

**The 2020 Indian Government's pesticide ban is a timely policy move
to safeguard the health and lives of Indian citizens**

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1. Well-thought policy action by the Government with potentially long-lasting positive effects

The draft 'Banning of Insecticides Order, 2020' by the Ministry of Agriculture and Farmers Welfare is a much awaited and greatly needed move. The Anupam Verma Committee, constituted in 2013, had recommended that the proposed twenty-seven pesticides be reviewed with respect to their toxicity levels and phased out thereafter [1]. Twelve pesticides proposed for bans belong to class I and II of the WHO toxicity classification and are acutely toxic to humans. The rest cause harm to the environment and pollute food and water [2].

The proposed regulations will be a significant step forward in elevating our agricultural safety standards and the health of farmers and agricultural labourers, who comprise approximately half the Indian population [3]. India's policy measures should be directed towards reducing exposure to these pesticides and occupational hazards faced by those working in the agricultural sector. This draft order is a very important step towards achieving this goal. As researchers studying the persistent problem of pesticide poisoning and its chronic effects on health, we strongly support this ban and request the government to officially implement and enforce it.

2. Harms associated with pesticides proposed to be banned

The harmful effects of hazardous pesticides on the environment have been a serious cause of concern among UN agencies and the international community. Many pesticides, including those now proposed for deregistration, have been linked to environmental pollution, and are a threat to beneficial bio-diversity due to devastating effects on non-target species such as honeybees and earthworms [4].

These same pesticides also pose threats to human health and wellbeing [5]. Pesticide residue in food has been linked to chronic health effects such as immune suppression, hormone disturbance, reproductive defects, and cancers even at low exposure dose [6-9]. Children possess a higher health risk of pesticide exposure through dietary intake as they consume more food per unit body weight as compared to adults [10, 11]. Food samples in India have been found to exceed maximum permissible limits [12, 13] which indicates that this ban will have far-reaching impacts.

The usage of these pesticides is an occupational hazard. There are numerous studies that show chronic exposure to these pesticides among farm workers has been linked to health problems such as respiratory disorders,

neurodegenerative disorders, and some types of cancer [14-16]. Indian field studies have also reported other adverse health effects amongst farm workers such as muscle pain, headaches, blurred vision, tremors, sleep disorders, and cardiac problems [17-19].

Farmers across the country are exposed to toxic compounds such as Acephate, Carbofuran, Dimethoate, Methomyl, and Monocrotophos, which cause serious occupational hazards and have been implicated in multiple cases of accidental acute poisoning across India [20, 21]. Accidental poisoning among children is a tragic consequence of accessibility to pesticides and contaminated spraying or application equipment in agrarian households [22, 23]. Furthermore, the use of these pesticides leads to devastating economic and social consequences for farmer families and rural communities.

3. The problem of suicidal ingestion

Suicidal ingestion of pesticides accounts for a large proportion of poisoning deaths in India. It is the second most common mode of suicide in India. Although the recorded number of self-poisoning deaths are estimated to be 23,172 per year [24], multiple studies show that the real number could be three times higher [25, 26].

Suicidal ingestion in combination with accidental poisoning deaths [27] in the country could potentially add up to 80,000 deaths every year that can be attributed to use and availability of toxic pesticides. It is a highly neglected area of research and the numbers could likely be even higher. This is a consequence of having extremely toxic compounds widely available and poorly managed in rural households. It is unreasonable to expect that such dangerous chemicals would be stored and used in full compliance with manufacturers' recommendations where training, the necessary protective equipment and associated facilities are not available.

The World Health Organization in its guidelines for pesticide regulators and registrars has stated that 'means restriction' by imposing bans is an important step towards reducing self-poisoning deaths in South Asia [28]. Evidence based research shows that a significant reduction is observed in the number of self-poisoning deaths if particular pesticides that are responsible for most deaths are identified and banned. A reduction in fatalities by over 50 percent was observed

in Sri Lanka post banning class I pesticides [29]. Significant reductions were also observed in Bangladesh after banning highly hazardous pesticides (especially monocrotophos) and South Korea after banning specific chemicals [30, 31].

In India, the pesticide bans the Government previously adopted are already saving lives. The 2011 endosulfan ban was associated with a downward trend in suicides nationally [32].

4. Toxicological findings from across the globe need to be taken into account to determine toxicity and harm associated with pesticides

India's overall usage of hazardous pesticides is lower than a few developed countries such as the United States of America, but this is not an efficient comparison. Agriculture in much of India is quite different to the mechanized agriculture typical of the USA and other regions with industrialised agriculture. Less than two percent of the population of USA is directly employed in agriculture and ninety-five percent of agriculture is mechanized which implies reduced contact between farm workers and pesticides. In contrast to this, seventy percent of Indian rural households are dependent on agriculture with farm mechanization levels being less than forty-five percent, putting Indian farmers and farming communities in direct contact with pesticides [33]. The toxicological effects of this direct exposure are exacerbated by the widespread malnutrition in these Indian communities and by the lack of safety in use (lack of education, affordable protective equipment, user regulation and enforcement). Therefore, the results of the experimental studies showing acute toxicity must be taken even more seriously in India.

Toxicological findings from high-quality experimental studies are useful for Indian assessments of the risks of pesticides to health, irrespective of their geographic source, and should be considered by Indian regulators. India has taken steps in the right direction by banning eighteen pesticides in 2018 which is praiseworthy and will yield long-term benefits. This ban is therefore a very necessary next step to transform Indian agriculture into a safer occupation for our workforce.

Studies from across Asia-Pacific report that Monocrotophos have shown very high toxicity to birds, fish and mammals [34, 35]. It is a major cause of pesticide poisoning in rural communities across Asia, and specifically in India [36]. The US Environmental Protection Agency (EPA)'s fact sheet also states that occupational use of this pesticide requires the

wearing of personal protective equipment. These findings have resulted in monocrotophos being banned in the 112 countries which is highly relevant to the Indian situation [37].

Numerous studies from India, USA, and the EU show that the pesticide Chlorpyrifos causes cholinesterase inhibition in humans causing nausea, dizziness, confusion, and at very high exposures (e.g., accidents or major spills) respiratory paralysis and death [38, 39]. The current chlorpyrifos label in the USA requires workers handling and applying chlorpyrifos to wear additional personal protective equipment, and restricts entry into treated fields for 24 hours or up to five days depending on the dosage [40].

It is not possible for Indian farmers to safely store or use highly hazardous pesticides, due their inherent toxicity and the lack of resources in rural agrarian communities. Recognising this situation across low and middle income countries, the United Nations' International Code of Conduct on Pesticide Management states that pesticides whose handling and application require the use of personal protective equipment that is uncomfortable, expensive or not readily available should be avoided, especially in the case of small-scale users and farm workers in hot climates [41]. Both government and pesticide industry has signed up to this Code of Conduct – therefore, highly hazardous pesticides should not be sold in India since adequate personal protective equipment is unaffordable, uncomfortable, and hardly ever used.

5. Regional precedent and endorsement of these specific bans

Many Indian states such as Kerala, Punjab, Maharashtra, Sikkim, and Andhra Pradesh have previously experienced the devastating impact of these pesticides on their citizens' health and the environment. To mitigate this impact, some states have already imposed bans on some of the pesticides listed in this order.

The state of Kerala imposed a ban on Carbofuran, Monocrotophos, and Atrazine from this list and also recommended safer alternatives for them [42]. The Vidarbha region in Maharashtra is notorious for a large number of occupational and self-poisoning deaths and the state government has attempted temporary bans on Monocrotophos and Acephate [43]. The high court of Maharashtra has asked the center to take cognizance of the state government's plea to ban highly toxic pesticides permanently [44].

Sikkim, Himachal Pradesh, Uttarakhand and all the seven north-eastern states have policies to promote organic farming with [45, 46] while Andhra Pradesh has a climate resilient zero-budget natural farming policy [47]. All the policies aim to achieve total eradication of chemical agriculture by promoting sustainable methods.

At the central level, the '*Paramparagat Krishi Vikas Yojana*' was launched by the Ministry of Agriculture and Farmers' Welfare to promote traditional methods of farming [48]. This move to ban toxic pesticides nationally is in support of various state legislatures and policy makers who have researched and realized the need to remove these chemicals from circulation.

6. Concerns over the ban of the 27 pesticides are unjustified

(A) Highly hazardous pesticide ban unlikely to impact agricultural productivity: The concern over potential decrease of farmers' yields and food security coupled with the belief that sustainable methods of farming are more cost intensive has discouraged law makers from banning pesticides. However, studies in India have shown that sustainable methods such as 'Integrated pest management' (IPM) and agroecology, do not lead to significant reductions in yields or significant increases in farmers' costs. A study from Nanded district in Maharashtra found that the per hectare crop yield was higher by 24 percent on IPM farms vs non-IPM farms in the selected villages. The use of some inputs was higher on IPM farms, but this did not make any significant difference in the average cost of cultivation between IPM and non-IPM farms. However, the unit cost of production was 19 percent less on IPM farms [49]. Evaluations of IPM in rice cultivating fields in Tamil Nadu showed an increase in productivity along with a decrease in the overall cost of production [50]. Studies from Andhra Pradesh and Karnataka also show similar results with no impact on productivity coupled with reduced input costs when sustainable agriculture is practised [51, 52].

In fact, the banning of the specific highly hazardous pesticides listed below have long-term benefits to the ecosystem and public health which potentially make these methods more advantageous to the global community:

Acephate is a WHO Moderately Hazardous (Class II) organophosphorus insecticide that is metabolised after ingestion to the WHO Highly Hazardous (Class Ib) organophosphorus insecticide methamidophos. There have been many cases of poisoning with either pesticide in India [53]. It is also known to adversely affect non-target species especially

honeybees [54]. In terms of agricultural productivity, studies from IPM initiatives on cotton crops in Gujarat and Maharashtra show no significant changes in productivity when removed from use [55].

Carbofuran is a WHO Highly Hazardous (Class Ib) carbamate insecticide that is more toxic than most other Class Ib compounds. It is the active metabolite of the WHO Moderately Hazardous (Class II) carbamate insecticide carbosulfan. Cases of suicide with liquid formulations of carbofuran have been reported in India [56]. It has also been implicated in adversely impacting important species such as the tropical earthworm [57]. Specific studies from South Asia and Bangladesh show that removal of carbofuran from usage does not affect productivity given correct substitutes and stable irrigation [58]. It has also been banned in the Indian states of Kerala and Punjab [42, 59].

Dimethoate is a WHO Moderately Hazardous (Class II) organophosphorus insecticide that is a common cause of suicide worldwide, with cases reported from across India [60], particularly Maharashtra. Dimethoate poisoning was a major cause of suicide in Sri Lanka after the deregistration of Class I pesticides [61]. There was a marked decrease in self-poisoning deaths in Sri Lanka following its ban in 2008 [62].

Monocrotophos is a WHO Highly Hazardous (Class Ib) organophosphorus insecticide that is a key cause of suicide in India. WHO published a report in 2009 listing monocrotophos acute poisoning studies across India. Being a highly lethal pesticide, it is responsible for a majority of poisoning deaths across government hospitals in India [63]. Monocrotophos, together with methamidophos, was responsible for the majority of suicidal deaths in Sri Lanka during the late 1980s and early 1990s. Their bans resulted in a rapid 25% reduction in overall suicide nationally [62]. Indian food samples are found to exceed acceptable residue levels frequently which suggests hazardous overuse of this pesticide among cultivators [12]. There have been incidents of mass deaths of school children accidentally poisoned with this highly hazardous pesticide. No significant impact of Class I pesticides bans, including monocrotophos, was observed in yield studies from Sri Lanka or Bangladesh [30, 64]. It has been banned by the Indian states of Maharashtra and Kerala [42, 44].

(B) Overall economic consequences will be positive: In addition to the existing health and poisoning hazards, the continued use of these pesticides has also affected Indian farmers economically.

In one instance, rice exporters from Punjab bore the brunt of high level of pesticide residues as exports plunged by a third in 2018-19 after failing to meet the stringent chemical residue norms of the United States of America and the European Union. Farmer bodies and exporter lobbies in the state subsequently campaigned for banning most of the pesticides mentioned in the draft order, namely, acephate, carbofuran, carbendazim, propiconazole, thiophanate methyl (major component is carbendazim), and chlorpyrifos [65]. The State of Punjab banned these pesticides in 2019 [59].

In May 2020, the European Union published its 'Farm to Fork Strategy' which aims not only to reduce pesticide use and the use of particularly hazardous pesticides by 50% by 2030, but also aims to enhance international standards by promoting trade with other countries that commit to high standards of safe and sustainable agriculture [66]. Continued use of pesticides banned in the European Union, therefore, will put the production of Indian farmers at risk of being rejected by importing countries. The action to ban these additional pesticides on the part of the Government is therefore very timely in term of protecting international trade in agricultural produce.

(C) Resilience against pest attacks will be unaffected: Due to the recent desert locust attack in north-western India, there is widespread concern about the country's pest management strategy if the proposed pesticides are banned especially Malathion and Chlorpyrifos. The FAO as well as the Indian government recommended compounds are 'Ultra Low Volume' (ULV) formulations which should only be sprayed by government trained agencies. The FAO strongly discourages locust control by individual farmers [67, 68]. Moreover, there are other recommended formulations which are less toxic and permitted for use [69]. Bio-pesticides such as metarhizium and beauveria are also being successfully used for locust control as the most effective method for locust control is monitoring of their known breeding grounds and applying low impact bio-pesticides for early control of hoppers [70]. Bio-pesticides have been known to effectively manage locust attacks without harming the environment [71, 72].

The Ministry of Agriculture and Farmers Welfare has detailed guidelines for managing pest infestations and attacks [73]. Following standard protocols will ensure that crops are not vulnerable to pest attacks. There are also emergency procurement protocols for governments to allow certain pesticides under exceptional circumstances as the FAO doesn't encourage individual control. Thus, the decision to ban these pesticides does not put Indian agriculture at risk.

7. Viability of transition to alternatives

Viable and cost-effective alternatives are available as replacement for all crop-pest relationships where the pesticides proposed for banning are used. It is vital that the agricultural authorities at federal and state levels ensure that these alternatives are accessible and available to farmers. Numerous studies have shown that shifting to IPM and agroecological approaches to crop production and protection saves farmer's money in terms of input costs while protecting their health and production environments and in many cases generating premiums for their cleaner agricultural products [74].

Agricultural research universities with adequate support from state governments can successfully help transition to sustainable forms of agriculture. Furthermore, they have the technical competence to cope with pest attacks in safe and sustainable ways through integrated crop and pest management techniques. State agricultural universities and departments regularly publish a package of practices best suited for the crops cultivated in the state [75].

This is evidenced by the 2015 'Whitefly' attack on cotton. The agricultural university of Punjab with the support of the state government procured high quality seeds, developed pest management techniques and appointed 'scouts' to survey villages and train farmers. Pesticide usage was reduced especially unscientific mixing of toxic compounds. These interventions showed transformative results on ground and in 2016 and 2017 cotton yields in Punjab hit a record 756 kg and 750 kg per hectare, respectively. The yields increased progressively every year with 806 kg per hectare in 2019 [76-78]. Maharashtra and Kerala have also worked on promoting safer alternatives to toxic pesticides [42, 79].

In addition to the high capacity of Indian research institutions, many international organizations such as Food and Agricultural Organization (FAO), the Consortium of International Agricultural Research Centers (CGIAR), the International Federation of Organic Agriculture Movements (IFOAM) and others are able to work with India to identify alternative control options.

Moreover, as evidenced by previous bans, pesticides are phased out over a fixed period of time to prevent the creation of obsolete stockpiles and make room for registration of new alternatives. Therefore, the concerns regarding immediate pest attacks due to lack of government approved alternatives are unfounded.

The government's focus should be on helping the farmers tide over initial glitches by educating them about alternatives to the banned pesticides, investing more resources into already existing IPM and agroecology measures, and diverting demand to safer, less toxic alternatives through existing industries. The Government should conduct surveys among farmers to identify the pattern of use of pesticides for each crop and to ensure effective alternatives for banned pesticides.

A review of India's 'Green Revolution' shows the gains in productivity from the green revolution were from innovations in plant breeding, expanding irrigation and fertilizers, and not specifically pesticides. In fact, pesticide use has been found to be directly proportional to policy measures such as subsidies. Once pesticide use was disincentivised in certain countries, usage reduced and farmers moved to more sustainable practices [80].

India's current focus on agroecological approaches through government schemes [48] is supplemented by this ban and promotes our indigenous form of agriculture.

8. Contribution to India's Development Goals

This draft order is potentially a step towards realizing India's vision of 'Doubling Farmer's Income by 2023' which can be achieved through Integrated Pest Management and reducing dependence on chemical pesticides [81].

These bans are very important to help India achieve its target of Sustainable Development Goals (SDG's) by 2030, namely SDG 2.4 (ensuring sustainable food production systems and implementing resilient agricultural practices), SDG 3.4 & 3.9 (reducing by one third premature mortality from non-communicable diseases through prevention and treatment and promoting mental health and well-being; substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination), and SDG 12 (sustainable consumption and production) [28, 82].

9. The way forward

India produces a large number of world's pesticides and is uniquely positioned to take a lead in eliminating the most hazardous pesticides from use and pointing the way towards better protecting lives, health and the environment of its

own citizens and global population. The Honourable Minister for Agriculture and Farmers Welfare stated in light of the COVID-19 pandemic, that the need of the hour is to have food free from chemical fertilisers and pesticides [48]. Traditional Indian methods of farming are not a step-back from conventional farming but the way forward. This notification aligns with the progressive direction of Indian agriculture.

It is proposed that India may continue exporting pesticides banned domestically to other countries in order to protect interests of pesticide manufacturers at home. This action would be morally and legally questionable even if a prior approval of importing country is obtained. Indian companies would generally export pesticides banned domestically to low income countries as high income countries have stricter laws and low-income countries may not possess capacity to conduct local assessment of potential harms. There is a growing international consensus that States have a duty and businesses a corresponding responsibility to prevent exposure of workers to hazardous substances, including pesticides, not only domestically but beyond its borders [83]. Apart from domestic restrictions, banning of exports should also be considered.

For sustainable agriculture, and for the safety of rural communities that are threatened with constant exposure to highly hazardous pesticides, banning is the most effective solution. This draft order is in alignment with India's development goals, human rights standards, and protection of interests of vulnerable groups, with potential significant long-term health, environmental, and economic benefits.

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