SCIENCE AND ENVIRONMENT FORTNIGHTLY

Down To Earth

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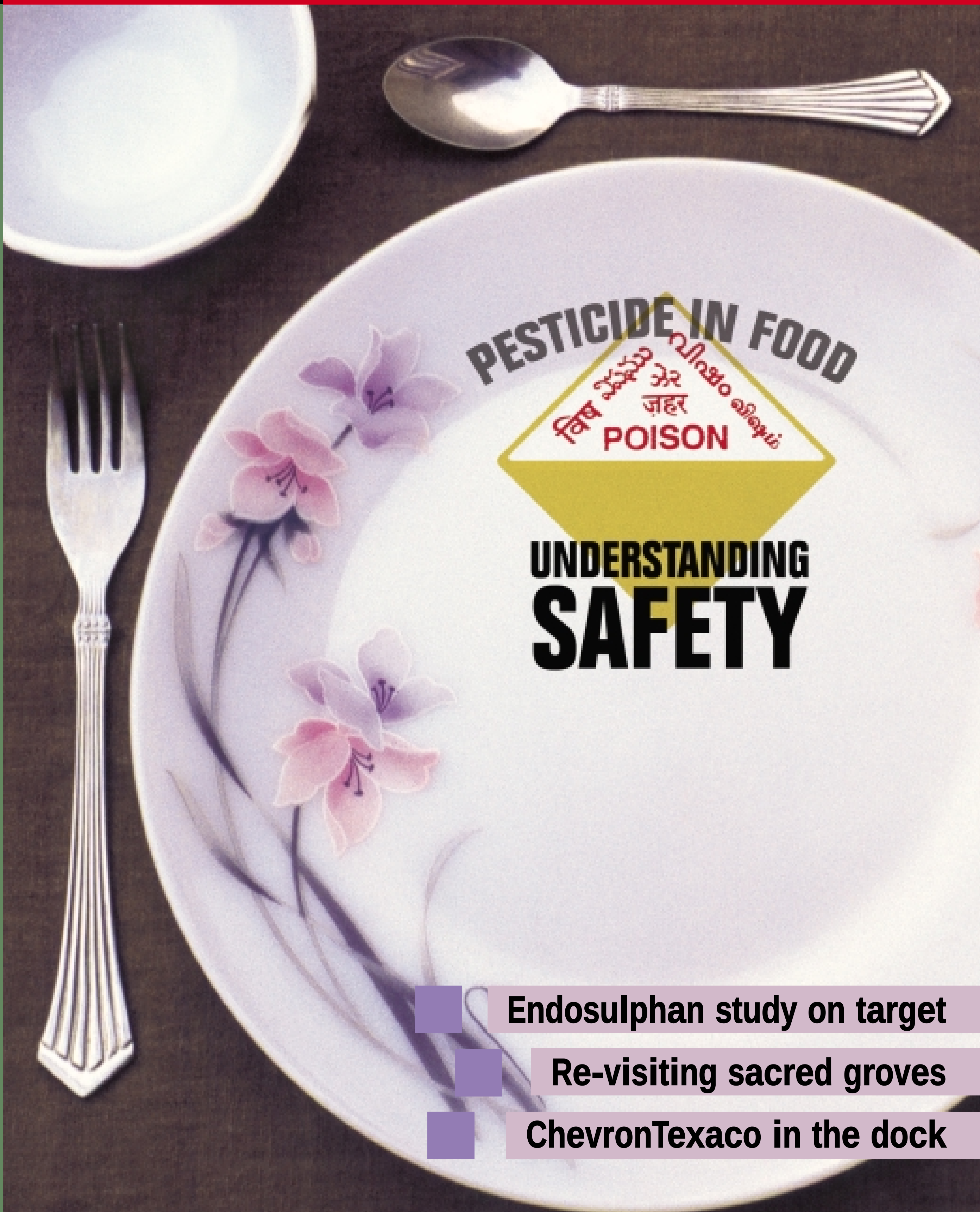

PESTICIDE IN FOOD

UNDERSTANDING SAFETY

Endosulphan study on target

Re-visiting sacred groves

ChevronTexaco in the dock

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A Refreshing Guide To Food Safety

There is never any end to learning. And so, surprises. We have learnt, over 20 years, that environmental governance in India is lackadaisical. Still, the extent of irresponsibility never fails to surprise.

Some months ago we did a study on pesticides in bottled water. We were really looking at pesticides in drinking water but research on municipal water supply was too difficult, so bottled water it was. We found pesticides. Where were they coming from? We found that the plants were using groundwater; the profile of pesticides in the bottles matched that in the groundwater. We understood more about the water use of these companies. Yet a question remained. Why did we find pesticides, and government not? So we looked at regulations and found that the science was about choosing the appropriate methodology of analysis. Government regulations were all about 'insensitive' detection methods, designed not to find what you looked for. We also learnt about the economics and technology of water treatment and how the management of the 'source' was critical. The more water was contaminated, the higher were the costs of treatment, the costs of ill heath.

But we were concerned about pesticide contamination. We wanted to understand more. So we did another study, this time on soft drinks. These companies also used groundwater. Our study helped to place on record that water was increasingly poisoned and even products like soft drinks, peddled through high value brand ambassadors, were unsafe.

New questions emerged. The cola giants challenged our study. They sent their street fighters turned college debaters who argued their drinks were "safe". Why? Because India used very low levels of pesticides on a per capita basis and contamination wasn't a problem. They even argued soft drinks were safe because there was even more pesticides in apples and milk. They talked about the acceptable daily intake (ADI) and said their drinks used only a small proportion of the ADI of each pesticide.

We understood regulation as setting the maximum residue levels (MRLS) of pesticides. If a product was in breach of its stipulated MRL, it was illegal or adulterated. This was how we understood 'safety'. But how wrong we were.

"The apple and milk has more pesticides" chant of cola companies made us dig deeper. We researched. We understood how the world defined safety of pesticide usage. Indeed, we began to understand that regulation of these small toxins was about regulating pesticides in our food. For this, regulators had to know what you and I were eating and how much. But more importantly, they had to know how much of a particular pesticide we could safely ingest over our lifetime. Then they had to ensure this safety threshold was not exceeded. This was the science, sociology and politics of ADI.

We present to you all that we have understood till now. Our ignorance has shocked us. But we are even more shocked by how little government has done to protect public health. This is a case of sheer negligence, even criminal negligence. What you will read contains tremendous anger, and concern. The system has been 'fixed' against public health and safety. It has been fixed against us.

We dedicate this research to our teachers: the cola companies and their brand ambassadors, particularly actor Aamir Khan. Where would we be without such threatening encouragement?

— *The CSE team*

DEFINING SAFETY

"All substances are poisons; the right dose differentiates a poison and a remedy". Modern food regulation is about determining what that right dose is in our daily diet

The world awoke to pesticide contamination of food years ago. As early as 1953, a resolution at the World Health Assembly expressed concern about "the increasing use of various chemical substances in food". This inaugurated a process that led, two years later, to the Joint FAO/WHO Expert Committee on Food Additives (JECFA) being formed. JECFA's initial mandate was to review and set safety standards only for all food additives — it defined additives as "non-nutritive substances added intentionally to food, generally in small quantities to improve its appearance, flavour, texture or storage properties". Later, it's mandate was broadened to include substances "unintentionally" introduced into food, such as pesticide and metal residues.

Then in 1961, this latter function of the JECFA was turned over to another body. The JMPR — the Joint FAO/WHO Meeting on Pesticide Residues, which provides scientific advice to the Codex Alimentarius Commission on regulating pesticide residues in the global food trade — was established to direct global food standards for pesticide contamination. Today, while these agencies set the global framework for safety, nations develop their own standards to combat the risk pesticides put humans into. A particular process enables this to happen:

A safety archstone called ADI

The archstone of managing this risk is a measure of safety called ADI, or acceptable daily intake. It is that amount of a pesticide we can ingest — daily, over a lifetime — without damaging health. It is expressed in relation to bodyweight (bw), so that safety levels for adults and children are variously calculated.

FIRST: Toxicity tests are done on animals, usually rats or dogs. The rats, or dogs, are given different amounts of a pesticide, and checked for a range of toxic effects, including birth defects, cancer, reproductive changes, neurotoxicity and harm to organs such as the kidney or liver.

The idea is to determine that limit till where a pesticide cannot cause harm: this is called NOAEL, or No Observable Adverse Effect Level. Sometimes, it is not possible to deduce this number. In such cases the safety mark is established at that point where the first sign of adverse effects appear. This is called LOAEL, or Lowest Observable Adverse Effect Level.

DECISIONS... DECISIONS...

STEP 1: NOAEL
Work out the noael, or no observable adverse effect level. This is done by conducting tests on animals, mostly rats and dogs in laboratories.

STEP 2: ADI
Then the ADI is calculated. Divide the NOAEL by a safety factor — mostly 100 times — obtained from inter-species variability (rats-humans) and intra-species variability (between humans).

STEP 1: MRL
Setting the draft Maximum Residue Level (MRL) for each crop and food item on which a pesticide is likely to be present. This is done through supervised trials on the fields, which establish least-possible residue levels on the crops. In addition, compare the draft MRLs with international and other country MRLs to get the range of the best and worst cases.

STEP 2: TMDI
Estimating the exposure level of the pesticide by estimating the theoretical maximum daily intake (TMDI): multiply the sum of the food intakes with the draft MRLs. This calculation is done for different sub-groups of the population — infants and children, pregnant women and the elderly.

STEP 3: COMPARE
Evaluating whether the TMDI level exceeds ADI. If the TMDI is below the ADI, then the draft MRLs are adopted as national standards (as it is determined that this level of consumption will not affect the health of people). However, if TMDI exceeds the ADI, all factors involved in the estimation of a pesticide's standard-setting are reviewed and reworked.

STEP 3A:
In case an ADI cannot be established, MRLs are set as "no detection" or that a standard is not prescribed and that these residues are not allowed on food products.

STEP 3B:
Adjusting the ADI to build in exposures from other pathways — water and air. In case the MRLs do not provide for other exposures, the MRLs have to be reworked so that exposure from other sources, once included, does not exceed the ADI.

Both these measures indicate the long-term effect on health, or chronic toxicity. But pesticides are incredibly poisonous. Often, a single dose is lethally adverse. To tackle such circumstances, global agencies also establish safety limits for acute toxicity, exposure in the short term. Thus JMPR and the United States Environment Protection Authority (USEPA) set what is called the Acute Reference Dose (ARfD), the maximum residue that can be safely consumed at a meal or in a day. Acute toxicity is typically calculated from LD-50, literally a potent quantity of pesticide that can kill 50 per cent of test animals either through ingestion or through contact with skin.

NEXT: Scientists then extrapolate animal toxicity data on humans. They adjust it downward usually by a factor of 100: a division factor of 10 is used to allow for the possibility that humans are more sensitive; a further division factor of 10 is used to allow for differences between humans.

Nowadays, there is increasing concern that this safety factor leaves infants and children vulnerable to pesticide toxicity attack. In the US, for instance, health activists want a further safety factor of 10 for children — so that the toxicity data is adjusted downward by a factor of 1000 — especially for organophosphate pesticides.

Now regulators have a number. But...

Today, ADI and ARfD are crucial tools to manage risk. But for them to be consistently effective, they need to be (a) constantly updated as the science improves; and (b) calculated on the basis of the latest, most credible data.

Consider, in this context, the vexing problem of how regulating agencies set ADI. The JMPR, for instance, uses information it receives from pesticide companies and from member nations. While the use of corporate data is invariably controversial, only those countries provide data that have a stake in pesticide production and export. Could these be reasons why the ADI that JMPR sets are higher (and therefore more lax) than those set by the USEPA, or in Australia? JMPR's 1999 ADI for chlorpyrifos is 0.01 mg/kg of bodyweight. That for the USEPA, set in the same year, is 100 times lower: 0.0001 mg/kg of bodyweight. Similarly, ADI set by the Food Standards Australia and new Zealand (ANZFA), set a decade before, is 30 times lower: 0.003 mg/kg of bodyweight. The question naturally rises: exactly how much of chlorpyrifos is safe?

Indeed, this matter of variously assessing ADI has the potential to compromise the search for the best, most effective safety limit. Suppose India wished to set a safety limit for malathion, for the sake of public health (till today, it doesn't have ADI for any pesticide; see: *But what about India?*). What amount of malathion intake would be harmless?

- JMPR's ADI for malathion is: 0.3 mg/kg bw/day.

Therefore:
- a 60 kg adult could safely consume (0.3 mg/day x 60 kg), or 18 mg of malathion each day;
- a 10 kg child can consume (0.3 mg/day x10 kg), or 3 mg of malathion each day.

- USEPA's adi for malathion is: 0.024 mg/kg bw/day — a mere 8 per cent of what the jmpr thinks is safe.

Therefore:
- an adult will be allowed 1.44 mg per day;
- a child will be allowed 0.24 mg daily.

A legal yardstick called MRL

Regulating pesticides on the ground revolves around a yardstick called the MRL — or maximum residue level — of a pesticide in a food commodity. It is a legally enforceable standard, and not a safety norm. It is set for a single pesticide, on all the different food items in which that pesticide's residues are likely to be found.

MRL is determined via supervised field trials of pesticides on crops. The intention is to arrive at practicable ways to minimise the residue in crops. Agricultural scientists work to determine the best agricultural practice and recommend the crops for which a pesticide should be used, and how it should be used.

Globally, if pesticide residue in a food commodity exceeds its MRL, then that food is legally considered adulterated, and penalties can be imposed.

Determine exposure

Exposure occurs primarily via what we eat. Therefore, knowing human dietary patterns is extremely crucial to determining exposure. But diets differ across the world. How, then, is exposure estimated?

One could do what the JMPR does, internationally. It uses dietary data prepared by the WHO's Global Environmental Monitoring System— Food Contamination Monitoring and Assessment Programme (GEMS/Food). GEMS/Food released the first-ever global guidelines to predict dietary intake of pesticides in 1989 (revised in 1997). It divided the world into five regional diets — Middle Eastern, Far Eastern, African, Latin American, and European — to estimate what people eat. For this they used the FAO's food balance sheet (a compilation of net food balance in countries).

Such data as the GEMS/Food estimates is believed to be adequate at the international level. But because such estimates are often rough and riddled with uncertainties, it is better if a nation develops its own national dietary model, and so estimate exposure.

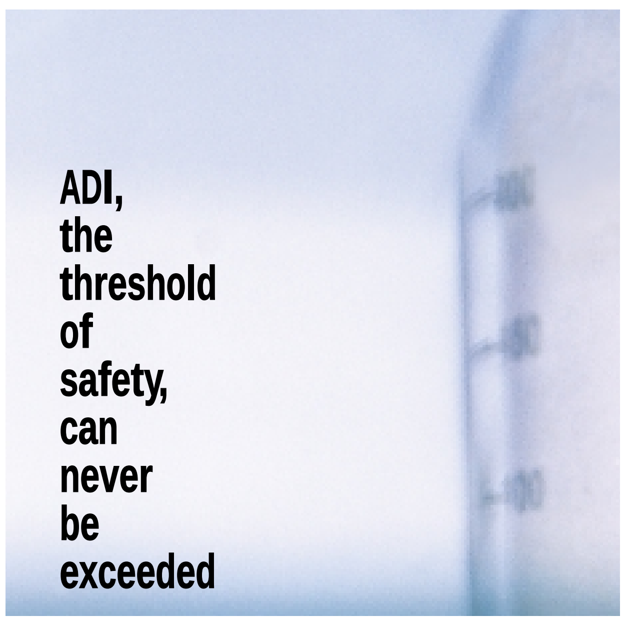
Exposure is always calculated for individual pesticides. Regulators know the residue level legally allowed for a pesticide on a food commodity, its MRL. Having figured out how much of that food we eat daily, preferably at the national level, they multiply the two quantities to arrive at the pesticide intake we can be legally exposed to. For instance, Indian MRL for pesticide monocrothophos in rice is 0.025 mg per kg. Indian diet for rice is 209 gms per day. Thus, exposure to this pesticide through rice is 0.005 mg per day.

The quantity arrived at through multiplication is called the TMDI, or theoretical maximum daily intake. TMDI is a first step; but if a government wishes to refine this process, it must improve the dietary model, and calculate exposure based not on the set MRL but on the actual residues found in the food — the estimated daily intake (EDI). Even better, exposure could be estimated by measuring pesticide intake in cooked food, what is called the Total Diet Study.

Exposure vs ADI

This is the step that really determines safety. The level of exposure to a pesticide is compared to that pesticide's ADI. If daily intake is below ADI, then the MRL determined for this process is officially adopted as the national standard. However, if the intake exceeds ADI, all the factors involved in estimating a pesticide's standards are reviewed and reworked. In cases where an ADI cannot be established, MRLs are set at "no detection" levels — here, no residue is allowed on any food commodity.

Finally, the MRLs are also adjusted to build in exposures from other pathways — water and air — always keeping ADI in mind. In no case can total exposure exceed the ADI.



RUHANI KAUR / CSE

This process works!

Countries following this process have been able to combat health risks from pesticides. But they are confronted with new challenges like multiple pesticide residues and exposure from pesticides that have common mechanisms for toxicity.

THE UNITED STATES: The US implements this process very stringently. It has assigned clear responsibilities to two nodal agencies — the USEPA and the US Food and Drug Administration (USFDA). The former is the standard-setting agency. It is entrusted with registering a pesticides for use. Before registration, it follows the above process: it establishes ADI — what it calls as Chronic Reference Dose — for that pesticide and sets MRLS (tolerance limits) for residues on food commodities. It makes sure exposure is well below ADI.

USFDA is the enforcing agency. It ensures MRLS are adhered to. It collects samples of food — raw and processed — and analyses them for pesticide residues, checking them against the USEPA-set tolerance levels. Samples are collected close to the point of production; also, import samples are collected at the point of entry into US markets. If "illegal" residues are found in either kind of samples, the USFDA invokes various sanctions, such as a seizure or injunction.

As a huge number of pesticides are used in the US , the USFDA uses a multi-residue test method that can detect up to 400 different pesticides in a food commodity.

The process the US follows is very effective It has been able to significantly reduce pesticide exposure. For instance, in 2000 a total of 6,523 food samples were analysed by USFDA — both domestic and imports. While pesticide residues were found in 40 per cent of domestic samples, almost all — 99.3 per cent — had residues below their MRLS. In the imported samples, roughly 4 per cent were found above MRL. Exposure was found to be well within ADIS.

EUROPEAN UNION (EU): The EU process is quite similar to what the US does. Here, the MRL is legally enforceable; non-compliance leads normally to legal proceedings against the supplier. Of late, the EU's Working Group on Pesticide Residues has adopted a policy of "naming and shaming" suppliers and wholesale agencies whose food samples were found excessively contaminated. The most recent annual report of the pesticide residue monitoring programme, published by the Food and Veterinary Office of the European Commission states that of the 46,000 samples of fruits, vegetables and cereals tested by the member countries, only 4 per cent of the samples exceeded MRL, that too by a mere 1.3-9.1 per cent. In the EU, too, the exposure is well within ADI.

OTHER GOOD PRACTICES: In Australia, the ANZFA monitors pesticide residues in foods. According to their dietary exposure report for 2002, the pesticide exposure for different ages and genders were below 16 per cent of the ADIS of all pesticides. All the exposures were found to be well within applicable health standards.

In Canada, too, enforcement works. The Canadian Food Inspection Agency (CFIA) tests thousands of samples annually to ensure MRLS are not exceeded. A four-year study from 1994-1998 tested 44,378 products — domestic and imported — and found that 98 per cent of the samples were in compliance. About 93 per cent of processed foods and 75 per cent of fresh samples contained absolutely no residues at all. A five-year study of water wells found that 99.9 per cent of the tested wells met government standards for pesticide residues in water.

But what about India?

RUHANI KAUR / CSE

BUT WHAT ABOUT INDIA?

A study in pure negligence

Two legislations regulate pesticides in India — the Insecticide Act, 1968 (IA) under the Union ministry of agriculture; and the Prevention of Food Adulteration Act, 1954 (PFA), under the Union ministry of health and family welfare. The former's provisions are enforced by the Central Insecticide Board (CIB) and Registration Committee (RC). The over 25-member strong CIB, headed by the Director General of Health Services, meets once in six months to advise on matters related to administering the insecticide act.

The RC is headed by the agriculture commissioner and meets once every month to register pesticides for use in India and for export. This it is supposed to do so after satisfying itself about a pesticide's efficacy and safety to human beings, animals and environment; relevant data to this end are collected from companies. But — and this is where its regulatory teeth begin to fall off — they do not fix ADI of a pesticide to be registered, nor set MRLS on food commodities. In global practices, the agency registering the pesticide establishes ADI, sets MRLS and then ensures cumulative exposure is within the safety levels. In stark contrast in India, a pesticide is registered without any of these mandatory safety regulations.

In fact, there is no legislative provision to link pesticide registration to setting MRLS. IA mandates registration, but PFA mandates MRLS. Such legislative blindness has ensured that, of the 180 pesticides currently registered, MRLS have been set only for 71. In other words, more than 60 per cent of pesticides currently registered have no MRLS.

In 2003, an effort was made to ensure that registration of a pesticide by the CIB would simultaneously require that the ministry of health fixed the MRL for that pesticide on different food. But after some discussion, the registration committee of CIB decided that the "fixation of MRL subsequent to supply to requisite data is a separate issue and linking this with registration will unnecessary delay registration." Clearly, the government wanted to quickly introduce pesticide — a 'development' imperative — rather than worrying about public health.

Moreover, the way in which MRLS are set under PFA further undermines safety. MRLS are set on the basis of recommendations made by the Pesticide Residues Sub-Committee of the Central Committee of Food Standards (CCFS), Union ministry of health. The CCFS meets once or twice a year, and standards are set on the basis of information supplied by government

No action taken so far

Pesticide residues found in baby milk powder by AICRPPR

	Himachal Pradesh		Hyderabad		Kerala	West Bengal	Bangalore
	HCH	DDT	HCH	DDT	HCH	HCH	HCH
Brand I	3.734	1.47	0.578	0.226	0.251	0.522	0.225
Brand II	1.128	0.839	1.067	0.32	0.243	0.494	0.013
Brand III	1.886	0.344	0.415	0.042	0.354	0.142	0.081
Brand IV	2.863	0.468	0.458	0.021	0.241	0.694	0.071
Brand V	3.031	—	0.389	0.054	0.168	0.279	0.026
Average	2.5284	0.78025	0.5814	0.1326	0.2514	0.4262	0.0832
Excess*	252.8	78.0	58.1	13.3	25.1	42.6	8.3

*Number of times higher than EU baby food norms (0.01 mg/kg for all pesticides)

Industry makes hay

While lawlessness shines

The use of pesticides in India began in 1948 with small-scale imports of DDT (for malaria control) and BHC (for locust control). Pesticide use in agriculture began the next year. In 1954, the first plant to produce DDT and BHC began operations. Today, the Indian pesticide industry is the twelfth largest in the world and the second largest in the Asia-Pacific region, only after China.

Estimates of current total market size vary between Rs 3,800 crore-Rs 4,100 crore. There are about 57 Indian companies and 10 MNCs in manufacturing pesticides in the organised sector, and more than 400 small-scale units.

The industry's installed capacity is very large: 1,62,760 metric tonnes, accounting for 10 per cent of global capacity. But capacity utilisation is a mere 55-60 per cent. Most pesticides produced in India are off-patented and so sell cheaply. Because of this, sales realisation is a tiny 2.5 per cent of global sales.

Apparently, India's per capita consumption of pesticides is very low — about 0.57 kg/ha (it is 1.4 kg/ha in Thailand and 6.6 kg/ha in Korea; Japan uses 10.8 kg/ha). But what estimates like this hide is that we use the most toxic ones. Insecticides — toxic and persistent — constitute more than 80 per cent of all consumption. In contrast, only 18 per cent of all pesticides used in the US are insecticides; in Western Europe, only 20 per cent and globally, 36 per cent.

Moreover, the consumption pattern in India is such that pesticide use is no longer primarily for the sake of food security. More than 50 per cent of use is concentrated on cotton, a cash crop. Liquidity seems the prime mover.

Leading Indian companies in agro-chemicals, 2002

Company	Sale (Rs crore)	Market share (per cent)
United Phosphorus Ltd	474	19
Excel Industries	356	14
Rallis	333	13
Others	1,365	54

Source: Anon 2002, Thirty seventh report, Standing Committee on Petroleum and Chemicals (2002), Production and availability of pesticides, Ministry of Chemicals and Fertilisers, Lok Sabha secretariat, Parliament of India, New Delhi, December 2002

research institutions and companies. But nowhere in this tedious process does ADI come into play, again in stark contrast to global practice.

PFA is oblivious of ADI. The CCFS has no mandate to establish it. Thus, when CCFS develops MRLS, it never cross-checks exposure levels against ADI. In other words, the legal standards for pesticides in food commodities have no safety considerations built into them. Even if these products meet the MRLS there is no guarantee of safety, for there is no way to find the safety threshold in the absence of ADI.

Gross mismatch

Worse still, there is no communication between the two sets of nodal regulatory agencies created under IA and PFA. There is a gross mismatch between the pesticides the CIB recommends for use on a food commodity, and those for which MRLS have been set under PFA for the same commodity.

Take sugar cane. The CIB recommends 13 pesticides to be used. However, under PFA, MRLS for only 2 of the recommended pesticides have been established. Similarly in rice, 56 per cent of recommended pesticides have no MRLS; in wheat, 43 per cent have no MRLS; in mango, 44 per cent. In coffee, 80 per cent of recommended pesticides have no MRLS.

This leads to a bizarre situation. A farmer is 'recommended' a pesticide for a crop, and uses it for that crop. In so doing, he follows the law as laid down under IA. But suppose there is no MRL for that pesticide under PFA. This means the crop cannot legally contain any pesticide residue. Now, if this farmer's crop shows residues of the 'recommended' pesticide, he would be violating PFA provisions. One way or the other, he has committed an illegality.

Enforcement: toothless

In India, meaningless standards leads directly to toothless enforcement. The latter is the responsibility of state governments. In states, food inspectors are appointed. They are supposed to keep proper track of pesticide residues in food commodities. To this end, they send samples to state-run laboratories. 70 such laboratories exist. But so does rampant contamination in all kinds of food.

From time to time, these laboratories may find contamination. But they cannot act on it. In such cases, samples have to be sent to the Central Food Laboratories established under the PFA. Four such laboratories exist to verify whether contamination exists or not. This process is so tedious that enforcing standards are almost non-existent.

Monitoring: to what end?

Pesticide residue are monitored by the All India Coordinated Research Project on Pesticide Residues (AICRPPR) under the Indian Agricultural Research Institute (IARI). But its mandate is to research research; it cannot enforce standards. Nothing indicates its helplessness better than a survey it did on branded baby food and milk. The products were highly contaminated (see table: *No action taken so far*); but all the AICRPPR did was to smugly proclaim it could merely publish the report. Till today, no action has been taken. There are still no pesticide residue standards for these products under PFA. The report's publication was also an exception; usually, AICRPPR residue monitoring data is treated as a national secret, and kept tightly under wraps.

In sum, the regulatory framework for pesticides in the country has nothing to do with human safety or food safety. The standard-setting agencies are completely cross-eyed. The regulating agency supposed to enforce MRLS does not monitor residues. The monitoring agency that watches out for contamination cannot regulate the poisonous presence of pesticides in food.

Is this merely a classic case of non-accountability? Isn't this pure criminal negligence?

POISON REPORT

How contaminated is food in India?

Contamination of food and water is dangerously high (see table: *Track record*). According to a 1999 AICRPPR report — *Pesticide Safety: Evaluation and Monitoring* by N P Agnihotri — only 2 per cent of food commodities worldwide were found to be above MRL, but in India this figure was as high as 20 per cent. In Uttar Pradesh and Kerala, food samples exceeding MRL were as high as 46 per cent and 53 per cent respectively. In general, fruits and vegetables and milk are India's most contaminated.

Fruits and vegetables

Between 1986 and 1996, AICRPPR analysed 4,111 samples from different states. About 55 per cent of samples were found contaminated; about 10 per cent exceeded their MRLS. Uttar Pradesh and Kerala reported 100 per cent contamination, with respectively 45.9 per cent and 52.8 per cent samples above MRLS. The most contaminated were pigeonpea (58.3 per cent samples above MRL), cowpea (32.7 per cent), snake gourd (19.4 per cent) and cauliflower (16.8 per cent). The three pesticides most prevalent were monocrotophos (31.3 per cent sample above MRL), methyl parathion (30.8 per cent) and DDVP (26.5 per cent).

Milk and milk products

The most extensive study carried out on milk is the five-year long study by the Indian Council of Medical Research (see box: *ICMR tested milk and baby food*). AICRPPR has also tested milk and milk products. Says their report: "all the monitoring studies carried out in India show that majority of milk samples are contaminated with residues of either DDT or HCH or both, and invariably these exceed their prescribed MRL levels". A total of 487 samples from 14 locations were analysed. HCH showed up in 89.7 per cent of samples, and 77.8 per cent exceeded this pesticide's MRL. In case of DDT, 86.7 per cent samples showed residues and 43.4 exceeded MRLS.

An analysis of India's research trends reveals two interesting facts. While there was substantial and rigorous research on pesticide residues in the 1960s and 1970s, research frequency started to drop from the late 1980s and became non-existent in the 1990s. Could this be due to the pesticide industry's growing clout? Or did government give up the regulatory ghost? Secondly, less research is made public. Pesticide residue analysis is treated as a classified secret. Senior scientists at the Punjab Agriculture University told *Down To Earth* that, every year, they send the research they undertake under AICRPPR to the head office in Delhi. But the last report AICRPPR published was in 1999. No data has been made available since. Why? Are scientists now collaborators in poisoning India?

ICMR tested milk and baby food

A report suppressed under industry pressure

In the late 1980s, the Indian Council of Medical Research (ICMR) initiated a study to assess how contaminated food commodities in rural and urban areas were. Data was collected from 1986 to 1991. Published in 1993, the report — *Surveillance of Food Contaminants in India* — has never been made public.

***Down To Earth* possesses a copy of this report. The evidence of contamination is damning, especially with respect to milk and milk products and baby food.**

A total of 2,205 milk samples from 12 states were tested for pesticide residues. HCH was detected in 85 per cent of samples. Maximum HCH poisoning was found in Andhra Pradesh, Bihar and Uttar Pradesh. DDT contamination was similarly high, with 82 per cent samples showing DDT residues.

20 commercial brands of infant formula were also tested. DDT and HCH showed up in, respectively, 70 per cent and 94 per cent samples.

The then ICMR director had indicated to *Down To Earth* that industry pressure caused the study to be withheld. It has been 10 years since the studies were done. The findings have never been validated. The truth remains consigned to the dustbin.

Track record

Summary data showing contamination of different food commodities in India (1965-1998)

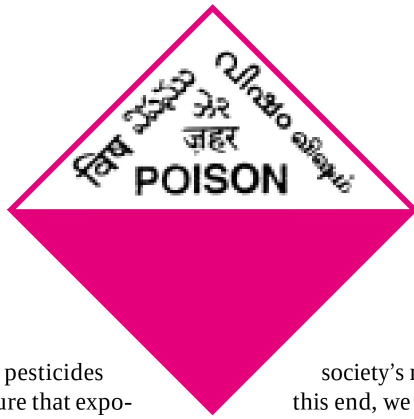
Food item	Samples analysed	Samples contaminated	Contamination (per cent)
Wheat	1,352	628	46.4
Rice	463	405	87.4
Sorghum	137	52	37.9
Pulses	487	211	43
Vegetables	6,803	3,642	53.5
Major vegetables*	2,930	1,659	56.62
Fruits	458	192	42
Spices	284	183	71.5
Honey	148	135	91.2
Total	13,062	7,107	54.4

*Tomato, okra, cabbage, brinjal, capsicum, potato, cauliflower

Source: G S Dhaliwal and Balwinder Singh (eds) 2000, Pesticides and Environment, Commonwealth publishers, New Delhi, p 207

HOW EXPOSED ARE WE?

The Centre for Science and Environment estimates the exposure of Indians to pesticides



Every nation that registers and uses pesticides must do its own homework and ensure that exposure to each pesticide, under no circumstances, exceeds the acceptable daily intake. Keeping toxins within strict limits not injurious to health is the true mandate of safety. Without this, the use of pesticides would be deadly.

But India does not regulate its use of pesticides through ADI — the safety threshold. Where, then, do we stand? If we were to estimate our exposure to pesticides through food, would it be within the ADI of the pesticides? We wanted to know. We needed to know.

We decided to calculate exposure

STEP 1: We checked the ADI of key pesticides used in India. JMPR apart, ADI is also fixed by the US' EPA and the Australian government's Department of Health and Aging. Within them, the ADI varied for many key pesticides. So we decided to estimate exposure twice — using the ADI of JMPR and then using the USEPA threshold. (see table: *Differing thresholds*)

STEP 2: We had to have data on what, and how much, Indians were eating. We decided to estimate the daily per capita consumption of various food commodities for India. For this, we used the FAO's Food Balance Sheet (FBS) 2001 data for India (see: *What we eat, and how much*). We reckoned we could. JMPR uses the same source to assess dietary intake. Also, this data is the most recent data (the Indian government's published data on dietary patterns is valid only for the 1990s).

STEP 2A: We also wanted to check what the exposure was of society's most vulnerable group — small children. To this end, we used the average diet of a 10 kg child (average of 1-3 years old, male and female child) from the *India Nutrition Profile* published by the Union ministry of human resource development in 1998. This was the most recent data available on the diet of children in India.

STEP 3: For our estimation, we used the theoretical maximum daily intakes (TMDIs) assessment model, prescribed by JMPR. This model is used as a screening methodology — using this model, if exposure levels are found to be above ADI, governments the world over work to find more accurate estimations. In this model, pesticide exposure is calculated by multiplying established MRLs with the average daily consumption for each food commodity, and then summing the results.

STEP 4: We used the MRLs prescribed in the Indian Prevention of Food Adulteration Act, 1954 for the legal limits.

Exposure= $\sum$ MRL x diet. Using this formula, we calculated exposure to 8 most commonly used pesticides in India.

Differing thresholds of safety

ADIs for 8 key pesticides used in India

Pesticide	JMPR (mg/kg bw)	USEPA (mg/kg bw)	Australia (mg/kg/day)
DDT	0.005	0.0005	0.002
Malathion	0.3	0.024	Not in the list
Monocrotophos	0.0006	0.00005	0.0003
Phorate	0.0005	0.00017	0.0005
Endosulphan	0.006	0.006	0.006
Chlorpyriphos	0.01	0.0001	0.003
Lindane	0.005	0.005	0.003
Carbofuran	0.002	0.005	0.003

Source: Codex website, USEPA's website and ANZFA website

What we eat, and how much

Average daily per capita intake of food commodities in India, 2001

Product	Daily per capita consumption (gms/day)	Percentage of total daily diet
Total Cereals	445	37.1
Total Pulses	29	2.4
Total Vegetables	239	19.9
Total Spices	5.4	0.4
Total Fruits	111	9.3
Total Meat	14.2	1.2
Eggs	4	0.4
Fish	12	1.0
Milk - Excluding Butter	179	15.0
Total Sugar & Honey	105.0	8.7
Animal Fats including ghee, butter	6	0.5
Vegetable Oils	26	2.2
Oil Crops	19	1.6
Treenuts	2	0.2
Total coffee, tea & cocoa	2.0	0.2
Average	1,200.0	

Source: CSE's estimation, based on food balance sheet, 2001, FAO

Monocrothophos mayhem

Estimating exposure to this pesticide for a 60 kg adult (below), and a 10 kg child (below, right)

Food commodity	Indian MRL (mg/kg)	Diet (gm/day)	Pesticide intake (mg/day)	Distribution* (per cent)
Wheat	0.025	158	0.0040	2.6
Rice	0.025	209	0.0052	3.5
Cereals, other	0.025	77	0.0019	1.3
Pulses	0	29	0.0000	0.0
Potatoes	0.05	43	0.0022	1.4
Tomatoes	0.2	20	0.0040	2.7
Onions	0.1	15	0.0015	1.0
Vegetables, other	0.2	160	0.0321	21.2
Condiments and spices	0	5	0.0000	0.0
Oranges & citrus fruits	0.2	20	0.0038	2.5
Other fruits	1	92	0.0921	61.0
Meat and poultry	0.02	14	0.0003	0.1
Eggs	0.02	4	0.0001	0.1
Milk	0.02	179	0.0036	2.4
Sugar & sweeteners[1]	0	105	0.0000	0.0
Animal fats	0.02	6	0.0001	0.1
Vegetable oil & crops[2]	0	45	0.0000	0.0
Tea, cofee and cocoa	0	2	0.0000	0.0
Total pesticide intake			**0.1510**	
ADI			**0.0360**	
Per cent of ADI			**419**	

Food commodity	Indian MRL (mg/kg)	Diet (gm/day)	Pesticide intake (mg/day)	Distribution* (per cent)
Cereals	0.025	119	0.0030	9.8
Leafy vegetables	0.2	7	0.0013	4.4
Roots & tubers	0.05	38	0.0019	6.3
Other vegetables	0.2	16	0.0032	10.6
Fruits[3]	0.86	20	0.0175	57.6
Meat, Fish & egg[4]	0.012	10	0.0000	0
Milk & milk products	0.02	164	0.0033	10.8
Pulses	0	20	0.0000	0
Sugar & sweeteners	0	19	0.0000	0
Oil and fats	0.02	7	0.0001	0.5
Condiments & spices	0	4	0.0000	0
Total pesticide intake			**0.0305**	
ADI			**0.0060**	
Per cent of ADI			**508**	

Note: Monocrothophos JMPR ADI = 0.0006 mg/kg of body weight

*This means: the proportion of pesticide intake through different food items.

1 There is MRL for sugar beet, but none for sugarcane. Therefore MRL assumed as 0. This is an under-estimation.

2 There is MRL for cotton seed oil but data for consumption not available there for assuming MRL as 0. This is an under-estimation.

3 Consumption data for fruits not available separately. MRL for fruits is weighted MRL of citrus fruits and other fruits using consumption pattern as per FAO 2001 FBS.

4 Separate consumption data not available. MRL for meat, fish and egg is weighted MRL, using consumption pattern as per FAO 2001 FBS. This is an under-estimation.

What did we find?

The theoretical maximum daily intake (TMDI) of various pesticides in India presents a horrific picture (see graph: *Toxic intake I*).

For a 60 kg adult in India:

- Of the 8 pesticides considered, TMDI for 5 pesticides is 140 per cent to 476 per cent of JMPR ADI;
- For DDT, the intake is 476 per cent of ADI;
- For Monocrothophos, an extremely toxic pesticide widely used, the intake is 419 per cent of ADI;

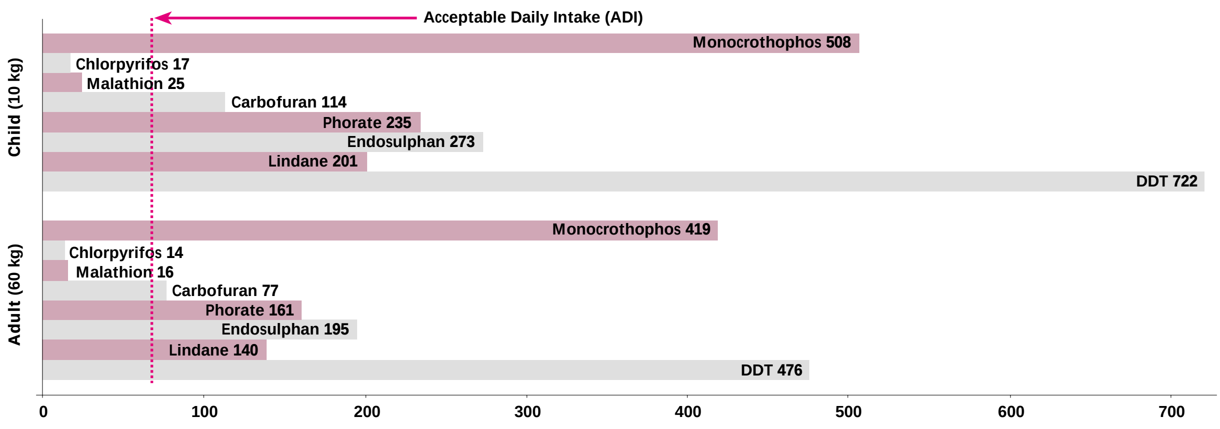
But what is truly frightening is what the young and vulnerable in our country are consuming. A 10 kg child is being literally poisoned each day through each meal:

- Of the 8 pesticides considered, TMDI for 6 pesticides is 114 per cent to a staggering 722 per cent of JMPR ADI;
- Monocrotophos intake by children is 508 per cent of its ADI;
- Lindane and Endosulphan intake is 201 per cent and 273 per cent, respectively, of their ADIS.

Malathion and Chloropyrifos were the only two pesticides for which the exposures, both for adults and children, were within the safety limit JMPR has prescribed.

Toxic intake I: less stringent safety limit

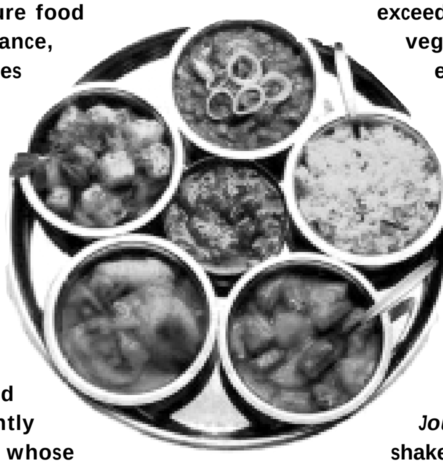
Pesticide intake by adult and child, as compared to ADI fixed by JMPR



Source: Estimated by CSE, based on FAO Food balance sheet, dietary data of India Nutrition Profile, 1998 and MRLs prescribed under PFA

A Total Diet Study

In the US, the Food and Drug Administration (FDA) conducts total diet study to estimate people's actual exposure to pesticides through food. FDA staff buy food from supermarkets or grocery stores four times a year, once from each of the four geographical regions of the country. 4 food baskets are prepared, comprising 261 food items. These represent over 3,500 different foods reported in the US department of agriculture food consumption surveys (so, for instance, apple pie would represent all fruit pies and fruit pastries). The foods are cooked and then analysed for pesticide residues.



The Indian government does not conduct any such study. But researchers have. M P Shukla, Satya Pal Singh, R C Nigam and D D Tiwari — all scientists at the Department of Soil Science and Agricultural Chemistry, C S Azad University of Agriculture and Technology, Kanpur — have recently undertaken a total diet study whose results are shocking.

The researchers collected samples of food a person normally eats — at breakfast, lunch and dinner — from in and around Kanpur. They then analysed the food for residues of organochlorine pesticides.

In the case of endosulfan, DDT and chlordane, the exposures were below the ADI. But for other pesticides, the levels were frighteningly high:

- **The daily HCH intake in average vegetarian diet exceeded ADI by 110 per cent. In average non-vegetarian diet, this pesticide's intake exceeded ADI by 118 per cent;**
- **The daily Aldrin intake in average vegetarian diet exceeded ADI by 442 per cent; in average non-vegetarian diet, by 1,500 per cent;**
- **The daily Dieldrin intake in average vegetarian diet exceeded ADI by 514 per cent; in average non-vegetarian diet, by as much as 6,000 per cent.**

These results were published in December 2002, in the *Pesticide Residue Journal*. But, so far, it hasn't been able to shake the apathy of those in charge.

But wait

This is because the JMPR's assessment for these two pesticides allows high — extraordinarily high — intake; its ADI for Malathion, for instance, is 18 mg per day for a 60 kg adult. JMPR had last reviewed Malathion ADI in 1997. But the USEPA has also reviewed its Malathion ADI, more recently in 2000. Based on this review, the USEPA has put its Chronic Reference Dose for Malathion at 1.44 mg for a 60 kg adult (the chronic reference dose is equivalent to ADI).

Therefore we re-ran the model using, this time, the latter ADI (see graph: *Toxic intake II*). This is what we found:

For a 60 kg adult in India:

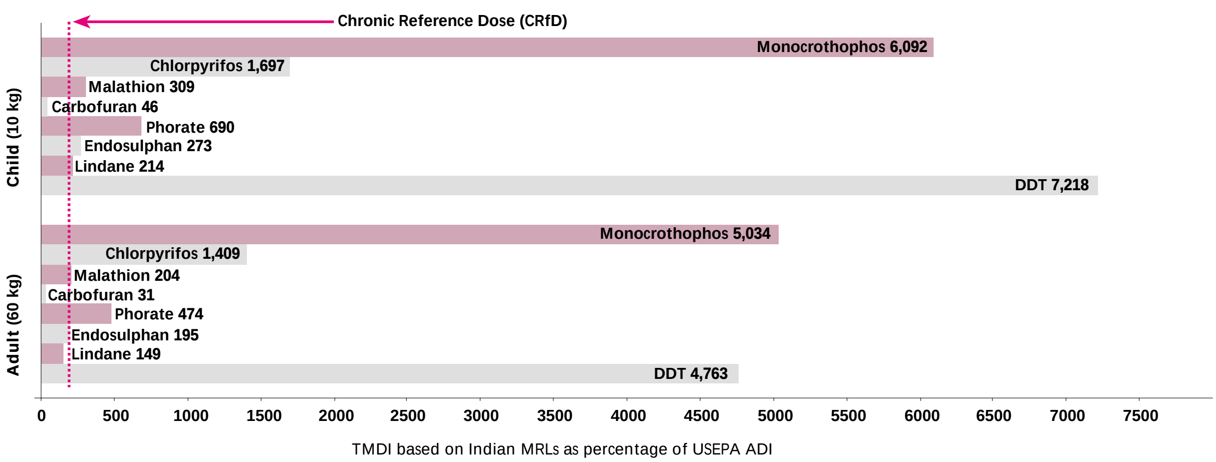
- Of the 8 pesticides considered, TMDI was 149 per cent to an unimaginable 7,218 per cent of USEPA ADI;
- DDT and Monocrothophos intake was 5,663 per cent and 5,034 per cent of ADI, respectively;
- Chlorpyrifos and Malathion intake were now 2,309 per cent and 204 per cent of their respective ADIS.

For a 10 kg child in India:

- Of the 8 pesticides considered, TMDI of 7 pesticides were 214 per cent to 7,218 per cent of the USEPA safety limit.

Toxic intake II: more stringent safety limit

Pesticide intake by adult and child, as compared to ADI fixed by USEPA



Source: Estimated by CSE, based on FAO Food balance sheet, dietary data of India Nutrition Profile, 1998 and MRLs prescribed under PFA

SO WHAT DO WE KNOW

It is time for the government to awaken from its hitherto smug slumber

First, responsible governments ensure safety by fixing the Acceptable Daily Intake (ADI) of each pesticide — in other words, toxicological science establishes the threshold at which a pesticide's residue is safe to consume, each day, over a lifetime. The ADI is the touchstone of safety. It cannot be breached. Regulation is about living within the ADI quota.

Second, living within the ADI quota requires a trade off between poison and nutrition. We have to ingest pesticides because we need nutrition, but we must not exceed our quota. So long as we cannot wish away pesticide use, it is imperative that this trade-off is a prudent one. What is 'safe' means calculating what we eat, how much we eat and how much pesticide can be allowed in all this. The food basket is also the pesticide basket.

Third, regulators have to ensure some 'elbow room' in the ADI. They must ensure our theoretical maximum daily intake — what we eat, in the process ingesting legally allowed pesticides — does not exceed the ADI. And that there is 'space' — that only a proportion of the ADI is used and that more and more accurate dietary-pesticide intake models are estimated . This ensures that pesticides are not a health hazard because the exposure is much below ADI.

Fourth, with exposure much below ADI, governments can make adjustments for consumption of pesticides through other foods and media — like water or even air. Then you can ingest some 'unaccounted for' pesticides through non-essential non-nutritive food, which is not part of the daily diet-pesticide calculation.

Fifth, regulation across the world is now moving towards tightening the acceptable toxicity of a pesticide so that the chemical itself is less harmful.

And...coke and pepsi?

Soft drinks are never included in global or national diet calculations. Soft drinks are not essential foods. Therefore, if any pesticide residues are allowed in a soft drink as 'safe', the drink will have to be 'fitted in' into the calculation of how much residue we can safely ingest daily on the whole. In other words, some essential food item will have to be thrown out of our diet basket. (And we are not even talking about residues in water, because water is still not adjusted in the daily diet). In other words, we will have to substitute soft drinks with, say, milk. Or apples. Or fruit juices or cereals.

Given that we are exceeding our ADI manifold, we literally have no space in our food-poison diet for non-essential and non-nutritive foods. Therefore, even as fruit juices — which have a nutritive value — can be "assigned" a pesticide quota, soft drinks cannot. Fruit juices or fruits are part of the nutrition-poison trade-off. They are fitted into our diets. Since safety is about setting and adhering to standards for pesticide residue in food products, if no standard has been set, then the product — in this case, soft drinks — has no 'business' containing pesticide residues.

If this is true of the world, what about India?

We do not even begin to ensure safety by fixing the ADI. In fact, we disregard safety and public health completely in our regulations. We register pesticides, we use these toxins but we do not know what our exposure is and how this can be contained. At best and at times, for some pesticides in some food, we fix the MRL. But we don't enforce the legal limits so that is also reduced to a meaningless farce. The system is managed, till it is so compromised that it is deadly for our health.

Estimations show that we exceed the ADI by upto 7,000 per cent in some pesticides. Children — most vulnerable — are worst affected. Their daily quota is exceeded manifold. How can this be acceptable? How can this have just happened under the noses of our informed regulators?

We will have to incorporate ADI into our regulatory systems. Pesticides can be registered for use only when the estimations of the intake and exposure have been completed, and established to be safe. For this, MRLS will have to be fixed at the time of registration. The government will have to do calculations based on diets, and only then register. Then, only if consumption is below safe levels. Only then.

Currently we exceed the ADI because we have set very high MRLS — legal limits for residues in our food. This will need to change. There is a ridiculous policy initiative to "harmonise" Indian MRLS with MRLS set under Codex Alimentarius — the global food standard agency. We need to harmonise our pesticide standards with our diets, not with Codex.

Because we exceed the ADI, we have no space for non-essential foods. Remember, pesticide regulation is about a nutrition-poison trade off. If our daily diet of pesticides is being exceeded just via essential food, we cannot allow pesticides in non-essential and non-nutritive foods. This is why we cannot allow pesticides in coke or pepsi (see box: *And...coke and pepsi?*).

But also, we will need to enforce the legal limits through an effective programme of surveillance and enforcement. We cannot argue that we cannot control pesticide contamination on our raw agricultural commodities and so cannot enforce standards for food safety. This is unacceptable. No, this is completely wrong.

Finally, we have to remember that regulation will cost. Every time we register a pesticide for use we will have to incorporate this cost — of regulation and enforcement. Otherwise, we are discounting the real costs — of ill health, perhaps death. This deliberate style of negligent governance — criminally negligent — must stop. ■