



EDITORIAL

PESTICIDE RESIDUES: THE HIDDEN REALITY IN NEPALESE VEGETABLES

Nepal began using chemical pesticides in 1952, starting mainly with DDT to control the mosquitoes that spread malaria. Imports of pesticides, mostly from India, have increased tremendously in recent years. According to the government's plant quarantine and pesticide management centre (PQPMC), Nepal has imported 635 tonnes of pesticides worth around Nepali Rupees (NRs) 830 million in the fiscal year (FY) 2017/18. More than 85% of this tonnage is used in small pocket-sized areas of vegetable production. About 169 active compounds are available under 3,034 trade names. In addition to pesticides, Nepal also imports fresh vegetables and fruits from abroad, primarily from nearby Indian city wholesale markets in Karnatak, Maharashtra, Kanpur, Varanasi, Gorakpur, Kushinagar, and Maharajgunj. According to Department of customs, Nepal has imported fruits worth NRs 17.03 billion and vegetables worth NRs 26.46 billion in the last few months of FY 2018/19. Pesticides are also widely used in India.

Despite the many effects of pesticides on health and environment, their application has become an "ultimate solution" for farmers wishing to kill or control insect pests, weeds and plant diseases in Nepal. Farmers apply pesticides in their fields to increase production. For information on how to use the pesticides, they depend mostly on information provided by pesticide retailers. Bhandari et al. (2018) discovered that only 7% farmers used safety gear such as gloves while spraying fields. Similarly, about half of the retailers did not know the colour codes displayed on pesticide packets and containers. Of all the pesticides, mancozeb had the highest average application rate (7.78 kg a.i./ha) [where a.i. means active ingredients], while dichlorvos had the highest extreme application rate (23.12 kg a.i./ha). In comparison to retailers, farmers perceived lower pesticide threats to their health and the environment, and for safety behaviours saw lower benefits and higher barriers, with some farmers creating their own pesticide cocktails. The hidden reality is that farmers are people in Nepal who are most exposed to pesticides, when applying them in their fields, and again when eating their own products. PQPMC has no recommended use information available for specific crops, so farmers and retailers remain confused or uncertain about *dose rates*, *application* methods, and other procedures needed for safe use of pesticides.

Eating foods that contain pesticides is harmful to human health. In order to monitor pesticides in foodstuffs, the Government of Nepal established pesticide residue testing labs (Rapid Bioassay of Pesticides Residue, RBPR) in seven different cities. This test-tube assay is mainly based on the inhibition of an enzyme that functions as neurotransmitter in the human body, so it is a good guide to possible danger. However, the test cannot quantify the residues of all kinds of pesticide used across the country. In developed countries, advanced techniques such as Liquid or Gas Chromatography Triple Quadrupole Mass Spectrometry (LC-MS/MS or GC-MS/MS) are used to monitor pesticide residues. Such techniques and well-equipped labs are needed in each province of Nepal for comprehensive monitoring of pesticide residues. Their application would contribute to occupational safety for retailers and farmers, food safety and security for consumers, and would complement official sustainability goals of the country under the United Nations charter (UNSDG 1-3).

Food safety is one of the constitutional rights of all Nepalese. Article 44 of the constitution has granted Nepalese rights to quality foodstuffs. Likewise, article 35 has granted Nepalese rights to good health. Bhandari et al. (2019) found residues of carbendazim in tomatoes at levels of 1.45 to 337 $\mu\text{g}/\text{kg}$. The European Union (EU) Maximum Residue Limit for this chemical is 300 $\mu\text{g}/\text{kg}$. The residues of triazophos in eggplants and tomatoes were 1.03 to 25.5 $\mu\text{g}/\text{kg}$ and 1.16 to 685 $\mu\text{g}/\text{kg}$ respectively (the EU MRL is 10 $\mu\text{g}/\text{kg}$). Residues of chlorpyrifos in tomatoes, eggplants, and chillies also crossed the EU limits. Up to seven different kinds of chemical residue were found on a single tomato sample, indicating high cumulative risk of over-exposure. In this study, the vegetable samples from Integrated Pest Management (IPM) fields had pesticide concentrations much lower than those found in fields with heavy pesticide application.

Previous researchers have already linked pesticide residues with various short- and long-term effects or disease. Known short-term effects are headache, skin-irritation, eye-irritation, muscle pain, fever, and weakness. Cancer, cardiovascular diseases, renal failure, Alzheimer's disease, Parkinson's disease, and strokes have been increasing in Nepal, and all may reflect long-term effects of pesticide exposure. The Government of Nepal has been providing some care in response to these health problems, but it will be more cost effective to implement preventive programs rather than focusing only on cures.

Information on the safe use of pesticides can be broadcast through radio, TV, and newspapers and other media. Educational programs such as documentaries and talk shows or “infotainment” may be effective. All these approaches would raise awareness about safe practices for farmers, pesticide distributors, and consumers. IPM training programs for farmers should focus especially on vegetables and need to be made available extensively. Establishing well-equipped labs in Nepal with modern technology to assess pesticide residues in domestic and imported foodstuffs should not be delayed. Pesticides such as profenofos, quinalphos,

triazophos, and carbendazim are not approved for use in EU, but are still widely used on fruits and vegetables in Nepal - they should be banned immediately! The Nepal Governments' recent decision in 2019 to establish maximum residue limits (MRLs) for pesticides in fruits, vegetables and tea is a great step forward, but will only be useful if followed by effective monitoring.

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