Pesticides: From Silent Spring to Indian Summer

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The debate over pesticide use in India has been framed in a false dichotomy: prevention of human and environmental pesticide poisoning versus increased foodgrain production and control of insect-borne diseases. However, analysis of the effects of pesticides reveals that increasing pesticide use does not boost foodgrain production over the long term but, instead, has led to a resurgence of both target and secondary pests.

IN the name of science and control over nature, man's systematic pesticide poisoning of plants, animals, soil, water, and the entire ecosystem rages on unabated and unnoticed. In 1962, Rachel Carson published the classic *Silent Spring* which shocked the western world into consciousness and led to the banning of DDT as well as enactment of pesticide regulations in many countries. In 1977, *Rolling Stone* editor David Weir provoked another public outcry by disclosing that US and European corporations were selling drugs, pesticides and other chemicals which were banned in their home countries to the developing world. Other revelations followed: in 1975, Ciba-Geigy used Indians as human guinea pigs to test the effects of pesticides and sprayed 38 Indians, aged 13 to 57, with the organophosphate, Nuvacron 40.

Nevertheless, while *Silent Spring* awakened the western world to the catastrophic implications of the systematic pesticide poisoning of the environment India still slumbers in a 'Kumbakarnic' sleep: only one of the world's most hazardous pesticides, known as the 'dirty dozen', is banned in India. The 'dirty dozen' include DDT, BHC (benzene hexachloride), Aldrin, EDB (ethylene dibromide), chlordane/heptachlor, methyl parathion, paraquat, DBCP (dibromochloropropane), chlormideform, 2, 4, 5-T, toxaphene and PCP (pentachlorophenol). These pesticides are deadly. Even one swallow of paraquat is a lethal dose for an adult. A spoonful of parathion, a nerve gas developed in the second world war, spilled on the skin is also lethal. Nevertheless, only 2, 4, 5-T has been disapproved for registration in India.[1] In sharp contrast, all of the 'dirty dozen' are banned or severely restricted in industrialised countries.

Measured by tonnage, at least 70 per cent of all pesticides used on Indian farms are banned or severely restricted in western countries and identified by the World Health Organisation (WHO) as extremely toxic or hazardous. An even grater percentage of pesticides banned in the west are used in indian public health programmes. For example, although DDT has been banned in 24 countries, India consumed 15,826 metric tons in public health programmes in 1984-85.[2] Similarly, although BHC, twice as toxic as DDT, has been banned in five countries and severely restricted in 15 countries including the US, 25,000 tons were used in India in 1986. And the list goes on: 150 tons of heptachlor, three times as toxic as DDT and banned in 20 countries, are consumed annually in India; DBCP, banned in 18 countries including the US, is used on wheat and other crops in India.

India is the largest consumer and manufacturer of pesticides among south Asian and African countries and pesticide use in India has multiplied 20 times between 1960 and 1980. The introduction of high-yielding variety seeds during the green revolution increased pesticide consumption as the new varieties are less resistant to pests than traditional seeds.

The risks of increased use of hazardous pesticides are magnified in India as in tropical conditions, it is very difficult to use protective clothing, face masks, gloves and boots while spraying. Furthermore, illiteracy and lack of information among farmers contribute to pesticide misuse. A recent survey of farm workers spraying pesticides in Gujarat revealed that the workers were not given any protective clothing, only 50 per cent covered their faces with a cloth and only 20 per cent washed their hands after spraying.[3]

As a result of the widespread use and misuse of hazardous pesticides, India accounts for over one-third of the 5,00,000 acute pesticide poisonings which the WHO estimates occur every year in the developing world. In addition to acute poisoning, exposure to the 'dirty dozen' pesticides produces latent diseases and disorders such as cancer, heart disease, brain, kidney and liver damage as well as sterility, spontaneous abortions and birth defects.

Indians face a much higher risk of death and disability caused by acute and cumulative exposure to pesticides as they carry more pesticide residues in their bodies than people anywhere else in the world. Indians ingest 40 times as much DDT and BHC as their American and English counterparts.[4]

The level of DDT and BHC residues in food in India is among the highest in the world. According to a 1984 study by the UN Food and Agriculture Organisation (FAO), all of the 1,500 samples of cereals, pulses, milk, oil and meat sampled from all over India contained DDT and BHC, and the residues exceeded the WHO safety limit in 25 per cent of the samples. In contrast, only 1.2 per cent of the food samples had residues above tolerance levels in market basket surveys in developed countries. Furthermore, Indian babies imbibe eight times more DDT in their mothers' milk than American, Swedish and German babies.[5]

In addition to the catstrophic effects on human health, pesticides have also polluted water, soil, and air as they do not degrade easily and can persist in the environment for as long as 20 years. Furthermore as pesticides are not selective biotic killers, they also kill many non-target species as well as the targeted pest. For example, DDT is highly toxic to aquatic life and bird populations and, due to aerial drift, it is impossible to prevent DDT from spreading to areas even remote from the site of application.[6]

However, the debate over pesticide use in India has been framed in a false dichotomy: prevention of human and environmental pesticide poisoning versus increased foodgrain production and control of insect (vector)-borne diseases. The systematic pesticide contamination of the ecosystem is defended as a necessary evil in order to increase agricultural yields and control malaria. However, analysis of the environmental and biological effects of pesticides reveals that increasing pesticide use does not boost foodgrain production over the long term but, instead, has led to a resurgence of both target and secondary pests. Similarly, although pesticides reduced the incidence of malaria following the second world war, a resurgence of malaria has occurred. Like all wonder drugs, pesticides promised miracles but only delivered addiction.

Pesticides have led to a resurgence of pests many times greater than the initial outbreak as, first, they are not selective killers. Pesticides poison many nontarget species including the natural predators and parasites position of the target pest. The few surviving natural enemies starve to death after spraying as the pest populations are temporarily too low to provide sufficient food. Subsequently, the surviving pests multiply without control as their natural enemies have been killed. For example, use of DDT to control the boll

weevil, a cotton pest, destroyed the fire ant, a natural predator of the boll weevil.

Pesticides also destroy the natural enemies of non-target pests thereby disrupting the population control mechanisms provided by nature and transforming insects which previously caused minor problems into serious pests. For example, use of DDT and methyl parathion to control the boll weevil destroyed the beneficial arthropod parasites and predators residing in cotton fields which resulted in an enormous outbreak of the bollworm and tobacco budworm known as the Heliothis complex. While the Heliothis complex had only caused minor and sporadic damage prior to the introduction of DDT, it replaced the boll weevil as the primary cotton pest by the early 1960s.

In addition to destroying natural enemies, pesticides result in the emergence of resistant insect species. Resistance develops according to the Darwinian concept of natural selection. As only the tough insects survive the chemical spraying, they become the parents of the next generation passing down the genetic traits for chemical resistance.

According to a 1980 study by the FAO, 432 species of arthropods are resistant to several insecticides. As a result, cotton farmers in Gujarat spray their fields 20 to 30 times more often than before with increasingly toxic and expensive pesticides which constitute over 50 per cent of cultivation costs.[7] In Maharashtra, expenditures on pesticides have increased by 340 per cent without any increase in the average yield. In Andhra Pradesh, the state where the highest amount of pesticides, 15,000 tons a year, are consumed, over 15 species of pests have become resistant to the commonly used agrochemicals.[8]

Furthermore, malarial mosquitoes have also developed resistance to pesticides. In 1961, after 10 years of DDT use, the number of malaria cases in India had fallen to 50,000. However, the Anopheles mosquito has become resistant to organochlorine pesticides such as DDT especially in areas which had adopted high-yielding forms of agricultural production. Indian officials have also reported resistance to the more toxic organophosphate and carbamate pesticides. As a result, a resurgence has occurred in malaria cases which number over two million today.

Widespread pesticide use has both eliminated the natural predators and parasites of many pests and produced the emergence of resistant pest species. The consequent explosion of target and secondary pests has diminished crop yields and inflicted prohibitive pesticide costs on farmers. The ineffectiveness of chemical pest control is revealed by the fact that the 1,00,000 tons of pesticides consumed in 1984-85 in India helped save only 10 per cent of foodgrain production.[9] Therefore, pesticide poisoning of the ecosystem is not a necessary evil which must be borne in order to increase food grain production or control malaria. On the contrary, the reduction and elimination of pesticide use and the adoption of alternate means of pest control are the first steps toward increasing crop yields and eliminating disease over the long term.

Recognising the ineffectiveness and tremendous hazards created by pesticides, many western countries have shifted towards use of Integrated Pest Management (IPM). The fundamental difference between IPM and pesticide use is that while chemical control spreads an indiscriminate biotic killer in the environment without regard to the interaction of such chemicals with the processes of nature, IPM stresses enhancing pest control mechanisms which already exist in nature and disturbing these natural processes as little as possible.

IPM relies on a combination of techniques which include biological controls such as releasing natural enemies of the target pest in the area where the pest is located; developing host resistance by selective breeding of resistant crop varieties; autocidal controls, that is, tactics which cause the pest to contribute to the reduction of its own population such as release of laboratory propagated sterile males; and cultural controls—techniques which make the environment less favourable to pest reproduction and survival. Cultural controls include early planting to avoid peak pest periods or sanitation to remove food and breeding sites for pests. Crop rotation is also used against pests which cannot survive for long periods of time without crop contact and trap crops are used to attract pests to a small early crop which is then destroyed.[10]

Experimental IPM programme in India have successfully reduced use of pesticides on cotton by one-half and have increased yields. The IPM programmes emphasise choosing a seed variety which avoids maximum boll formation during the peak period of bollworm activity, sowing in May, use of parasites and sanitation measures such as uprooting crops at the end of the season.[11]

In Cuttack, Orissa, an IPM programme used early maturing, short duration varieties of rice resistant to gall midges and the stem borer, and rice stubble was destroyed by ploughing after harvest to avoid pest carryover. As a result, the major rice pest, the stem borer, reached the economic injury level only in one of 11 villages and pesticides use was drastically reduced to one spraying in the field and the nursery.[12]

Biological controls have been proven successful in controlling vegetable crop pests in India. For example, larval parasites were used to control Plutella xylostella, a cabbage pest, by 47 per cent; consequently, 100 per cent of the plants produced normal heads of cabbage with only the outer leaves damaged.[13]

Biological controls have also been successfully used instead of DDT to control malarial mosquitoes. A strain of the bacterium Bt var israelensis Serotype H-14 is a mosquito larvicidal agent which achieves 100 per cent mortality. Fish have also been used to reduce breeding of the Anopheles malarial mosquito from 32.8 per cent to 1 per cent in India one month after introduction into wells in Pondicherry. Another Indian field experiment used natural and synthetic garlic extracts as a mosquito larvicide against Anopheles.[14]

Instead of using BHC to control storage pests, jute bags treated with either 2 per cent asorbic acid or 1 per cent acetic acid protected stored wheat grain for three months. Furthermore, the leaves and seeds of the 'neem' tree, indigenous to India, have been used to discourage pests when mixed with grains in storage.[15]

Experimental evidence reveals that Integrated Pest Management is a far more sustainable agricultural practice than pesticide spraying as it selectively controls pests without either creating an outbreak of newly resistant species or contaminating the entire ecosystem with toxic chemicals. In a country where over 22,000 deaths from pesticide poisonings occur each year, the manufacture and use of the 'dirty dozen' must be banned and replaced with a more ecologically and economically sound form of agriculture as the silent spring has turned into an even more deadly Indian summer.

Notes

1 UN Consolidated List of Products whose consumption, and/or sale have been banned, withdrawn, severely restricted or not approved by governments, Second Issue, 1986: Additional Source: Directorate of Plant Protection Quarantine and Storage, Faridabad.
2 'Status Report on Pesticide Residues *vis-a-vis* Consumer Protection', Department of Science and Technology, Government of India, 1987.
3 David Bull, *A Growing Problem: Pesticides and the Third World Poor*, OXFAM, 1982, p 51.
4 'Poison in Your Food', *India Today*, June 15, 1989.
5 Ibid.
6 Terry Gips, 'Breaking the Pesticide Habit: Alternatives to 12 Hazardous Pesticides', International Alliance for Sustainable Agriculture, 1987.
7 UN Consolidated List..., op cit.
8 Ibid.
9 Ibid.
10 Gips, op cit.
11 Bull, op cit, p 136.
12 Ibid, p 136.
13 Gips, op cit, p 162.
14 Ibid.
15 Ibid.