

Policy Brief on Ensuring Safe Vegetable Production amid Heavy Metal Risks Free from Wastewater Irrigation in Punjab, Pakistan

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ABSTRACT

The untreated wastewater irrigation in producing vegetables from the peri-urban areas of Punjab, Pakistan, poses enormous health risks because the wastewater, particularly the industrial wastewater, is a source of heavy metals that cumulate in vegetables. This policy brief accentuates the contamination of wastewater irrigated vegetables with heavy metals and gives recommendations on safe vegetable production based on recent studies. This policy brief calls for the need to have strict regulation and monitoring of irrigation practices based on wastewater for sustainable agriculture and public health assurance.

Key Words: Wastewater irrigation, Heavy metal, Vegetable safety policy, Punjab agriculture.

I. INTRODUCTION

Due to the shortage of good quality water caused by climate change, there has been over-reliance on the use of untreated wastewater for irrigation. Long-term irrigation of crops using wastewater leads to the accumulation of heavy metals in soil and the saturation of the adsorption capacity of the soil, hence the accumulation of heavy metals in plants. Vegetables can have heavy metals accumulated beyond the permissible levels of the World Health Organization (WHO) due to the irrigation of crops using wastewater

(Atta et al., 2023). Many organ systems in the human body, such as the gastrointestinal system, nervous system, renal system, hematopoietic system, and cardiovascular system, are targeted by heavy metal poisoning (Khan et al., 2023). Due to heavy metal poisoning, the severity of the effect depends on the route of exposure, types of heavy metals, levels of exposure, ages of exposed individuals, and the sex of the exposed individuals (Tchounwou et al., 2012). Pregnant women and children have higher susceptibility and sensitivities towards heavy metal exposure and hence have higher severity of heavy metal toxicity effects compared to others (Khan et al., 2023).

II. KEY FINDINGS

1. **Accumulation of Heavy Metals:** Recent studies have reported the accumulation of heavy metals in vegetables above the permissible limit safe for human consumption. A high concentration of Cd, Cr, Mn, Ni, Pb and Mg has been reported in vegetables irrigated with wastewater. The concentration of said metals was found above the permissible limits set by WHO and European Commission posing serious health risks (Iqbal et al., 2018).
2. **Health Risks:** Serious health issues arise in human beings as a result of contaminated food consumption and a very low concentration of heavy metals become very harmful due to lack of effective excretion mechanism for toxic metals in human body (Ghosh et al., 2012). The intake of heavy metals on sustained basis led to reduced immunological resistance due to the loss of basic nutrients from human body and is responsible for chronic diseases in adults and developmental related disorders in children (Atta et al., 2023).
3. **Soil Contamination:** Excessive accumulation of heavy metals takes place in soil receiving wastewater irrigation, persisting over time and leading to enhanced complications related to safe food production (Khan et al., 2023).

III. THE MAIN BODY

Current Practices: Wastewater is being used for irrigation purposes as it provides nutritional benefits and better crop growth, particularly for the cultivation of vegetables in peri-urban areas. Despite associated health risks, farmers use untreated wastewater due to its availability (Ensink et al., 2002).

Health Impacts: The heavy metals are absorbed by vegetables grown with wastewater irrigation and become a part of food chain impacting human beings directly upon consumption. The heavy metal concentration may increase in body and may become above the safe levels due to consumption of contaminated vegetables routinely. Children and women are more vulnerable to heavy metal associated health risks such as neurological, cardiovascular and gastrointestinal issues (Khan et al., 2023).

Environmental Concerns: The disposal of wastewater in environment not only impacts human health through contaminated food consumption but also a source of surface and ground water contamination. The leaching of toxic metals from soil surface to ground water leads to broader ecological impacts (Atta et al., 2023). Wastewater may also be a source of pathogens. As a result, the soil quality is deteriorated, water quality is impacted and the life of terrestrial and aquatic organisms is influenced (Jaramillo and Restrepo, 2017).

IV. POLICY IMPLICATIONS

There is an urgent need for policy interventions regarding the regulation of wastewater use in farming. The effective policy development and implementation is the need of time to address the human health risks associated with wastewater irrigation practice.

V. POLICY RECOMMENDATIONS

1. **Regulation of Wastewater Use:** Strict implementation of regulations related to wastewater irrigation is required. The treatment standards for wastewater should be maintained to reduce toxic metals in wastewater used for irrigation purposes, soil and plants.
2. **Monitoring and Surveillance:** A comprehensive monitoring system for regular assessment of toxic elements accumulated in wastewater, soil and vegetables should be established. There should be transparent public reporting mechanisms to increase the efficiency of system.
3. **Public Awareness Campaigns:** A province and country wide awareness campaign is needed through social media and extension services to aware the general public and farmers regarding the risks associated with wastewater irrigation to produce vegetables and crops and significance of safe practices for agriculture.
4. **Research and Development:** Research is needed to establish hyper accumulator vegetables and crop plants that must not be grown using wastewater irrigation. Similarly low accumulating plants need to be identified and better ways to deal with wastewater irrigation practices to reduce health risks are to be determined.
5. **Support for Farmers:** Technical and financial support to farmers and access to treated water and good quality irrigation water will be helpful in adoption of safe irrigation practices by farmers.
6. **Rainwater harvest:** The facilities to harvest and store rainwater should be developed to provide safe quality irrigation water in peri-urban zones for the cultivation of vegetables.
7. **Water storage facilities:** The development of storage facilities to store river water and provision for irrigation purposes will not only help provide good quality irrigation water but will also reduce the chances of water scarcity in the country.

VI. CONCLUSION

Vegetables are regarded as foods which are normally taken by rich and poor people on a daily basis. The wastewater irrigation practices are causing health risk associated with the consumption of vegetables to increase due to the presence of heavy metals in the vegetables. The production of safe vegetables will help in reducing the health risks associated with the consumption of vegetables containing heavy metals. In the task of production of safe vegetables, there is an immediate need of intervention of policies for controlling the wastewater irrigation practices, controlling the concentration of heavy metals in vegetables, and adoption of safe practices in agriculture.

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