Indian J.L.Sci.3(2) : 123-127, 2014 Review Article ISSN : 2277-1743 (Print)
ISSN : 2278-7879 (Online)

FOOD SAFETY ASSURANCE THROUGH REGULATION OF AGRICULTURAL PESTICIDE USE IN INDIA: PERSPECTIVES AND PROSPECTS

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ABSTRACT

Food is the basis of sustenance hence safety of food is an imperial issue. Pesticide agrochemicals have long been used in agricultural production to reduce substantial crop loss, following; severe pest infestation. Residues of pesticide contaminants in food and that beyond safety levels pose threat to consumer health. Effective food safety system is essential for security of nation's food supply whether the contamination being intentional or unintentional. Moreover, assurance of food safety is mandatory to assist international trade distribution of food. Therefore, food safety is a critical component of human health, global food security and consequent sustainable development.

KEYWORDS : Food safety, Contamination, Pesticide residues, MRLs, Agriculture

Productivity in terms of food-grains, fruits vegetables, oilseeds and pulses, poultry, dairy, sugar etc. constitute the bulk of the output in India's agriculture sector. The performance of agriculture is important for availability and access to food, as large population in the country is dependent on this sector (Annual Report, Department of Agricultural cooperation 2012-13).

Agricultural Pesticide Use - Need, Benefits and Risks Involved

Agrifarming demands destruction of agents, largely pests; which stands in the way of profitable crop yields. Chemical agriculture; through application of pesticides, is considered to be a requisite for the production of adequate food supply for an increasing national population and control of insect borne diseases.

In a wake of assurance towards food security; green revolution has contributed to creation of new pests and diseases, with resultant growing demand for pesticides (Shiva, 1991). Horticultural crops cultivated as monocultures favor pest propagation. Genetic uniformity of crop varieties therefore requires high doses of pesticides; increasing ecological hazard of pesticide use (Shiva, 1991). India is the second largest country in Asia and seventh in the world; with nearly 50% cultivable land area (and 0.6kg/hectare pesticide consumption); (CIA World Fact book) that supports food demand of over 15% of the world population. Additionally, India is the global contributor (Gupta, 2004) to manufacturing and usage of large quantities of pesticides. It is estimated that more than 60% of consumption of pesticides in India is garnered by insecticides, whereas herbicides and fungicides together contribute upto 40% of total pesticide utilization (Devi, 2010). Among the crops, cotton, rice, vegetables and fruits account for the largest share of pesticide consumption in the country.

Food has been recognized as main source of exposure of the general population to pesticides and accounts for more than 90% of total exposure (Adachi and Okano, 2006). Pesticide residues in food and crops are a direct result of application of pesticides to crops growing in the field, and to a lesser extent from pesticide residues remaining in the soil (Mills, 1936). Many pesticides are found to be hazardous chemical contaminants with problems of ecotoxicity and environmental persistence. Several of the pesticides are mutagenic (Galloway et al., 1987), carcinomic (Leiss and Savitz , 1995) and genotoxic (Giri et al., 2002) compounds. There is an essential dearth of elemental information on exposure assessment through pesticide residues among various age groups in India (Battu et al., 2004).

Food Safety Concept and Issues

According to FAO/WHO, 1997 food safety is defined as assurance that food will not cause harm to the consumer when it is utilized according to its intended need. Thus food safety assurance involves the reduction of risks which may occur in the food. Implementation of good agricultural and manufacturing practices is primary step in reducing the risks associated with produce.

Safety assurance of food and the nutrition it provides is not only a necessity but an obligatory right of the consumer. Food safety is an imperial parameter to

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determine food security. Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life as according to Food and Agriculture Organization, FAO. Food security as a multi-faceted concept deals with, availability of ample supplies at a global, national level and is also concerned with adequate nutrition, well-being and safety of consumers.

Safety assessments for pesticides in food are held in compliance to set regulations as Maximum Residue Limits, MRL's. MRL's are intended primarily as a check that the pesticide is being used correctly through good agricultural practices; and also to assist global export in treated produce (Puri, 2014).

Direct and Indirect Effects on Food Production

Agricultural production is essentially an outcome of the interplay of natural resources such as land, water, soil, plant biodiversity and various agricultural inputs like pesticides, organic manure, equipments etc. Land and water are finite resources. Land degradation is major threat to our food and environmental security. Land degradation in the form of depletion of soil fertility results in decline of productivity attributed more importantly to deterioration in soil quality. Depletion of soil and water quality due to pesticide agrochemical leachates hence needs to be evaluated; alongwith regulation of use of pesticides (Dev and Sharma, 2010). About 70% of the pesticides used in agricultural fields reach neighboring water bodies through rain or irrigation (Ridgway et al., 1978) or by their direct use in the water bodies for control of aquatic weeds (Li , 1975). Apart from direct crop use of pesticides; run-off from agricultural field to water bodies (which in turn is utilized for irrigation purposes) has impact on soil quality. Use of agrochemical controls has resulted in negative externalities that have widened enormously over the last few decades (Devi, 2010). There is hence evident exposure risk to the population, from very high levels of pesticide residues in and from agricultural output.

Regulatory Assessment of Pesticide Residues in Agriculture

Pesticide residues are specified pesticide products remaining in food after the use of a pesticide. These include pesticide derivatives such as conversion products, metabolites, and reaction products considered to be toxicologically significant. Pesticide residues undergo two critical biological processes that are a cause for concern, of; bioaccumulation and magnification in food chain.

Regulations on Maximum Residue Levels MRLs

In India MRLs of pesticide agrochemicals in food products is regulated through the Prevention of Food Adulteration Act (PFA), 1955. Existing MRLs on pesticides and agrochemicals specified in the PFA are incorporated in the Food Safety and Standards Regulations, 2010.MRLs are listed by chemical product for specific food commodities. However, in some cases, tolerance limits are established for more generic categories of food (Mishra, 2011). In the absence of an established MRL, Codex Alimentarius MRLs are followed.

Codex maximum pesticide residue limit MPRL; is the maximum concentration of a pesticide residue expressed as mg/kg, legally permitted in or on food commodities as recommended by the Codex Commission (Codex Alimentarius Commission, 1997). These are based on good agricultural practice data and foods derived from commodities that comply with the MRLs intended to be toxicologically acceptable for consumption.

Regulations on Use of Pesticide Agrochemicals

Regulation of agricultural use of pesticides, their manufacture and sale is governed through the Insecticides Act, 1968 and the Insecticides Rules, 1971 under Ministry of Agriculture. All insecticides undergo a registration process with comprehensive labeling for their composition, active ingredient/s, recommended dosage, target pest/s, agricultural use and indicated safety information through CIB & RC Central Insecticides Board & Registration Committee (Bhushan et al., 2013). Bans on registration can be recommended for the MRLs found to be above the PFA limits in post harvest agricultural produce. Moreover; new insecticide registrations are not approved without establishment of maximum residue levels MRLs on crops and commodities under the Food Safety and Standards Act, 2006 (Annual Report, Department of Agricultural cooperation 2012-13).

Table 1 : State Based Scenario of Non-Recommended Use of Pesticides on Food Items in India

Food (Place)	Pesticide	Status in India	Health hazard	MRL (ppm)	CODEX MRL (ppm)	Pesticide residue obtained (ppm)
Tomato (Allahabad, U.P.)	**DDT**	Restricted use	Carcinogenic, endocrine disruptor	0.001	-	0.108
Wheat (Gorakhpur, U.P.)	**Aldrin**	Banned	Carcinogenic , affects reproductive system	0.01	0.02	2.20
Cauliflower (Amritsar,Punjab)	**Chlorpyrifos**	Registered for use	Affects nervous system	0.01	0.05	1.17
Brinjal (Allahabad, U.P.)	**Heptachlor**	Banned	Affects nervous system, liver, leukemia suspect	0.05	-	0.48
Rice (Faizabad, U.P.)	**Chlorfenvinfos**	Banned	Endocrine disruptor	0.025	-	0.356
Apple (Gorakhpur, U.P.)	**Chlordane**	Banned	Affects central nervous system, liver, kidneys, eyes	0.1	0.1	0.93
Cardamom (Idukki , Kerala)	**Quinalphos**	Registered for use	Endocrine disruptor	0.01	-	0.15 - 0.25

From: Misra, 2011. www.fssai.gov.in data

Problems in Regulations -Regulatory Violations

Numerous cases of violations have been reported indicating paucity in approved usage of pesticides.

In a study by (Srivastava et al., 2011) high levels of pesticides permethrin-II, HCH, dichlorvos, chlorfenvinfos; exceeding approved MRLs were detected in vegetables including cucumber, cauliflower, cabbage, radish and okra. Similarly in another monitoring study (Mukherjee, 2003) reported 31% of the vegetable samples exceeding pesticides above the prescribed tolerance limit. Among the four major chemical groups, residue levels of organophosphorous were highest followed bicarbamates, synthetic pyrethroids and organochlorines in 80 crop samples (Kumari et al., 2003). Additionally about 32% of the samples showed contamination with OPPs and carbamate insecticides above their respective MRL limits.

According to monitoring reports of AICRP, 1999 (All India Coordinated Research Project on Pesticide Residues project of Indian Council of Agricultural research) 59% of food samples tested were found contaminated with pesticides. Fruits, vegetables and milk were found to be highly contaminated; with 20% samples of all commodities exceeding MRLs. More than 40% fruits and vegetable samples exceeded MRLs confirming presence of monocrotophos, DDVP and Methyl Parathion as most prevalent WHO class -I highly hazardous pesticides in states like UP and Kerala. According to AICRP 2001 report, high contamination levels 61%; in fruits and vegetables was indicated out of which 11.7% failed regulations. Of a total of 15,321 samples analyzed, residues were detected in 1,044 samples of which; 188 samples were detected for residues above maximum residue limits. Out of 5,170 vegetable samples; 11.5% were contaminated (with 2.3% above their respective MRL) while 0.9% of fruit samples were found to fail regulatory limits (Kuruganti et al.).

In their main findings the monitoring scheme 2010-11 found several foods had residues of pesticides that were either banned or of restricted use in the country. For instance, DDT not recommended for vegetables was found to be 108 times the recommended levels; in tomatoes. Banned pesticides like aldrin, chlordane, chlorfenvinfos and heptachlor were also reported in samples of vegetables, apple, rice, wheat, milk and butter (Indicated in table 1). In this context, issue of usage of pesticides in non-recommended crops needs to be examined in much greater detail.

Despite the presence of set regulations and time dependent regulatory evaluations there is no dearth of reports on unwarranted agricultural pesticide applications. Many areas are open to subjugate unprecedented pesticide

Table 2 : Quality of Pesticides Available in India

Tenure	Pesticide Samples Analyzed	Misbranded Pesticide Samples found	% of Samples Misbranded
2008-2009	47420	1839	3.8
2009-2010	59005	1989	3.4
2010-2011	59331	1742	2.9
2011 2012	62092	2137	3.4

From: Directorate of Plant Protection, Quarantine & Stroage, Faridabad

use. Infrastructure for testing quality and composition particularly to investigate presence of chemical pesticides, is deficient. Need of well-equipped, accredited laboratories in an imperative that has a direct bearing on the quality of pesticides available to the farmers. The farmers of India have a basic knowledge of traditional agriculture but there is lack of the technical understanding of pesticide use and application. This makes them susceptible to unreasonable and injudicious use of pesticides and banned products (Bhushan et al., 2003).

Many pesticides are found to be misbranded (see Table 2) which can be misleading for their intended usage. In cases of misbranding of pesticides, delay in legislative action can also be an escape to the defaulters.

Future Outlook

The ever-rising population of the country puts continuous burden on agriculture to improve productivity. Significant role of pesticides in agricultural scenario is thus likely for management of pests; contributing to increased crop yields.

Lack of technical know-how confers pesticide utilization essentially at the prejudice of the farmers. Therefore, there is an ardent need to adopt strategies in accordance to the principles of good agricultural practices. Misbranding of pesticides, their unprecedented and non-recommended use on produce; pose need for regulations to assure food safety and public health. Furthermore, it is important to assure quality of pesticides used in context of due concerns about hazards associated with their persistence in the environment. In the light of problems of pesticide safety in foods; effective regulations of pesticide use is a must. Use of safer alternatives such as biopesticides and botanical pesticides obtained from natural plant sources are some of the future strategies for minimizing human exposure to chemical pesticides. Additionally, promoting cultural, biological, mechanical techniques integrated in IPM Integrated Pest Management approach can serve environment friendly substitute to limit need based utilization of pesticide chemical controls in agriculture.

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