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REDUCING PESTICIDE EXPOSURE RISK AMONG FARMERS AND FARM WORKERS

In this blog, Dr. T. P. Rajendran stresses the need for comprehensive measures to reduce pesticide handling risks, a growing public health concern. While protective gear is essential, he argues it is insufficient to address the broader challenge.

CONTEXT

Asia, in general, and India, in particular, have been on the brink of serious health consequences due to agrochemical exposure—especially pesticides—affecting farm families, agricultural labourers, women, and children (Box 1). The use of pesticides increased in volume and frequency during this millennium as it has become essential to enhance crop production and productivity. Despite their benefits in pest and disease control, the use of pesticides poses serious health risks to farm labourers and farmers. India records over 33,000 deaths from accidental and intentional pesticide poisoning, with evidence suggesting the actual number could be significantly higher.

Box 1: Pesticides and Human Health

Pesticides can cause acute toxicity if a high dose is inhaled, ingested, or comes into contact with the skin or eyes. In contrast, prolonged or recurrent exposure to pesticides leads to chronic toxicity. Pesticides produce different types of toxicity, for instance, neurotoxicity, mutagenicity, carcinogenicity, teratogenicity, and endocrine disruption. The toxicity symptoms of a pesticide formulation may depend on the specific active ingredient and the presence of synergistic or inert compounds that can enhance or modify its toxicity.

Exposure of pesticides to the human body through different entry points (nasal or dermal) over a prolonged period leads to continuous absorption into cells and results in cancers and other serious health issues. A systematic review of pesticide exposure, associated risks, and long-term human health impacts identified consistent associations between chronic pesticide exposure and non-communicable diseases, including cancer, neurological disorders, and endocrine disruptions. The review also noted that an increased incidence of respiratory issues and neurodegenerative diseases was often associated with occupational exposure to pesticides. People exposed for a prolonged time frame, or at high concentrations, particularly agricultural workers, were more likely to experience long-term health hazards, resulting in loss of livelihood and additional financial burden for treatment.

Source: Damalas and Koutroubas, 2016; Ahmad et al, 2024; Banerjee et al, 2024

Over ninety per cent of pesticides used in the country are applied in the form of sprays. Direct exposure mainly occurs during the preparation and application of pesticide sprays, as well as during the cleaning of spray equipment. Those who mix, load, and spray pesticides may encounter these chemicals through spills, splashes, direct contact due to faulty or missing protective gear, or pesticide drift. However, farmers can also be exposed even when performing tasks unrelated to direct pesticide application. When working manually in areas treated with pesticides, they may face significant exposure from direct spray, drift from nearby fields, or contact with pesticide residues on crops or soil. This type of exposure is often overlooked. The most common routes of exposure for farmers are through the skin and inhalation of contaminated materials. Dermal exposure typically occurs on body parts not covered by protective clothing, such as the face and hands. Farmers' pesticide exposure can be reduced by minimising pesticide use and properly using suitable personal protective equipment at all stages of pesticide handling.

HANDLING PESTICIDES

Handling pesticides basically starts with manufacturing, transportation, and storage at manufacturing premises, and market godowns (warehouse) are primarily governed by the Insecticides Act, 1968, and the Insecticide Rules 1971. These cover aspects related to managing factory premises, effluent treatment, packaging of pesticides, safe transportation and storage of pesticides in marketing premises and godowns (warehouse).

Many states have provided specific guidelines on safe handling of pesticides, starting from on-farm storage, mixing, spraying, clean up and disposal. On-farm exposure to pesticides can happen at each of the above stages if necessary precautions are not observed.

On-farm storage guidelines prescribe keeping pesticides in original containers, marking storage areas with warning signs, keeping pesticides away from the house premises and the reach of children and livestock. However, in reality, these guidelines are not followed in most farms, partly due to a lack of awareness and inadequate storage infrastructure.

Mixing pesticides in water at the recommended dosage for crop application should be done carefully in a drum or bucket, as the case may be, and then stirred with a wooden stick. This is the most dangerous phase, since it involves handling concentrated pesticide formulations. Although the guidelines clearly state that bare hands should never be used for mixing pesticides with water, it is

common to see farmers using bare hands, which can lead to contact toxicity. Farmers also measure the pesticide at face level, which increases the risk of inhalation. Very rarely, farmers use hand gloves, eye goggles or nose masks when mixing pesticides.

While spraying pesticides, care should be taken to prevent drift and possible dripping from the spray nozzle. Various manual, mechanical, and battery-operated knapsack sprayers, bullock cart-fitted sprayers, tractor-mounted sprayers, and drone-based sprayers are being used in India. The use of electric battery-operated sprayers and drones is extensive in several other countries. However, the drone-based spraying technology is still in its infancy in India for pesticide application due to various technical difficulties in using its formulations. Drones shouldn't be used in farms with open water bodies to prevent accidental poisoning of non-target organisms.

Under the current scenario, exposure to pesticides from manual sprayers is higher, and operators require protective cover. In the case of tractor-mounted sprayers, the driver operating the machine is also highly vulnerable to exposure to pesticides through drift and wind. Prudently, they should protect themselves by wearing protective apparel. Unfortunately, those engaged in pesticide application do not wear appropriate protective gear.

When cleaning sprayers and disposing of pesticide containers, it is crucial to prevent contamination of water bodies. Additionally, flowing streams shouldn't be used for washing vessels and sprayers. Leftover insecticide suspension has to be disposed of properly by pouring it into a specially dug hole in the ground or a pit latrine. Detergent should be used liberally to wash the face and limbs of the operator and the persons involved in the spraying operation. However, many of these practices are not followed mainly due to ignorance about potential health risks. Although annual health check-ups for those exposed to pesticides are recommended, they are not practised.

AWARENESS ON SAFE HANDLING OF PESTICIDES

In India, awareness of safe handling of pesticides is minimal among farmers and farm labourers. The FAO has developed an International Code of Conduct on Pesticide Management Guidelines for personal protection when handling and applying pesticides. However, many extension personnel are not aware of these international guidelines or the FSSAI's national guidelines on the safe use of pesticides. Though institutions like the National Institute of Post Harvest Management (NIPHM) in India offer courses on this topic for state extension officers, these programmes only reach a fraction of extension personnel.

Training programmes for educating farmers on storing pesticides, the use of personal protective equipment while spraying, safe disposal of containers and the first aid that needs to be provided in case of an emergency are minimal. Some pesticide manufacturers that are part of CropLife Asia have begun sharing their extension materials, which include components on the safe handling of pesticides. In India, Croplife India has been organising several events to promote the use of personal protection equipment while using agrochemicals. However, there is a need for national and state-level programs to strengthen extension and training in this area.

ADDRESSING THE CHALLENGE

Education on Best Practices on Safe Handling of Pesticides

In India, safe handling of pesticides is yet to receive the necessary attention from Extension and Advisory Services (EAS). There is a need to organise specific extension programmes on this topic. For this, the extension staff, especially those working closely with farmers, do need training on this topic.

To raise awareness and educate farm families on safe pesticide handling, extension materials featuring pictorial depictions on dos and don'ts for pesticide handling and the use of protective gear in local languages must be developed. These materials must clearly indicate what to do, what not to do, why specific actions are taken, why others are not, how to perform them correctly, and how not to do them. Providing leaflets in pesticide packets with instructions in tiny print about product use and antidotes in case of poisoning is insufficient. These leaflets should be enhanced with visual descriptions of good practices in pesticide use, including the use of appropriate equipment such as sprayers and drones.

Extension and Advisory Services (EAS) should develop training modules on this theme, including educational videos and other communication materials in collaboration with pesticide manufacturers. The Extension Division of the Indian Council of Agricultural Research, through its country-wide network of Krishi Vigyan Kendras (KVKs), could take a lead in promoting awareness on this topic. The Directorate of Extension of the State Agricultural Universities should also develop appropriate communication and training materials on the safe handling of pesticides. This should also be an essential topic for training extension officials at the state and district levels.

The pesticide industry has a vital role in promoting pesticide literacy among farmers and farm labourers. The corporate social responsibility (CSR) funds of these companies should also be utilised to do this.

Promoting Spray Drift Protection Apparel.

The scientific advancement in developing cotton fabric coated with a specific chemical that can absorb and degrade all pesticide chemistries is offering a solution for spray drift protection to operators and farm families in India. Recently, Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, unveiled "Kisan Kavach", India's first-of-its-kind anti-pesticide bodysuit, designed to protect farmers from the harmful effects of pesticide exposure. Its fabric has been patented for its property of decomposing pesticide chemistry. *The Kisan Kavach* outfit was launched as an innovative dress designed for farmers and their labourers to wear while applying pesticides in crop fields, ensuring minimal exposure to pesticide chemistries o*n* their bodies. Touted to cost approximately INR 4000, this product can be used for over 50 wash cycles, lasting more than a year.

This technical textile, developed from bio-degradable chemistry, has been proven to absorb pesticide substances, thereby preventing spray particles from falling on the operator's body. The protection it offers to pesticide applicators is a significant advantage for farmers and their workers in India and other Asian countries, where manual and power sprayers are still commonly used in fields. Kisan Kavach is made from breathable Oxime fabric, which allows the spray operator to stay comfortable in the hot sun. The suit is washable multiple times and can be reused many times. I am confident that farm families will benefit from using this important apparel to carry out crop protection spraying operations on their farms.

This product from M/s Sepio Health Pvt. Ltd., Bengaluru, may be included in all government schemes and programmes that are promoting Integrated Pest Management / Integrated Crop Production Management across all Indian States and Union Territories. The Kisan Kavach is soon to be available on e-commerce platforms, as informed by Prof. Praveen Kumar Vemula, M/s Sepio Health Pvt. Ltd., C-Camp, GKVK Campus, Bengaluru-560065.

Research on Exposure

Though data on toxicity is mandatory before registering a new pesticide, there are very few follow-up studies on how these chemicals affect human, livestock, and environmental health. When registering pesticides, there are rules for post-marketing surveillance of the chemistry involved to assess their impact on the health of users and the environment, including aquatic systems in farmlands. Pesticide manufacturers may be advised to conduct national-level studies through accredited agencies, where public trust is high.

The country-wide data generated needs to be published as a monograph by the Ministry of Agriculture and Farmers Welfare. This monograph shall have two parts, viz.

a. the exposure data and health data of farm families, as well as their livestock and
b. the agrochemical residues in their farm commodities.

Such profiling of risk due to agrochemicals can also be extended to the environmental impact of these chemicals. These monographs can serve as valuable tools for planning the judicious use of agrochemicals in farming.

Maintaining a record of the agrochemical impact on the health of farm and rural individuals, as well as their animals, through an annual monograph, is a good practice for various socio-economic purposes, as well as for developing policies on national human health management. The monograph can also include:

- records of ailments, including allergies, in public health institutions, suspected to be from short-term and long-term pesticide exposure in farms;
- chronic ailments, long-term impact, historical data, and
- pesticide residues in farm commodities.

END NOTE

We have a moral responsibility to safeguard farm labourers and farm families from hazards arising from pesticide use in farming. Investing in on-farm safety measures is also crucial for reducing the overall health management burden on the country. The social cost arising from the increased health burden caused by the unsafe handling of pesticides can thus be offset through such socially benevolent programmes.

The primary responsibility for implementing these measures lies with pesticide manufacturers and their associations, in collaboration with relevant central and state government entities, as part of an annually monitored program. The Ministry of Agriculture and Farmers Welfare at the Centre can set the guidelines and provide funding to address this issue at the national Level and incentivise states to follow.

Making protective gear available at concessional rates is crucial in reducing harmful exposure. State Departments of Agriculture and State Agricultural Universities can play a greater role to promoting safe and responsible use of pesticides and promoting protective gears. But that alone is not enough. This must be supported by sound educational programmes on the potential health risks associated

with pesticide handling and methods for reducing pesticide exposure. In other words, there is a need for an effective behavioural change communication strategy to address this issue, and Extension and Advisory Services must play a leading role in addressing this challenge.

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