century, causing an average rise in temperatures estimated by Houghton at 2.4 degrees Celsius. That will produce widespread disruption to climate and raise sea levels as ice caps melt.

The Alliance of Small Island States is not happy at progress so far in stopping this happening. It represents countries such as Kiribati in the Pacific and the Maldives in the Indian Ocean, whose flat coral atolls could disappear beneath rising sea levels within a few decades.

Last year the Alliance submitted to the Convention a proposal for industrial nations to cut emissions by at least 20 per cent by the year 2005. The proposed protocol is likely to be a central feature of the Berlin meeting, says Lise Backer of the Stockholm Environment Institute.

The second area of controversy is likely to be "joint implementation". The Convention, as signed in Rio, allows nations to meet their targets either jointly or individually. The United States has proposed fulfilling its obligations, not by cutting emissions at home, but by planting trees in Central America to mop up the extra gas. Germany could similarly opt to cut emissions in Polish power stations rather than its own industrial heartlands.

Some economists argue that joint implementation will allow the most cost-effective reduction in emissions. "There are 20 or so such deals already being planned", says British environmental economist David Pearce. And some people in the developing world are also keen. Jyoti Parikh of the Indira Gandhi Institute for Development Research in Bombay told a conference in London last year that it is "a very significant opportunity to attract money and technology to developing countries."

Richard Mott of the World Wildlife Fund in the US believes low-cost tree planting across the tropics might soak up carbon but will stifle technical innovation in energy-efficient technologies.

And at a meeting of convention signatories last August, developing nations argued that joint implementation should only be permitted between industrialised nations that are subject to the existing targets.

Meanwhile, back in the real world, the eruption of Mount Pinatubo in 1992 caused a temporary cooling of the planet, shielded by volcanic debris in the upper atmosphere. But that is now virtually over. And the record temperatures seen in the late 1980s seem set to be exceeded well before the end of the current decade.

— GEMINI NEWS

The Ailing Aral Sea

There was once a great and mighty sea in Central Asia that was cleanest and bluest in the world. Who is going to save it? ***Ian MacWilliam*** *reports for Inter Press Service.*

THE bluff still has a seaside look about it, with a line of jetsam along the beach and the rusting hulk of a boat on its side nearby.

But what is glaringly absent is the sea. Where the water should be, the beach stretches away forever, the sand giving way to a lifeless desert of salt flats, with a listless trail of castle wandering across it.

Where the horizon should be, the salt flats and sky disappear in a brown blur — a pall of dust laden with salt and pollutants which the strong north wind blows from the exposed seabed over the one-time fishing port of Muinak and all the once rich farmlands of the Oxus delta.

There are two oil tanks where the government built a small port, then a second further out, then a third as the water retreated. But the sea is now 75 km from Muinak and boats no longer ply its waters.

There was an international outcry in the late 1980s when it became known that the Aral Sea, once the world's fourth largest lake, was disappearing. Reports about the now independent Central Asian republics still routinely invoke the tragedy of the vanishing sea.

Several years on, however, the sea is still shrinking and it is increasingly clear that the Central Asian republics have neither the will nor the means to reverse this unprecedented disaster. The international community has offered little more than sympathy.

The Aral Sea is fed by two great rivers, the Amu Darya, or Oxus, and the Syr Darya. Since 1960, vast Soviet irrigation schemes built to water the arid lands of Central Asia have taken so much water from the rivers that the sea has received too little to make up for evaporation. The sea, which has no outlet, is simply evaporating.

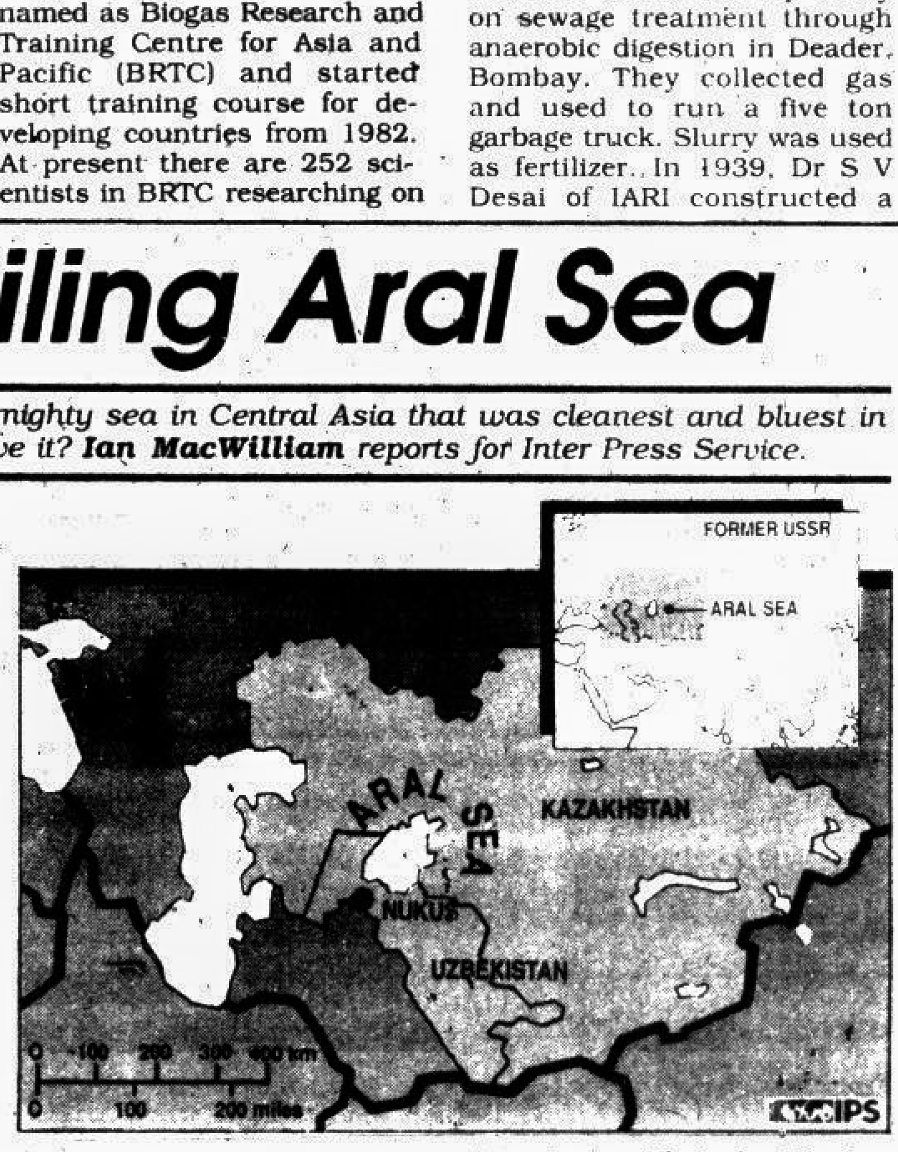
Between 1960 and 1993, the water level fell more than 16 metres, its surface area shrank by nearly half and its volume by 75 percent. Its salinity increased more than threefold, killing off the fish which were once the basis of a thriving fishing industry.

"It was a wonderful sea with sparkling blue water," recalls Marinika Babanazarova, director of the museum of art in the regional capital Nukus. "Then it disappeared very quickly in the seventies."

The sea's retreat is causing the degradation of the regional environment. For as the forests died or gave way to the cotton monoculture Moscow decreed for much of Central Asia, the rich marshlands of the delta also disappeared.

"There were beautiful forests in the delta, but they have disappeared," says Marinika. "We used to go there for picnics."

Pesticides and herbicides from chemical-happy Soviet collective farms poisoned local wildlife. The number of bird



species nesting in the Syr Darya delta, for instance, is estimated to have fallen from 173 to 38.

Tigers once lived in the Oxus delta, but the last was killed in 1972. The sturgeon which produced Aral caviar vanished and the rich shoals of fish went belly up.

The last fish were caught in the early eighties. Fishing boats stranded by the retreat of the sea have been out for scrap and the fishermen have had to search for other, scarce work.

Nearly four million people live around the Aral in the region affected by environmental problems, mostly along the two rivers. Their health has declined drastically along with the environment. Salt and dust blowing off the exposed seabed have caused an increase in respiratory problems, while polluted water from the rivers causes stomach and other illnesses.

The two rivers are the only source of water, but by the time they reach the delta regions they are composed of run-off from the irrigation system and are laden with pesticides, defoliants, fertilisers and raw sewage.

Dr Andrei Vervikhvorst, head of the mother and child unit of a medical institute in Nukus, says there has been a massive increase in anaemia in recent years. One hundred percent of pregnant women here are anaemic.

Studies have also revealed high rates of typhoid, dysentery, birth defects and the highest infant mortality rates in the former Soviet Union.

The sea now lies in two independent republics, the northern half in Kazakhstan and the southern half in Uzbekistan. Both republics use large amounts of river water for irrigation. Neighbouring Turkmenistan also irrigates large areas with Oxus water.

The Oxus delta lives mostly in Karakalpakstan, a part of Uzbekistan.

People in Karakalpakstan accuse the Uzbek government in Tashkent of taking no interest in their problems. Uzbek officials certainly dislike publicising the problems and have discouraged journalists from visiting the area, no doubt because of the simmering resentment towards Tashkent which is immediately apparent there.

The five Central Asian republics pledged early this year to give one percent of their Gross National Product (GNP) to an Aral Sea fund. So far none has paid up.

The only solution, according to local joke often told by Mukus residents who have watched environmental experts come and go over the years, would be for every visiting expert to bring a bucket of water with him or her.