



CONSUMPTION OF PESTICIDES IN INDIA: AN OVERVIEW

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ABSTRACT

This paper describes the consumption trends of pesticides over the period of 2003 to 2017 across the states in India. The industrialization of the agricultural sector has increased the chemical burden on natural ecosystems. Pesticides are chemicals used in agricultural lands, public health programs, and urban green areas in order to protect plants and humans from various diseases. The pesticide economy of India is more export-oriented in nature. The growth rate of domestic consumption of pesticides over the years has shown wide fluctuations, though the overall trend is negative. Analyzing the trend of pesticide consumption in 28 states and Union Territories (UTs) of India for the period 2003 to 2017, a positive growth trend has been observed in 17 states/UTs. The highest growth has been observed in Jammu & Kashmir, Andaman & Nicobar Islands and Tripura. Uttar Pradesh, Maharashtra, Andhra Pradesh, Punjab and Haryana are the states that accounted for 70 per cent of total pesticide consumption. The use-intensity of pesticides has been found highest in Jammu and Kashmir, followed by Punjab and Haryana. However, Punjab and Haryana have exhibited a declining trend in pesticide consumption. On the contrary, Meghalaya where the intensity of application is comparatively low, has registered an increasing trend in pesticide consumption. In the areas of North East Region in general apply low levels of pesticides and are in a declining mode of consumption, except the states like Sikkim, Meghalaya, Tripura, Manipur and Nagaland where noted positive growth rate. This paper has also highlighted the critical review of government policy.

KEYWORDS : Domestic, Consumption, Marketing, Intensity, Fluctuation.

Introduction

Pesticides are substances or mixtures of substances that are mainly used in agriculture or in public health protection programs in order to protect plants from pests, weeds or diseases, and humans from vector-borne diseases, such as malaria, dengue fever, and schistosomiasis. Insecticides, fungicides, herbicides, rodenticides, and plant growth regulators are typical examples. These products are also used for other purposes, such as the improvement and maintenance of non-agricultural areas like public urban green areas and sport fields. Furthermore, there are other less known applications of these chemical substances, such as in pet shampoos, building materials, and boat bottoms in order to eliminate or prevent the presence of unwanted species.

Many of the pesticides have been associated with health and environmental issues, and the agricultural use of certain pesticides has been abandoned. Exposure to pesticides can be through contact with the skin, ingestion, or inhalation. The type of pesticide, the duration and route of exposure, and the individual health status (e.g., nutritional deficiencies and healthy/damaged skin) are determining factors in the possible health outcome. Within a human or animal body, pesticides may be metabolized, excreted, stored, or bioaccumulated in body fat. The numerous negative health effects that have been associated with chemical pesticides include, among other effects, dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects. Furthermore, high occupational, accidental, or intentional exposure to pesticides can result in hospitalization and death.

Residues of pesticides can be found in a great variety of everyday foods and beverages, including for instance cooked meals, water, wine, fruit juices, refreshments, and animal feeds. Furthermore, it should be noted that washing and peeling cannot completely remove the residues. In the majority of cases, the concentrations do not exceed the legislatively determined safe levels. However, these "safe limits" may underestimate the real health risk as in the case of simultaneous exposure to two or more chemical substances, which occurs in real-life conditions and may have synergistic effects. Pesticides residues have also been detected in human breast milk samples, and there are concerns about prenatal exposure and health effects in children.

This current review aims at highlighting the urgent need for a new concept in agriculture involving a drastic reduction in the use of chemical pesticides. Given the fact that the health effects have been extensively discussed in the current literature, this paper focuses on the major chronic health effects and recent findings regarding health effects that have been associated with exposure to common classes of chemical pesticides, i.e., organochlorines, organophosphates, carbamates, pyrethroids, triazines, and neonicotinoids. More emphasis is given to the widely used herbicide "glyphosate," which is an organophosphate pesticide very closely related to current agriculture. The important health effects, as discussed below, reveal the urgent need for implementing alternative solutions.

The UN Food and Agriculture Organization estimates that in developing countries, pests, weeds and disease destroy about 40 per cent of crops while they are still in the fields and 6 to 7 per cent of them after the harvest. In Africa and Asia, the pre-harvest losses are estimated at 50 per cent. Many researchers (Cramer, 1967; FAO, 1975; Pimentel, 1992; Oerke et al., 1995) have put global crop losses due to pests between one-third and one-half of the attainable crop production, with crop losses in developing countries at the higher side. The crop damage is caused highest by insects, followed by pathogens and weeds. Consequently, the use of chemical pesticides in agriculture has been an integral part of crop production in many regions, often at very high levels and unscientific pattern of application (Atreya, 2007; Devi, 2010; Shetty et al., 2010). The role of pesticides in augmenting agricultural output has been well perceived and these have been considered as essential inputs in agricultural production.

There is overwhelming evidence that some of these chemicals do pose potential risks to the ecosystem in general and human beings in particular (Jeyaratnam, 1990; Forget, 1993; Devi, 2010). It is estimated that around 800,000 people in developing countries have died due to pesticides since the onset of the Green Revolution. Nearly 20,000 people in developing countries die each year because of pesticide consumption through their food (Bhardwaj and Sharma, 2013). Though all sections of the population are exposed to the risks of pesticides at different levels, the direct exposure risk is more among workers in production centres, supply chain and end-users (farmers and farm workers). Reports addressing the health concerns of pesticide exposure are more concentrated

in the case of farm workers and farmers (Nyakundi et al., 2010; Devi, 2012) and are rather limited for the workers in production and handling sectors.

Despite several policy decisions, the pesticide consumption pattern and the regulatory mechanism across the states continue to be conventional—the one that was designed to achieve the objectives of green revolution. This mismatch in policy, governance and practices needs to be reviewed critically, in the background of organic farming policy. This paper analyses the pesticide consumption pattern in India and its different states to understand the pattern and trends of their consumption.

Pesticide Economy in India

The increasing demand for agricultural products and the resultant commercialization of agriculture have induced a rising use of agricultural chemicals in India. The shift of agriculture management strategies to the mode of agribusiness laid emphasis on risk management as one of the major challenges in agriculture. Some estimates project that 35-45 per cent crop production is lost due to insects, weeds and diseases, while 35 per cent crop produces are lost during storage. India is at the fourth position in the global suppliers of agrochemicals, after USA, Japan and China.

According to a report by database *Research and Markets*, the Indian pesticides market was worth Rs 197 billion in 2018. The market is further projected to reach a value of Rs 316 billion by 2024, growing at a Compound Annual Growth Rate of 8.1 per cent during 2019-2024. As on October, 2019, a total of 292 pesticides were registered in India. The total as well as per hectare consumption of pesticides in India shows a significant increase after 2009-10. The recent increase in pesticide use is said to be because of higher use of herbicides as cost of manual weed control has risen due to increase in agricultural wages.

Total pesticide consumption is the highest in Maharashtra, followed by Uttar Pradesh, Punjab and Haryana. On the other hand, per hectare consumption of pesticides was the highest in Punjab (0.74 kg), followed by Haryana (0.62 kg) and Maharashtra (0.57 kg) during 2016-17.

As per the Standing Committee on Chemicals and Fertilizers (2013) of India, pesticide production in India during 2011-2012 stood at 68490 tonnes. The pesticides consumption in India grew by 13.17% between 2014-15 to 2017-18 according to the reports by PAN. Biopesticides accounted only 10% of the total pesticides consumed on an average. The countries used 69282 tonnes of pesticides (Chemical and Biopesticide) in 2017-18 but it reduced to 60201 tonnes in 2018-19.

The total value of annual production of pesticides in the country is about `8000 crore, out of which pesticides worth 6000 crore are consumed in the country and the rest are exported.

The pesticide market in India is expected to grow at 12-13 per cent per annum to reach \$6.8 billion (2017) of which the domestic demand growth may be at the rate of 8-9 per cent and export demand at 15-16 per cent. According to The India Pesticides Industry Analysis, the CAGR (compound annual growth rate) is 14.7 per cent making the predicted size of market at 2,29,800 million by 2018. According to the estimates of *Research on India* (a leading provider of market intelligence reports of industries), the pesticide market in India is expected to grow at a rate of 2.38 per cent (CAGR) per annum.

The Indian pesticide scenario seems to be more export-oriented, as their exports have been increasing over the years.

The major export destinations for India are: USA, UK, France, Netherlands, South Africa, Bangladesh, Malaysia and Singapore. The recent export data (2015) show that the herbicide, 'Dicamba', is the maximum exported pesticide from India to the tune of about 30,000 kg with the value of US\$6,51,578, followed by 'Cypermethrin' formulations with 19,000 litres.

(Source: <http://www.infodriveindia.com/indiaexport-data/pesticide-export-data.aspx>).

Among the pest control chemicals, insecticides dominate the industry with 65 per cent of consumption, followed by herbicides (16%), fungicides (15%) and others (4%). This pattern is different from global pattern where herbicides form the major share (44%), followed by fungicides (27%), insecticides (22%) and others (7%). The herbicide sector in India is the one that has shown the fastest growth, mainly due to the rising farm wages, thus making manual weed control costly (Devi, 2011).

Cotton and paddy are the major crops where pesticides consumption is 50 per cent and 18 per cent, respectively. Cotton covers only 5 per cent of the cropped area, but accounts for 50 per cent of pesticide use. Rice, which is grown over 24 per cent of the cropped area, consumes 18 per cent of the pesticides. Fruits and vegetables account for a significant share of agrochemicals, while they account for 18 per cent of cropped area. Sugarcane uses 2 per cent of the pesticides and other crops grown over 6 per cent of the cropped area account for 1 per cent pesticides only. (Source: agropages.com).

Trend in consumption of pesticides (technical grade) in India



Table 1 : State-wise consumption of pesticides (technical grade)

States/UTs	Total pesticide consumption (tonnes)			Per ha (kg) pesticide consumption 2016-17*
	2003-04	2008-09	2015-16	
Punjab	6780	5760	5743	0.74
Haryana	4730	4288	NR	0.62
Maharashtra	3385	2400	11665	0.57
Kerala	326	273	1123	0.41
Uttar Pradesh	6710	8968	10457	0.39
Tamil Nadu	1434	2317	2096	0.33
West Bengal	3900	4100	3712	0.27
Chhattisgarh	332	270	1625	0.26
Andhra Pradesh	2034	1381	2713	0.24
Odisha	682	1156	723	0.15
Gujarat	4000	2650	1980	0.13
Bihar	860	915	831	0.11
Karnataka	1692	1675	1434	0.10
Rajasthan	2303	3333	2475	0.05
Madhya Pradesh	62	663	732	0.03
All India	41020	43860	54121	0.29

Source: Ministry of Chemicals and Fertilizers, Govt. of India, ICAR-NIAP. Note: NR refers to not reported; *GCA based on 2014-15

Table 2 : Year-wise chemical pesticide consumption in India

Year	2014-15	2015-16	2016-17	2017-18	2018-19 (Provisional)
Grand total of chemical pesticide consumption in India (Unit: Quantity in MT Tech. Grade)	56121	58221	52755	62183	53453

Source: Government of India, Ministry of Agriculture & Farmers Welfare, Department of Agriculture, Cooperation & Farmers Welfare, Directorate Of Plant Protection, Quarantine & Storage

Trends in Pesticide use in India

The demand and availability position of different pesticides is reviewed regularly during the Zonal Conferences on inputs for kharif and rabi with the state representatives of the Departments of Agriculture. The data from Government of India show that the consumption of chemical pesticides (in terms of technical grade) has declined from 72,130 tonnes in 1991-92 to 53,453 tonnes in 2018-19. The consumption of pesticides shows wide fluctuations over the years, which may be due to its relation with weather parameters and availability in the market. During extreme years of drought, like in early-2000s, the consumption tends to move downwards. The intensity of use (consumption per hectare of gross cropped area) has also exhibited a similar trend. Table-2 depicts a general downward trend in pesticide consumption, except in the past few years, which exhibit a rising trend. This trend, however, does not match with the organic farming policy, in general.

Pesticide Consumption and Distribution Pattern

There is a wide regional variation in the use of pesticides across the states in India. Table 1 details the state-wise consumption of chemical pesticides in India in 2003-04 to 2016-17. Uttar Pradesh, Maharashtra, West Bengal, Rajasthan, Punjab and Haryana are the states that account for 70 per cent of total pesticide consumption in India. Twelve states consume more than 1000 tonnes each, annually. Maharashtra is the leading consumer with 11665 tonnes. Sikkim, Mizoram, Goa, Meghalaya, Nagaland, Manipur and Arunachal Pradesh are relatively the poor consumers of pesticides (less than 100 tonnes each). Rest of the states (Madhya Pradesh, Chattisgarh, Jharkhand, Bihar, Uttarakhand, Himachal Pradesh, Assam and Odisha) can be included in the medium users group where the pesticide consumption is between 100 and 1000 tonnes.

However, this comparison is meaningful only when it is made at unit area consumption level. This was estimated by dividing the pesticide consumption by gross cropped area in the respective states for a selected year (intensity of use).

The state of Punjab tops in the intensity of pesticides application with an average level of 0.74 kg/ha, followed by Haryana (0.62 kg/ha). Most of the North East states (Sikkim, Assam, Nagaland, Arunachal Pradesh, Manipur), Rajasthan and Madhya Pradesh apply pesticides at less.

The general policy towards organic production can be facilitated only if the pesticide sales are regulated and organic alternatives are popularized. However, these trends do not reflect the type of pesticide material that is consumed and hence, we cannot conclude that these trends are against the objectives of green growth strategies. This, analysis, however underlines the need for more detailed analysis with focus on pesticide formulations that are used (i.e. ecofriendly

or not/ new generation chemicals which are more toxic and persistent but more effective and need to be applied in lesser quantities). The analysis also indicates the need for focused policy interventions in states where the use pattern exhibits positive trends, if the chemicals are of negative ecosystem impacts.

Conclusions

The policy towards use of chemical pesticides during green revolution era has been promotive in nature. The policy support in favour of HYVs naturally Indira Devi et al. : Pesticide Consumption in India: A Spatiotemporal Analysis 171 necessitated the application of chemical pesticides. Later on, these chemicals were used in a highly unscientific way, starting from the choice of chemical to the application practices, timing and even necessity (Devi, 2009). The pesticide application has often been adopted as a risk avoidance strategy, where the chances of pest incidence/critical pest population are often wrongly perceived to be on the higher side.

Taking into consideration the health and environmental effects of chemical pesticides, it is clear that the need for a new concept in agriculture is urgent. This new concept must be based on a drastic reduction in the application of chemical pesticides, and can result in health, environmental, and economic benefits.

We believe in developing pesticide-free zones by implementing a total ban at local level and in urban green spaces is easily achievable. Furthermore, alternative procedures to the current model of food production should be implemented in new agricultural policies targeting sustainable development and protection of the consumers' health. Despite the difficulties of establishing an innovative concept, the transition to a new cleaner and safer agricultural model is necessary.

The analysis has pointed out to the need for a detailed look on the pesticide-use pattern, distribution systems and regulatory mechanism at a micro level. The attainment of green growth strategies and sustainable development goals necessitates the adoption of safe production practices in agriculture. This can be ensured through scientific management of supply chain systems.

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