

Pesticide Use in Indian Agriculture: Trends, Market Structure and Policy Issues

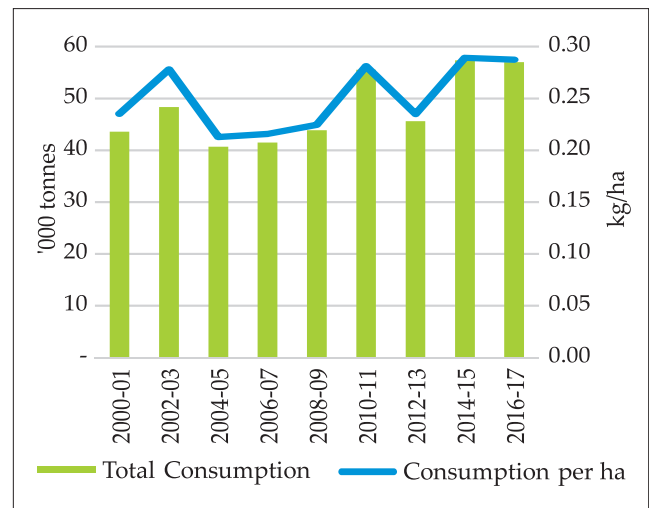
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Chemical control of pests is a common practice in agriculture. There are more than a thousand pesticides of both chemical and biological nature used around the world to minimize crop losses. Agriculture in developing countries suffers most because of high incidence of various pests. In India, estimated annual production losses due to pests are as high as US\$ 42.66 million (Sushil, 2016). Although chemical pesticides are well known for their effectiveness, their impact on soil and environment, and presence of residue in food products are matters of concern. Other issues relate to structure of pesticide industry and the regulations for registration and quality assessment. This brief discusses these issues in the context of Indian pesticide industry.

Pesticide Use in Agriculture

Insecticides, fungicides and herbicides are commonly used for pest control in agriculture. However, insecticides form the highest share in total pesticide use in India. Both total as well as per hectare consumption of pesticides in India show significant increase after the year 2009-10 (Fig. 1). In the year 2014-15, pesticide consumption was 0.29 kg/ha (GCA), which is roughly 50 per cent higher than the use in 2009-10. The recent increase in pesticide use is because of higher use of herbicides as cost of manual weed control has risen due to increase in agricultural wages (FICCI, 2015). However, per hectare use of pesticide in India is much lower as compared to other countries like China (13.06 kg/ha), Japan (11.85 kg/ha), Brazil

Fig. 1 : Trend in consumption of pesticides (technical grade) in India



Source: Based on data from Ministry of Chemicals and Fertilizers.

(4.57 kg/ha) and other Latin American countries (FAOSTAT, 2017).

Pesticide consumption is the highest in Maharashtra, followed by Uttar Pradesh, Punjab and Haryana (Table 1). During the last decade, the total consumption increased in Maharashtra and Uttar Pradesh, while it slightly declined in Punjab and Haryana. States like West Bengal, Gujarat and Karnataka have seen a steep decline in the total consumption. On the other hand, Chhattisgarh and Kerala showed a steep increase in total pesticide consumption. 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 the year 2016-17, while the consumption levels were lower in Bihar, Rajasthan, Karnataka and Madhya Pradesh (Table 1).

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

States/UTs	Total consumption (tonnes)			Per ha (kg)
	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

Note: NR refers to not reported; *GCA based on 2014-15.

Source: Ministry of Chemicals and Fertilizers, Govt. of India.

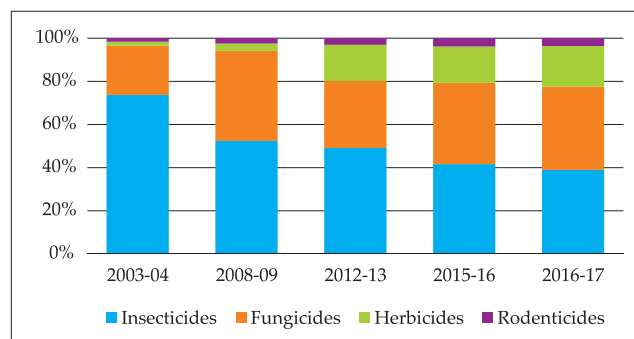
The share of pesticides in the cost of cultivation was 3 per cent in cotton, 1.9 per cent in paddy, further lower in wheat (0.7%) and sugarcane (0.3%). Agricultural Input Survey data show that in 2011-12, per cent area treated with pesticides was the highest in cotton (66.70%) followed by arhar (64.74%), jute (53.27%) and paddy (48.62%) and low in maize (25.01%). Over the period 1991-92 to 2011-12, there has been a substantial increase in the proportion of area treated with pesticides across all crops, except cotton and jute. Such decline in the proportion of area treated with pesticides in case of cotton is due to introduction of Bt seed. However, during 1991-92 to 2011-12, difference between the proportion of area treated with pesticides under irrigated and un-irrigated conditions has narrowed down primarily because of use of hybrids in rainfed areas which require effective pest management.

The Production Scenario

Pesticide production in India is dominated by insecticides and fungicides followed by herbicides and rodenticides (Fig. 2). However, the share of insecticides has come down from more than 70 per cent in 2003-04 to 39 per cent in 2016-17. The shares of fungicides, herbicides and rodenticides

are growing over the period. The growth in the use of fungicides is high mainly because of their application in fruit and vegetable crops. Major pesticides produced in India are Mancozeb, 2-4-D, Acephate and Profenofos.

Fig. 2 : Share of pesticide groups in total pesticide production (technical grade)



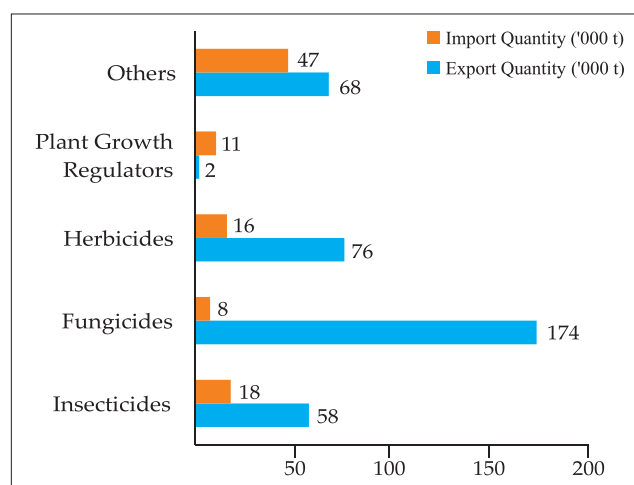
Source: Ministry of Chemicals and Fertilizers.

The share of extremely and highly hazardous pesticides (WHO classification) in the total production has been decreasing over the last decade. In 2016-17, the share of extremely hazardous pesticides (WHO Ia) was 6.62 per cent, highly hazardous (WHO Ib) 4.81 per cent, and moderately hazardous (WHO Class II) 38.26 per cent. The share of slightly hazardous (WHO Class III) and unlikely to present acute hazard (WHO Class U) was 6.79 per cent and 39.36 per cent, respectively.

Trade in Agro-chemicals

Total export of agro-chemicals in 2016-17 stood at 377.76 thousand tonnes, with the share of fungicides being the largest in terms of export quantity (45.94%) (Fig. 3) and herbicides accounting

Fig. 3 : Export and import of major agro-chemicals by India, 2016-17



Source: DGCI&S, Ministry of Commerce and Industry.

for the largest share in terms of value of exports (28.19%). As per data provided by Central Board of Excise and Customs (CBEC) for the year 2016-17, top five pesticides exported from India were Mancozeb, Cypermethrin, Sulphur, Acephate and Chlorpyrifos, while the major products imported were Glyphosate and Atrazine. The trade data need careful interpretation as both formulations and technical grade pesticides are traded by different firms. However, Indian firms mostly import technical grades, or formulations which are protected through patents, and the exports are mostly of formulations.

Brazil, USA and France are the major destinations for export of agro-chemicals from India (Table 2), while China and Germany are major exporters of agro-chemicals to India. Insights from CBEC data show that chemical pesticides of technical grade are mainly imported from China and Germany. Glyphosate and Atrazine are the major pesticides imported (by quantity) mainly from China. In case of Glyphosate, domestic manufactures import technical grade and manufacture formulations which are sold in domestic markets. Glyphosate is also exported to Latin American and African countries by large companies. Atrazine is imported by many firms (domestic and multinational), which is mostly converted into formulations for domestic markets. Acephate is a major pesticide exported to Brazil and one large company exports about 80 per cent of the total quantity. Another large company exports roughly 75 per cent of total quantity of Macozeb to various African and Latin American countries.

Table 2 : Major export and import destinations for agro-chemicals in 2016-17 (tonnes)

	Country	Insecticides	Fungicides	Herbicides
Export	Brazil	9437.61	42898.27	20457.02
	U S A	3275.35	8307.82	6095.06
	France	Nil	7954.77	Nil
Import	China	11095.18	2220.28	15243.93
	Germany	1065.93	1523.81	Nil
	Japan	Nil	Nil	2428.02
	Israel	Nil	Nil	4732.66

Source: DGCI&S, Ministry of Commerce and Industry, Govt. of India.

Market Structure of Pesticides

The pesticide industry is considered to be highly competitive, as there are many products and their producers in the market. The Annual Survey of Industries data show that the industry comprises around 600 companies, of which more than 60 per cent are involved in producing

insecticides, fungicides and herbicides. The 4-company concentration ratio in 2014-15 was 19 per cent, showing that top-4 companies produce one-fifth of total output of the industry. The 8-company concentration ratio was 29 per cent. Subsidies form a meager part in this industry. The total production subsidy received during the year 2014-15 amounts to Rs. 12 crores, which is only 0.03 per cent of total output produced (MoSPI, 2017). Although the market structure is quite competitive, it is somehow not reflected in domestic prices which have risen significantly during the last five years. The highest increase in domestic prices was of profenofos (63%) followed by DDVP (58%) and Chlorpyrifos (51%) during 2010-11 to 2015-16.

Registration and Quality Control

The Insecticides Act (1968) and Insecticides Rules (1971) regulate import, registration, production, sale, transport, distribution and use of pesticides with a view to prevent risk to human beings or animals. All pesticides have to necessarily undergo the registration process with the Central Insecticides Board and the Registration Committee (CIB&RC) before production or sale. For manufacturing or import, applicant submits data on various aspects, including chemical composition, toxicity, bioefficacy, etc. to CIB&RC. On some aspects (particularly bioefficacy of pesticides) published, authentic report of R&D organizations is also considered as a valid data source. The Committee after ensuring the validity of application provides a registration number and certificate. As on June 2017, total 279 products (265 chemicals and 14 bio-pesticides) and 658 formulations including combinations are registered with CIB&RC.

There are regulations and procedures for testing pesticides at different stages. The Central Insecticide Laboratory (CIL) is mandated to test the referral samples submitted by any officer or agency of the Central or State Government, while State Pesticide Testing Laboratories (SPTL) mainly test the samples taken at the manufacturing and point-of-sale for quality control. Results of STPLs indicate that around 2.5 to 3 per cent of samples tested were misbranded (not as per the label) during 2008-09 to 2012-13. In total, 28 pesticides and four formulations are banned for manufacturing, import and use, eight pesticides are withdrawn and 13 pesticides are restricted for use in the country. Recently, on the advice of an expert committee, 12 pesticides are completely banned from January 2018 and another six from December 2020 (DAC&FW, 2016).

Environmental Issues

Major challenges faced by the industry are stringent environmental regulations across the world, low focus on R&D by domestic manufacturers due to high costs, need for innovation and product diversification, lack of awareness about safe use of pesticides among farmers, long gestation period for new products and product quality assurance (FICCI, 2015). While the farmers need to be protected for sub-standard products, programs for safe use of pesticides and reduction of potential health and environmental impacts should be undertaken. Possibility of sub-standard products cannot be ruled out and therefore, enforcement of point-of-sale quality inspection and protection of farmers with consumer forums deserve emphasis.

Bio-pesticides have the potential to control crop losses and reduce negative environmental externalities. Bio-pesticides constitute around 3 per cent of pesticide market in the country. So far 14 bio-pesticides have been registered under the Insecticide Act 1968 in India. Consumption of biopesticides has increased from 219 tonnes in 1996-97 to 683 tonnes in 2000-01, and further to around 3000 tonnes in 2015-16 (Sinha and Biswas, 2008; DAC&FW, 2017). Studies indicate that use of bio-pesticides in integrated pest management can reduce pesticide use by 66 per cent in cotton and by 45 per cent in cabbage (Birthal, 2003). Thus, bio-pesticides can play an important role in shifting the focus from chemical pesticides to reliable, sustainable and environment friendly options. But the pace of development of market for bio-pesticides is not so impressive. Storage of bio-pesticides requires special facilities and skills, which should be developed at all levels in the supply chain. Also, if necessary, fiscal incentives may be provided for production and use of bio-control agents.

Conclusions

There are some issues which need immediate attention to strengthen domestic pesticide industry and safe application of pesticides. Firstly, it is important to regulate and encourage the use of cost-effective and environmentally safe pesticides. The uniformity in testing procedures (parameters, labs, actors, etc.) and deregistration of outdated, hazardous pesticides are necessary for avoiding

the adverse impacts. The point-of-sale quality assurance and farmers protection mechanisms in case of spurious products must be strengthened. The industry association can also be involved in this task. The second important consideration is the promotion of safe application practices and awareness among farmers. The third issue relates to assessment of potential effects of strengthened patent regime on pesticide industry, particularly its likely effect on product prices. In such a situation, competition promoting policies should be adopted. Lastly, there are certain gaps in data on pesticide production and use. In particular, data on use of bio-control agents are scanty. For chemical pesticides, the production, consumption and trade data from different sources are difficult to reconcile, which must be addressed.

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