

Restoring the shield against a sinister sun

RECENTLY, at the 20th meeting of the Open-ended Working Group of the Parties to the Montreal Protocol in Geneva, the participants noted with satisfaction that environmental conservation movement across the globe had begun evolving solutions. The Montreal Protocol, they observed, has ushered in a ray of hope. The developed countries in some measures have fulfilled their commitments and shown the way to the developing countries. There have been growing awareness and action in every country to phase out ozone-depleting substances.

The International Ozone Day, observed on September 16, with the theme *Save our sky, protect yourself, protect the ozone layers* is an embodiment of people's commitment to protecting the ozone layer. Over the last ten years, there has been encouraging progress. Almost 90 per cent reduction in consumption and production of ozone-depleting substances has been measured in the developed countries. Developing countries are following suit. Scientists hold out hope that the ozone layer would begin to recover very soon and complete its recovery in 50 years from now - a long way still to go.

The ozone layer

Earth's atmosphere is divided into several layers. The troposphere, the lowest level, extends from the planet's surface up to about 10 kilometres in altitude. The next layer, the stratosphere, continues from 10 to about 50 kilometres. Most atmospheric ozone is concentrated in a layer in the stratosphere, about 15-30 kilometres above the Earth's surface. Ozone is a molecule containing three oxygen atoms. It is blue in colour and has a strong odour. Normal oxygen, which we breathe, has two oxygen atoms and is colourless and odourless. Ozone is much less common than normal oxygen. Nearly two million out of every 10 million air-molecules are normal oxygen, but only three are ozone.

However, even the small amount of ozone plays a key role in the atmosphere. The ozone layer absorbs a portion of the radiation from the sun, preventing it from reaching the planet's surface. Most importantly, it absorbs the portion of ultraviolet light called UVB. UVB has been linked to many harmful effects, including various types of skin cancer, cataracts, and harm to some crops, certain materials, and some forms of marine life.

At any given time, ozone molecules are constantly formed and destroyed in the stratosphere. The total amount, however, remains relatively stable. The concentration of the ozone layer can be thought of as a stream's depth at a particular location. Although water is constantly flowing in and out, the depth remains constant.

While ozone concentrations vary naturally with sunspots, the seasons, and latitude, these processes are well understood and predictable. Scientists have established records spanning several decades which detail normal ozone levels during these natural cycles. Each natural reduction in ozone levels has been followed by a recovery. Recently, however, convincing scientific evidence has shown that the ozone shield is being depleted well beyond changes due to natural processes.

The damage done

For over 50 years, chlorofluorocarbons (compounds containing chlorine, fluorine and carbon) were thought of as miracle substances. They are stable, non-flammable, low in toxicity, and inexpensive to produce. Over time, CFCs found uses as refrigerants, solvents, foam blowing agents, and in other smaller applications. Other chlorine-containing compounds include methyl chloroform, a solvent and carbon tetrachloride, an industrial chemical. Halons, extremely effective fire extinguishing agents and methyl bromide, an effective produce and soil fumigant, contain bromine. All of these compounds have atmospheric lifetimes long enough to allow them to be transported by winds into the stratosphere. Because they release chlorine or bromine when they break down, they damage the protective ozone layer.

In the early 1970s, researchers began to investigate the effects of various chemicals on the ozone layer, particularly CFCs, which contain chlorine. They also examined the potential impacts of other chlorine sources. Chlorine from swimming pools, industrial plants, sea salt, and volcanoes does not reach the stratosphere. Chlorine compounds from these sources readily combine with water and repeated measurements show that they rain out of the troposphere very quickly. In contrast, CFCs are very stable and do not dissolve in rain. Thus, there are no natural processes that remove the CFCs from the lower atmosphere. Over time, winds drive the CFCs into the stratosphere.

The CFCs are so stable that only exposure to strong UV radiation breaks them down. When that happens, the CFC molecule releases atomic chlorine, which is highly active. One chlorine atom can destroy over 100,000 ozone molecules. The net effect is to destroy ozone faster than it is naturally created. To return to the analogy comparing ozone to a stream's depth, CFCs act as a siphon, removing water faster than normal and reducing the depth of the stream.

Large fires and certain types of marine life produce one stable form of chlorine that reaches the stratosphere. However, numerous experiments have shown that CFCs and other widely used chemicals produce roughly 85 per cent of the chlorine in the stratosphere, while natural sources contribute only 15 per cent. Large volcanic eruptions can have an indirect effect on ozone levels. Although Mt Pinatubo's 1991 eruption did not increase stratospheric chlorine concentrations, it did produce large amounts of tiny particles called aerosols (different from consumer products also known as aerosols). These aerosols increase chlorine's effectiveness in destroying ozone. The aerosols only increased depletion because of the presence of CFC-based chlorine. In effect, the aerosols increased the efficiency of the CFC siphon, lowering ozone levels even more than it would have otherwise occurred. Unlike

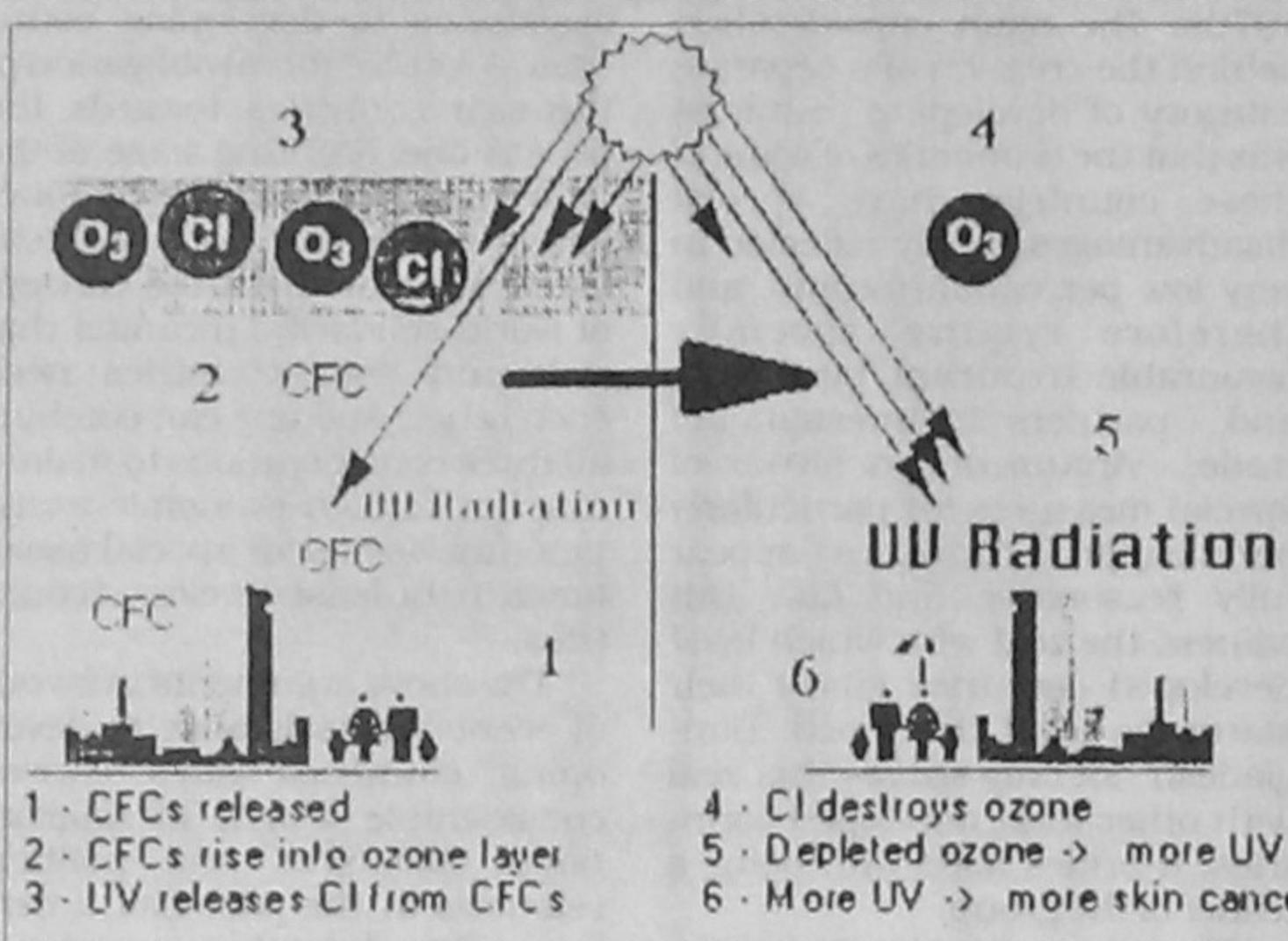
For years man has unknowingly engineered depletion of the Earth's stratospheric ozone layer -- our shield against the sun's hazardous ultraviolet rays. Thankfully, in recent years, there have been increasing awareness of and conscious efforts towards protection of the protective shield. Production and consumption of ozone-depletion substances in the developed countries has gone down substantially. Developing countries are fast following suit. It's still a long way to go, writes Md. Asadullah Khan

long-term ozone depletion, however, this effect is short-lived. The aerosols from Mt Pinatubo have already disappeared, but satellite, ground-based, and balloon data still show ozone depletion occurring closer to the historic trend.

One example of ozone depletion is the annual ozone "hole" over Antarctica that has occurred during the Antarctic Spring since the early 1980s. Rather than being a literal hole through the layer, the ozone hole is a large area of the stratosphere with extremely low amounts of ozone. Ozone levels fall by over 60 per cent during the worst years.

In addition, research has shown that ozone depletion occurs over the latitudes that include North America, Europe, Asia, and much of Africa, Australia, and South America. Over the US, ozone levels have fallen five to ten per cent, depending on the season. Thus, ozone depletion is a global issue and not just a problem of the South Pole. Reductions in ozone levels will lead to higher levels of UVB reaching the Earth's surface. The sun's output of UVB does not change; rather, less ozone means less protection, and hence more UVB reaches the Earth. Studies have shown that in the Antarctic, the amount of UVB measured at the surface can double during the annual ozone hole. Another study confirmed the relationship between reduced ozone and increased UVB levels in Canada during the past several years.

Ozone depletion process



The consequences

Laboratory and epidemiological studies demonstrate that UVB causes non-melanoma skin cancer and plays a major role in malignant melanoma development. In addition, UVB has been linked to cataracts. All sunlight contains some UVB, even with normal ozone levels. It is always important to limit exposure to the sun. However, ozone depletion will increase the amount of UVB, which will then increase the risk of health effects. Furthermore, UVB harms some crops, plastics and other materials, and certain types of marine life. Higher air temperatures also increase the concentration of ozone at ground level. The natural layer of ozone in the upper atmosphere blocks harmful ultraviolet radiation from reaching the Earth's surface; but in the lower atmosphere ozone is a harmful pollutant. Ozone damages lung tissue and causes particular problems for people with asthma and other lung diseases.

Incidence of skin cancer in the United States has reached epidemic proportions. Health experts predict that one in five Americans will develop skin cancer in their lifetime. Excess UV radiation may also affect the body's general ability to fight off disease.

One impending tragedy is the possible blinding of almost all non-nocturnal animals and insects outside the darkest jungle. While humans can certainly protect their eyes, most other forms of life cannot do so.

Just as worrisome is the threat to world's food supply. High doses of UV radiation can reduce the yield of basic crops such as soybeans. UV, the most dangerous variety of ultraviolet, penetrates scores of metres below the surface of oceans. There the radiation can kill phytoplankton (one-celled plants) and Krill (tiny shrimp-like animals) which are at the bottom of the ocean food chain. Since these organisms found in greatest concentrations in Antarctic waters nourish larger fish, the ultimate consumers, humans may face a maritime food shortage.

Even then the progress made so far in the developed countries is encouraging. According to UN Environment Programme, which oversees the Montreal Protocol, there has been a spectacular progress, almost 90 per cent drop in CFC consumption since 1986 in industrialised countries. There has been a similar reduction in halons the ozone hostile chemicals used in fire fighting. In 1990, Montreal Protocol was broadened to include two potent industrial solvents not covered in the original agreement: methyl chloroform and carbon tetrachloride and now methyl bromide will be included.

Encouragingly, some of the countries that resisted CFC controls at first are taking the lead today sometimes to their own surprise.

Germany became the first country to establish a system for recycling CFCs from discarded refrigerators. Sweden, Switzerland and the Netherlands are working on their own refrigerator recycling programmes. Japan was at first leery of changes in as much as it would raise the cost of doing business. But Matsushita, NEC and Sony all have switched over to technologies that will eliminate the use of CFCs. There are also encouraging initiatives in the US as well. The Hughes

corp now uses a chemical derived from lemon juice instead of CFCs in its weapons manufacturing programme. Northern Telecom, a Canadian firm that does most of its business in the US, has developed dechlorinating processes that do not need cleaning and has become the first major North American company to end reliance on CFCs throughout its operations.

Crazy climate

Scientists are also convinced about the danger of ozone depletion that has brought about potentially disastrous changes in climate. They are also concerned about the greenhouse effect, a long-term warming of the planet caused by chemical changes in the atmosphere. When stratospheric ozone intercepts UV light, heat is generated. The heat helps create stratospheric winds, the driving force behind weather patterns.

Sherwood Rowland, a chemist at the University of California at Irvine who first discovered the dangers of CFCs, and others figured it was a combination of factors that made the ozone layer over Antarctica particularly vulnerable. First, the polar vortex collects CFCs that waltz from the industrialised world. Second, the super frigid air of the Antarctic night causes clouds of tiny ice crystals to form high up in the atmosphere. When the CFCs break down, the resulting chemicals cling to the crystals where they can decompose further into ClO (chlorine monoxide), among other substances. And finally when the sun rises after the long winter night, its light triggers a wholesale demolition of ozone by chlorine monoxide.

Scientists are now convinced that greenhouse gases, pumped into the atmosphere unchecked, have been the root cause of the ozone depletion leading to the deteriorating state of the planet. The report coming from the International Panel on Climate Change, a respected UN-sponsored body made up of more than 1,500 leading climate experts from 60 nations, is quite gloomy. Unless the world takes immediate and drastic steps to reduce the emissions of heat trapping gases, says the panel, the so-called greenhouse gases could drive global temperature up as much as four degrees Celsius that would bring about profound effects on climate and health systems.

But

the technical challenge is to find substances and processes that can replace CFC-based systems without doing further harm to the stratosphere. Happily, that endeavour has worked. In fact, it has turned out to be much easier than anyone expected. Except for medical aerosols, some fire-fighting equipment and certain metal cleaning applications there are now effective substitutes for virtually every ozone-depleting chemical. Moreover, in a surprising number of cases, the new processes are actually cheaper and better than the old.

The real task for those countries that invested heavily in CFCs in the past is to develop systems for recovering and recycling the chemicals they have already used. Industrialised countries of the world bear direct responsibility for most of the damage that has been done and they can best afford the costs attached to switching technologies. But

Huge swaths of densely populated land, especially in the coastal regions of Bangladesh, India, Maldives, parts of China, Cook and Marshall Islands could be inundated by rising seas. Entire ecosystems could vanish as rainfall and temperature patterns shift in an unpredicted way. Droughts, flood and storms could become more severe. Faced with a collapsing economy, rising crime and intra-party conflicts in the political arena, the government in our country has pushed environmental issues like ozone depletion, greenhouse effect and global warming far down on its list of priorities. People, educated and uneducated alike, show no concern about the ozone problem. Aerosol cans and foam products getting into the market are easily grabbed by buyers who either do not know about CFCs or do not particularly care. Grassroots pressure has spurred Mexico and Thailand to phase out CFCs other than the fact they feared that exports not meeting strict ozone friendly standards could soon face international sanctions. In Mexico, for example, consumer complaints persuaded local manufacturers that it was time to begin removing CFCs from aerosol products. The changeover happened so quickly that when one company ran out of labels saying, THIS IS A CFC-FREE PRODUCT, store managers rejected the shipment, knowing many of their customers would leave unlabelled spray cans on the shelf.

Here in our country, the government as well as the political leaders, irrespective of their ideological orientation, must wake up to the distress call and should remember ozone when they think about other threats to the planet. If they always wait until there is indisputable evidence that serious damage is occurring, it could be too late to halt the damage. Consider the widespread scientific predictions of global warming from the greenhouse effect. People by now know for certain that something terrible is going to happen. Even then humans have boosted the amount of carbon dioxide in the atmosphere by at least 25 per cent.

It is reckless to subject nature to such giant experiments when the outcome is almost known and the possible consequences are too frightening to contemplate. Even if we have started a crash effort to save the ozone layer, the cure will not be instantaneous. The world may not know for decades how costly the years of recklessness will be. And whether our children should be afraid to look up. Among the strategies recommended in the IPCC report includes switching from coal and oil to natural gas turning to nuclear and solar energy, slowing deforestation, altering land-use and traffic patterns, curbing automobile use, changing lifestyles and employment. In other words, people in the developed world would have to completely transform their society and rich countries like the US would have to subsidise poor but fast developing nations. And that's just to roll carbon dioxide emissions back to 1990 levels, the goal most environmentalists endorse.

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Black gold and 'greenmail'

IT was, you might think, an unlikely scenario. At a recent conference of the oil and gas industry in the Norwegian city of Stavanger, I found myself speaking the same language as the chairman of the giant oil company Texaco. We had both been invited as keynote speakers obviously seeing things from very different perspectives at the biennial gathering of oil and gas engineers. It was therefore all the more impressive to hear Texaco's chairman not only recognising that climate change has become a reality but also admitting openly that the petroleum industry bears some responsibility in addressing this global threat.

What a change from the aggressive stance of the Global Climate Coalition, which was founded for the purpose of attempting to refute any evidence of climate change and of lobbying the United States Congress to resist measures to reduce emissions of carbon dioxide under the Climate Change Convention. But then the Coalition, which was supported by a large majority of companies in the coal, oil and gas sector, has recently been deserted by most big oil companies, either in a spirit of corporate and social responsibility or because they were responding to the demands of consumers and a range of concerned organisations.

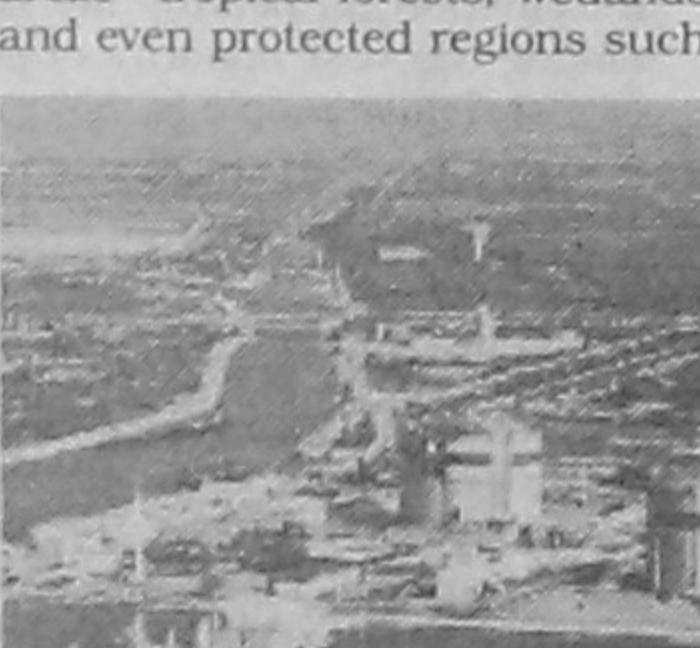
Indeed, we are now seeing huge advertisements from oil industry leaders such as Shell and BP Amoco announcing that they are committed to converting themselves into energy companies and, in the process, to developing alternative sources of energy for the future. That is a very welcome change of attitude at a time when governments must ratify the Kyoto Protocol under the Climate Change Convention and when strenuous efforts will be made to avoid requirements to reduce carbon dioxide emissions.

On the other hand, we have yet to see whether these oil company public relations campaigns are any more than what some environmentalists dismiss as 'greenmail', after the predominant colour of the advertisements. Such scepticism is not surpris-

ing. The conservation organisation WWF is increasingly finding conflicts between its objectives as a conservation organisation and the effects of oil exploration and exploitation in some of the world's remotest and most sensitive areas: tropical forests, wetlands and even protected regions such

as the oil companies must put their money where their mouths now appear to be and practise the more careful approach they publicly espouse. They need to understand that technological development is not simply a matter of pollution control but applies equally to the maintenance of biological diversity. For instance, a study of sea-floor fauna would reveal whether the ecosystem is damaged by the remnants of drilling platforms and whether techniques for retrieving them should be invented. At the same time, the industry should demonstrate its environmental commitment by establishing a worldwide standard of operations, rather than seeing what they can get away with in different areas because of differing economic conditions, culture and media profile.

There is, too, a tendency to



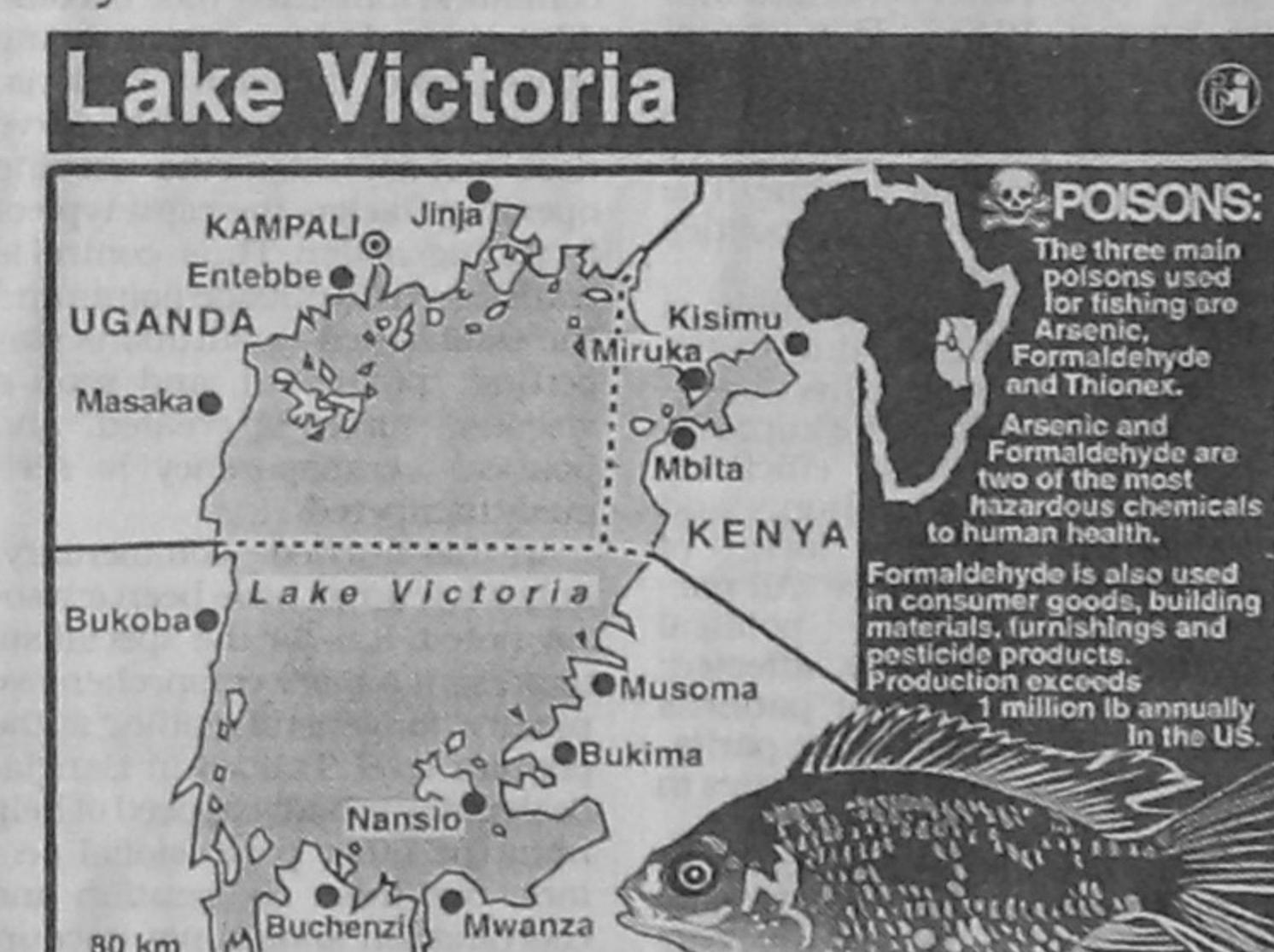
Tanker and storage tanks.
Credit: WWF/Michel Gunther



Oil leak in Russia.
Credit: WWF/Michel Gunther

A mortuary called Lake Victoria

The European Union banned Kenyan, Tanzanian and Ugandan fish products in 1999 because of the use of toxic chemicals in fishing Africa's largest fresh-water lake, Lake Victoria. But as competition for shrinking markets grows, Kenyan fishermen continue to use chemicals despite the threat of a permanent ban on their export to the EU, John Kamau writes from Kisumu, Kenya



Lake Victoria

They are telling the industry to ensure that chemical use and unhygienic practices are rooted out. The ball is in your court."

Fishermen at the Kenyan beaches admit they use chemicals to boost their catch. When asked where the chemicals come from, a fisherman called Oryango, said: "Do you need to ask? There is a mortuary in town."

In 1998 mortuary attendants in Kenya were selling formaldehyde to traditional brewers. But after a lethal brew killed six people and blinded four others in the central Kenyan village of Kirere, the trade went underground.

The business has now reappeared in the fishing industry where chemical use is costing the industry about six billion Kenyan shillings a year, industry sources say.

Formaldehyde is mixed with herbs and poured into the lake by a leading boat while another boat trails behind collecting the dead floating fish.

Fishermen on the Kenyan side

are telling the industry to ensure that chemical use and unhygienic practices are rooted out. The ball is in your court."

Those in the industry insist that if the government puts a central monitoring authority in place, the problem will ease. At the moment, the fisheries department is poorly funded and lacks facilities to police the lake.

"We hope the government will put in place a central monitoring authority like the one in Tanzania," said Hirsli Shah, the chairman of Kenya Federation of Employees.

Others insist that local fishermen should be educated on modern fishing methods as a short-term measure to control the problem.

Among the EU demands is that proper monitoring should be put in place in all landing beaches in the lake. It has proposed that the 180 landing beaches on the Kenyan side should be cut to just nine for easier monitoring but locals have rejected the idea.

"We do not oppose the development of fish-landing beaches to improve quality, but any project must be approved by

the concerned communities," said Dr Ochola Kapio of Uhuru Lake Forum, a local non-governmental organisation that works with fishermen.

A visiting EU team last year criticised the way fish was being handled at the beaches as well as the absence of quality-testing facilities.

Most beaches lack basic facilities such as toilets while a fish-quality monitoring laboratory due to be set up in western Kenya has stalled through lack of funds. The EU, in a recent statement, insisted that the interest of its consumers was paramount and refused to lift the ban.

The frustrations are leading to buck-passing. Some angry fishermen blame magistrates who fail to give harsh penalties on those caught using chemicals.

The magistrates are entirely to blame," said Michael Otiemo, who quit fishing after the collapse of the EU market. "They are letting people free with small penalties even after they have been found using chemicals. Everyone thinks chemicals are worth the risk. If the judiciary and the police are firm, the lake pollution would not be continuing."

The three East African countries are now planning to harmonise fishery legislation. A task force is currently formulating the new legislation.

When the bills finally become operational they will assist in pollution control and general environmental management of the lake," says Prof Joseph Odhiambo, head of the Lake Victoria environmental management programme. -- Gemini News

The author is editor of the Nairobi-based 'Rights Features Service' and writes for 'New African' magazine.