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Pesticide Delivery System in Apple Growing Belt of Kashmir Valley[$]

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Abstract

This study has looked into the existing pesticide delivery system in the apple growing region of Kashmir valley. Marketing system of pesticides in the valley is largely unregulated, characterized by the existence of a network of pesticide companies, viz., multinationals (MNCs) and nationals (NCs), authorized distributors/dealers, unlicensed traders and rampant availability of sub-standard/spurious pesticides. The value of all pesticides consumed in the state has been estimated at ₹ 361 million, of which 52.3 per cent is of NCs and 33.6 per cent is of MNCs and rest being of other companies. Of the total pesticides used in the state, 86 per cent are applied on apple. There are multiple channels of pesticide delivery in the valley. However, this study has discussed marketing channels of important fungicides, insecticides and acaricides. It has been observed that farmers pay a higher price for pesticides became of the presence of a number of intermediaries in the channel. The marketing efficiency has been relatively low in the channel where farmers purchase pesticides from the traders. The results have further revealed that farmers apply pesticides indiscriminately in violation of the scientific recommendations. About one-third of the pesticides available in the market are reported to be either sub-standard or spurious. The existence of unlicensed dealers/ traders has further accentuated the magnitude of malpractices in the pesticide delivery system. Based on findings, the study has emphasized upon an effective regulation of pesticide trade through strict legislations so as to prevent marketing of spurious/sub-standard agro-chemicals.

Key words: Pesticides, delivery system, spurious/sub-standard pesticides, apple, Kashmir valley, marketing channels

JEL Classification: Q13, Q16

Introduction

During the past two decades, there has been a substantial increase in the use of pesticides in terms both of volume and value. The demand for agro-chemicals depends upon the type of crops grown, farmers' knowledge about technologies and their profitability and also upon the availability, affordability and ease in accessing the input and output markets. Among different crops grown in Jammu & Kashmir, apple cultivation is highly capital-intensive with pest control alone accounting for more than 54 per cent of variable costs. The steady increase in apple productivity in the valley during the past three decades was, by and large, achieved by increasing the use of fertilizers and pesticides. In the apple-growing belt of the valley, chemicals are being used indiscriminately without considering scientific recommendations. The choice of chemicals/brand preferences are steered by traders and market functionaries. The judicious application of

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pesticides in apple should, therefore, be the concern of all stakeholder in view of their lower productivity in India compared to that in countries like Switzerland, Israel, France and Belgium. The excessive/ indiscriminate use of pesticides not only increases the cost of apple cultivation but also results in many human health problems and environmental contaminations. These problems get accentuated with the use of spurious chemicals and the existence of a chain of functionaries/unlicensed dealers between firms and farmers. In this backdrop, this paper has investigated the delivery system of pesticides in the apple-growing belt of Kashmir valley.

Data and Methodology

The study has used both secondary and primary data. The secondary data were obtained from various published/unpublished records of the Directorate of Horticulture/Agriculture, Government of Jammu & Kashmir, and the primary data on various aspects of supply system of pesticides were obtained from 200 farmers selected by using multi-stage stratified sampling from two major apple-growing districts, Shopian and Baramulla in the Kashmir valley. Besides farmers, office bearers of 20 pesticide companies, 15 distributors, 7 sub-distributors, 15 dealers/sub-dealers, 10 traders-cum-market functionaries (contractors) and 10 retailers were also selected for eliciting information. Although it was intended to collect information on marketing of most of the pesticides, in this paper only those marketing channels and pesticides have been discussed regarding which complete information could be obtained. The paper has included the five channels given in Box 1 for discussion.

Since the efficiency of input marketing channels emphasizes upon the lower prices of pesticide supplies, an attempt was made to estimate the marketing efficiency (ME) of different channels by employing Equation (1):

$$ME = \frac{1}{PC / PF} \qquad \ldots(1)$$

where,

ME = Efficiency of input marketing channel,

PC = Price received by the company, and

PF = Price paid by the farmers for pesticide.

A higher value of ME means more efficiency of marketing channel and vice versa.

Results and Discussion

Growth of Apple and Pesticide Application

The state owing to its specific advantage has made commendable progress in area expansion under fruits and their productivity (Baba, *et al*., 2012). In the past 37 years, area under apple has increased three-fold, from 0.47 lakh ha to 1.42 lakh ha and its production has increased five-fold to reach 18.52 lakh tonnes in 2010-11. Since 1970s, the growth of apple sector has shown three distinct trends. Area, production and productivity of apple grew at a significantly higher rate during 1975-86 (period I), but slackened during 1987-98 (period II). In the recent decade (1999-2010), although apple area and production have resumed the growing trend, the productivity growth has been quite low (Table 1). The decomposition analysis has revealed a contribution of 16.98 per cent of productivity to apple production since early-1970s (Baba *et al*., 2010). Price incentives, mainly because of rising demand for apple, especially among the high- income groups and strong market linkages have prompted farmers to shift more area towards this crop. Although this shift was

Box 1

Channel I	:	Company →	Distributor →	Sub-distributor →	Dealer →	Sub-dealer →	Retailer →	Farmer
Channel II	:	Company →	Distributor →	Sub-distributor →	Dealer →	Trader →	Farmer	
Channel III	:	Company →	Distributor →	Dealer →	Sub-dealer →	Farmer		
Channel IV	:	Company →	Distributor →	Dealer →	Farmer			
Channel V	:	Company →	Distributor →	Trader →	Farmer			

Table 1. Compound growth rates in area, production and yield levels of apple in J&K: 1975-2010

(Per cent)

Period	Area	Production	Yield
Period I (1975-86)	3.25*	7.57*	4.32*
	(0.28)	(0.94)	(0.99)
Period II (1987-98)	2.15*	4.09*	1.94
	(0.17)	(0.95)	(1.01)
Period III (1999-2010)	4.95*	6.17*	1.21
	(0.17)	(0.71)	(0.72)

Note: Figures within parentheses indicate standard errors
*Denotes significance at 0.05 or better probability levels

supported with the supply side factors like availability of planting material, the evidence of continuous expansion of apple area in future will require an efficient input delivery system, especially for pesticides.

Cultivation of apple is a cost-intensive venture and therefore resource-poor farmers cannot manage a large area under this crop. Despite it, a major proportion of total area cropped (62.15%) was allocated to apple cultivation in parts of Baramulla and Shopian districts (Field Survey, 2009; 2010). The cost of variable inputs for managing one kanal of an average-age bearing orchard was estimated at approx. ₹ 5000; in which the cost on pesticides accounted for around 54 per cent. Farmers use pesticides frequently and spray their crop more than eight-times.

Existing Pesticide Delivery System

Pesticide Marketing Companies

The pesticide delivery system in the state is quite complex due to the presence of a number of multinational companies (MNCs), national companies (NCs) and market functionaries like distributors, sub-distributors, dealers and unlicensed traders. There is an extensive network of pesticide companies and their authorized functionaries that popularize and sell agro-chemicals in the rural areas. In the state, there are 22 big pesticide marketing companies – 7 multinational (MNCs) and 15 national/generic companies (NCs). Each of these companies has authorized distributors/ dealers that facilitate promotion/sale of pesticides through a network of unorganized market functionaries. Besides, several unlicensed dealers and retailers who are not completely aware about the toxicity of pesticides, also sell pesticides primarily to earn big margins. The unorganized system of pesticide trade in the state is expected to result in unstable prices, availability of sub-standard/spurious chemicals and distress sale of farmers' produce. This scenario necessitates the analysis of entire pesticide delivery system is Jammu and Kashmir.

Market Share of Different Companies

In 2009, the total sale of pesticides by weight was 1828.5 thousand kg or litres. The shares of companies by status indicated that MNCs and NCs accounted for 22.3 per cent and 60.7 per cent of the total sale of pesticides, respectively. Pesticide market in the state (in terms of value) was estimated at ₹ 369.1 million (Table 2). The calculated shares of the MNCs and NCs in value terms of pesticides were 33.6 per cent and 52.3 per cent, respectively. Difference between the shares of MNCs in terms of weight and value was due to higher prices of their products as compared to prices offered by the local companies. The entry of a number of local companies in the pesticide market is expected to increase the share of national companies. Among different MNCs operating in the pesticide market in the state, Bayer and Syngenta enjoy a higher share. Among NCs, Fungicide India Ltd (FIL) and Rallis have major shares in both quantity and value of pesticides marketed. A good number of other small companies also market pesticides, accounting for over 17 per cent of the total pesticides sold in the state. The product profile has a bearing on the share of different companies in the pesticide market.

Table 2. Share of different companies in pesticide market of J&K

(Quantity in '000 kg/L, value in million ₹)

Companies	Quantity	%	Value	%
MNCs	407.3	22.3	123.9	33.6
NCs	1110.1	60.7	192.9	52.3
Others*	311.1	17.0	52.3	14.2
All	1828.5	100.0	369.1	100.0

Note: *Includes Devidayal pesticides, Vivid pesticide, Vivek pesticides, UP Agro-chemicals, Pulvalizing Mills, Willowood, Somotome, Insecticide India Ltd, Krishi Rasayan, etc.

Market Share of Different Pesticides

The total sale of pesticides by weight (1828.5 thousand kg/L) in 2009 was comprised of major agro-chemicals like 14 fungicides, 6 insecticides, 6 weedicides, 3 plant growth regulators and 1 acaricide and their sale in value terms is summarized in Table 3. Fungicides accounted for the highest (71.1%) sale of total pesticide in the state, followed by insecticides (15.4%) and acaricides (7.7%). The plant growth regulators and weedicides constituted only 3.6 per cent and 2.3 per cent of total pesticide market, respectively. The highest selling pesticide by value was Mancozeb (23.2%), followed by Captan (13.3%), and Fenzaquin (7.0%). Weedicides like Paraquat, Butachlor and 2, 4-D together constituted only 0.3 per cent of total pesticides sale in the state.

It is obvious that few pesticides are more costly than others, depending upon the pesticide chemistry and value of active ingredients. Although several fungicides/insecticides/acaricides are available in the market, they are often suspected for their being spurious. Chemicals like Carbendazim or Endosulfan which are not recommended by the agricultural research institutions or have been banned, are also available in the market. Some pesticides are available in the market with different trade names captioned by the manufacturing companies. Figures documented in Table 3 indicated that the pesticides applied on apple constituted about 83 per cent of total value of agro-chemicals utilized in the state.

Density of Licensed Pesticide Dealers

The total number of licensed pesticide dealers in Kashmir valley is 559, of which 121 are in Baramulla district, 91 in Anantnag, 87 in Kulgam and 79 in Pulwama (Table 4). On an average, 1.9 licensed traders were available for supplying pesticides to farmers per ten villages. The density of licensed traders was relatively more in Kulgam, followed by Shopian and Anantnag. Contrary to this, the dealer density was lower in Budgam and Ganderbal districts.

Channels of Pesticide Sale

The companies sell major portion of their produce (68%) through distributors to ultimate farmers. About 11 per cent chemicals are sold to institutions for direct consumption while another 16 per cent are sold to co-companies existing in the markets which in turn manipulate products to qualify their own standards and

Table 3. Market share of different pesticides in J & K

(Value in million ₹)

Agro-chemical	All crops		Apple (% of all crops)
	Value	%	
Fungicides	**262.4**	**71.1**	**89.2**
Bitertanol	13.3	3.6	100.0
Captan	49.0	13.3	78.8
Carbendazim	19.3	5.2	77.1
Copper oxide	6.0	1.6	75.0
Copper oxicholoride	11.3	3.1	60.0
Difenconazole	16.3	4.4	100.0
Dodine	22.5	6.1	100.0
Fenarimol	0.9	0.3	80.0
Flusilazole	1.3	0.4	100.0
Hexaconazole	15.2	4.1	100.0
Mancozeb	85.5	23.2	93.2
Propineb	12.2	3.3	100.0
Streptocycline	3.8	1.0	100.0
Ziram	3.2	0.9	100.0
Others (Metalaxyl, Triadimefon, Sulphur, etc.)	2.4	0.7	38.8
Insecticides	**56.9**	**15.4**	**62.3**
Chloropyriphos	20.1	5.5	78.6
Dichlorvos	12.9	3.5	0.0
Endosulfan	9.5	2.6	93.0
Ethion	6.0	1.6	86.8
Phorate	5.2	1.4	79.0
Quinalphos	1.5	0.4	99.8
Others (Monocrotophos, Dimethoate, Carbofuron, etc.)	1.8	0.5	0.0
Acaricides	**28.2**	**7.7**	**93.3**
Fenzaquin	25.9	7.0	100.0
Others (Milbemectin, Clodinafop, etc.)	2.3	0.6	18.0
Weedicides	**8.5**	**2.3**	**8.0**
2, 4-D	0.2	0.1	0.0
Butachlor	0.3	0.1	0.0
Glyphosate	1.2	0.3	21.7
Isoproturon	1.5	0.4	29.5
Metribuzin	5.0	1.4	0.0
Paraquat	0.4	0.1	0.0
Plant growth regulators	**13.2**	**3.6**	**73.8**
Alpha-nepthalic acetic acid	3.5	0.9	0.0
Ethofenprox	4.7	1.3	100.0
Sea weed extracts	5.0	1.4	100.0
All agro-chemicals	369.1	100.0	82.95

Table 4. Number and density of licensed pesticide dealers

District	Licensed dealers (No.)	Villages covered (No.)	Licensed traders per 10 village(No.)	Licensed dealers per '0000 ha of GCA
Pulwama	79	381	2.1	14
Shopian	74	231	3.2	29
Bandipora	24	123	2.0	10
Baramulla	121	485	2.5	18
Anantnag	91	326	2.8	12
Kulgam	87	274	3.2	23
Kupwara	29	442	0.7	6
Srinagar	26	117	2.2	39
Ganderbal	6	104	0.6	3
Budagm	22	515	0.4	4
Kashmir valley	559	2998	1.9	14

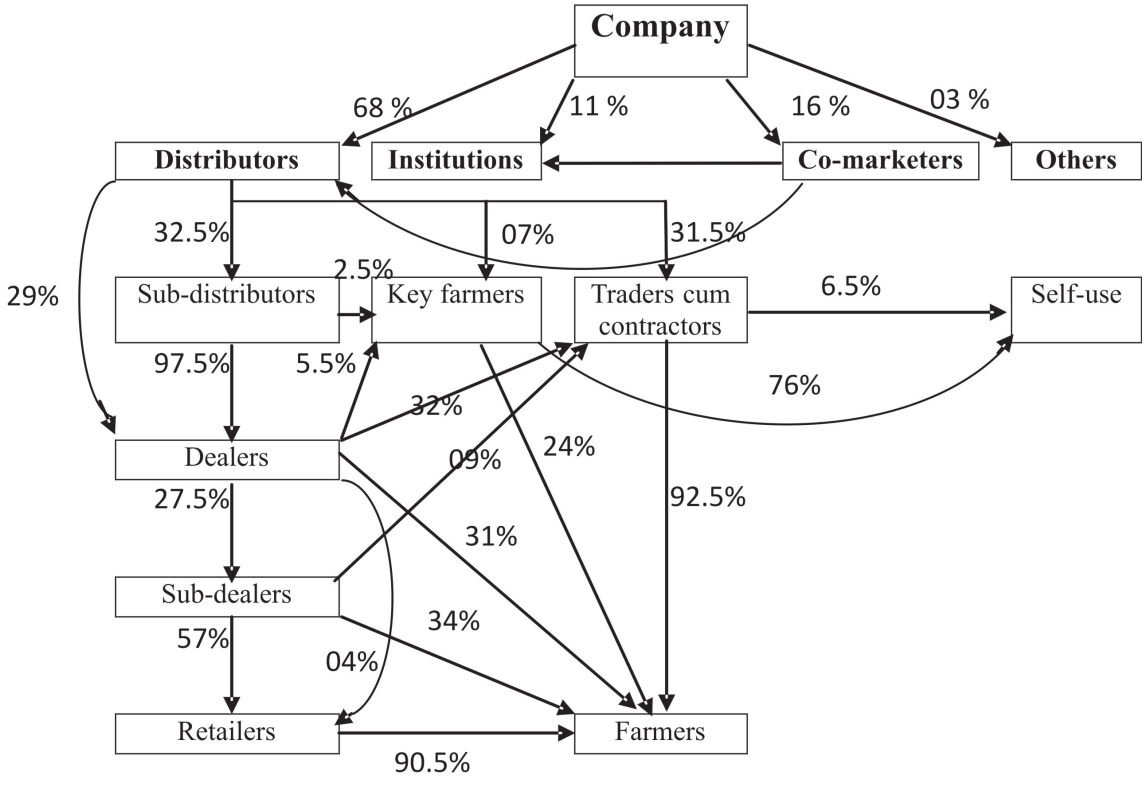

Figure 1. Existing pesticides delivery system in Kashmir valley

deal with distributors and institutions (Figure 1). After distributors agro-chemicals undergo a number of ownerships before reaching the ultimate consumers; leaving a wide room for malpractices and adulteration. Distributors push forward their pesticide supplies through four market functionaries, viz., sub-distributors, dealers, traders-cum-contractors and key farmers. About 34 per cent of the total supply is forwarded through sub-distributors, followed by 31 per cent through trader-cum-contractor and 29 per cent to dealers directly, while 7 per cent is sold to key farmers. Sub-distributors exclusively dispose off their produce through dealers (97.5%) and only 5.5 per cent is sold to the key farmers. Similarly, dealers, sub-dealers and retailers sell their produce through different functionaries.

Price Spread and Marketing Efficiency

The price spread in various marketing channels of selected pesticides has been detailed in Table 5. In Channel-I, farmers purchase pesticides through retailers or local dealers. Companies incur all the expenses to make the pesticides ready for sale in the market. In this channel, companies dispose off their produce through their authorized distributors. The price received by the company varies from 68.7 to 79.6 per cent of farmers' price in the case of fungicides and acaricides, respectively. The marketing efficiency in this channel was highest for acaricide (0.796), followed by fungicides (0.687), and insecticides (0.676).

In Channel-II, trader-cum-contactor exists as one of the intermediaries between company and farmers (Table 5). Here, the dealer sells the produce to the contractor and gets a higher price for pesticides than it can earn by sale to sub-dealers or retailers. Among all the functionaries of in this channel, contractor could grab a big profit, ranging from 10.4 to 18.2 per cent of farmers' price. Traders have tied up arrangements with the dealers and pay him a little more price than he could earn in other channels. Due to bulk buying and selling of pesticides, trader-cum-contractor earns market economies of scale. He deals with the packed produce and bears little spoilage costs. Even after spending on spoilage, loading/unloading, etc., a dealer is able to retain a sufficient margin due to the fact that he deals in huge quantities of pesticides. In this channel, farmers pay a relatively more price for pesticides compared to channels in which they purchase from other functionaries. The marketing efficiency of all pesticides in this channel was lower than in Channel-I.

In Channel-III, there is a narrow spread of prices between consumers and company due to the non-existence of sub-distributors. In this channel, company could receive 79.3 per cent of farmers' price in the sale of acaricides, followed by fungicides (73.7%). In this channel, sub-dealer sells pesticides directly to the farmers at a lower price than they could purchase through Channels-I and -II, owing to the absence of retailers between sub-dealer and farmers. Sub-dealer earns higher margins in this channel than in Channel-I. The efficiency of this marketing channel ranged from 0.678 to 0.793 in insecticides and acaricides, respectively which is better than in Channels-I and II.

In Channel-IV, distributors and dealers incur all the expenses and take the pesticides to the farmers (Table 5). Since the pesticides undergo only a few transfers, farmers pay relatively lower prices. In this channel, distributors and dealers also realize fairly good margins. This channel is highly efficient vis-à-vis other channels of pesticide marketing. The estimated marketing efficiency ranged between 0.744 in the sale of insecticides and 0.826 in acaricides while the efficiency of fungicides sale was 0.761.

In Channel-V, distributor prefers selling pesticide received from the company through trader-cum-contractor with expectation of more prices from them (Table 5). Since there are only two functionaries in this channel, the cost/margins are much less. Traders lie between distributor and farmers and accordingly farmers purchase pesticides at higher prices. The marketing efficiency of different pesticides sold through this channel is even lower than in Channel-I.

Exploitative Role of Traders/Dealers

a) Mis-guidance of Traders/Dealers and Poor Adoption of Scientific Pesticide Packages

The farmers in the study area are guided by trader-cum-contractors or unlicensed dealers and their choice/brand preference of chemicals is steered by these players. Even farmers formulate and apply pesticides as directed by these dealers. Accordingly, the scientific pesticide spray schedule released by SKUAST-K in collaboration with line departments has depicted poor adoption in the field. Farmers use agro-chemicals indiscriminately without consideration of age of orchards, number of sprays, and compatibility of chemicals. It was observed that all the dormant spray oils are being sprayed at more than recommended levels and showed a technological gap of about 70 per cent. At farmers' level, fungicides and insecticides/acaricides were being applied 20 per cent and 48 per cent more than recommendations, respectively (Table 6).

The sale of unlabelled and spurious pesticides was highly prevalent in the apple-growing regions, especially in the Baramulla and Shopian districts. Moreover, the use of banned chemicals (like Endosulphan) and pesticides not present in spray schedule (like Carbendazim) was also prevalent in the study area. Another problem was the use of incompatible combination of fungicides and insecticides (like Captan, Ziram with Chloropyriphos and Fenzaquin) in the study area among a good

Table 5. Price spread in different channels of pesticides marketing in J&K

(Per cent of farmers' price)

Agro-chemicals	Company price	Distributor		Sub-distributor		Dealer		Sub-dealer		Retailer		Contractor		Farmers' price (₹/kg or L)	Marketing efficiency
		C	M	C	M	C	M	C	M	C	M	C	M		
Channel I															
Fungicides	68.7	0.5	5.3	0.5	2.4	0.7	3.1	1.2	2.6	3.6	11.3	-	-	1921	0.687
Insecticides	67.6	0.6	5.2	0.5	3.3	0.9	2.5	1.3	3.8	3.8	10.4	-	-	471	0.676
Acaricides	79.6	0.2	6.8	0.1	2.9	0.2	3.8	0.3	3.0	0.9	2.3	-	-	2661	0.796
Channel II															
Fungicides	64.6	0.5	5.0	0.5	2.3	0.7	4.6	-	-	-	-	3.7	18.2	2045	0.646
Insecticides	63.5	0.6	4.9	0.5	3.1	0.9	5.8	-	-	-	-	4.7	16.1	502	0.635
Acaricides	74.7	0.2	6.4	0.1	2.7	0.2	4.2	-	-	-	-	1.1	10.4	2833	0.747
Channel III															
Fungicides	73.7	0.6	7.3	-	-	0.5	7.2	0.5	10.3	-	-	-	-	1790	0.737
Insecticides	67.8	0.6	7.2	-	-	0.5	8.5	0.6	14.8	-	-	-	-	470	0.678
Acaricides	79.3	0.2	7.8	-	-	0.1	6.5	0.2	5.9	-	-	-	-	2668	0.793
Channel IV															
Fungicides	76.1	0.6	7.5	-	-	0.5	15.2	-	-	-	-	-	-	1759	0.761
Insecticides	74.4	0.7	7.9	-	-	0.2	16.8	-	-	-	-	-	-	428	0.744
Acaricides	82.5	0.2	8.2	-	-	0.1	9.0	-	-	-	-	-	-	2564	0.825
Channel V															
Fungicides	64.5	0.5	9.0	-	-	-	-	-	-	-	-	3.7	22.2	2045	0.645
Insecticides	63.5	0.6	11.3	-	-	-	-	-	-	-	-	4.7	19.9	502	0.635
Acaricides	74.7	0.2	8.8	-	-	-	-	-	-	-	-	1.1	15.2	2833	0.747

Note: C = Costs, M = Margins

Table 6. Technological gaps in pesticide application

Chemical	Gap (%)
Dormant oil	70.0
Fungicides	20.0
Insecticides/acaricides	48.0

proportion of farmers. Application of spurious/sub-standard pesticides with wrong formulations and combinations of incompatable chemicals may further prompt the ignorant farmers to go for yet higher doses of pesticides which may have a long-term negative implications for crop yield and environment.

Famers using overdose of chemicals were asked about their perception on using the current level of pesticides and as high as 84 per cent of the farmers showed concern about the availability of spurious pesticides. They used chemicals at more than recommended level because they perceived that the pesticides available in the markets have a lower efficacy (70.50%) than it actually should have by standards (Table 7). Indebtedness to traders-cum-contractors and the dependence on their technical guidance was one of the reasons behind use of pesticides at current level as highlighted by 68.5 per cent of the farmers. Scarcity of skilled labour and ignorance about chemicals were other reasons that farmers shown concern in applying current level of agro-chemicals. The farmers using over-dose of pesticides opined that higher incidence of disease/pest (41.32%) was the major reason behind the current level of pesticide-use. To sum up, farmers' perception of lower efficacy and suspected quality of pesticides had made them to use these chemicals at levels higher than the scientific recommendations.

Table 7. Reasons reported by farmers behind using current level of pesticides

Reason	Respondents (%)
Lower efficacy of chemicals	70.5
Spurious/sub-standard pesticides	83.5
Indebtedness and traders' guidance	68.5
Scarcity of skilled labour	19.5
Ignorance about chemicals	25.5
Higher incidence of diseases/pests	41.5

b) Supply of Spurious Pesticides on Credit

The traders-cum-contractors and unlicensed intermediaries are important functionaries in the pesticide delivery system. The presence of these players in pesticide marketing system in the valley has deprived farmers of real benefits. Traders advance loan to resource-poor farmers, either in cash or kind (fertilizers and pesticides) against standing crops. The farmers are being exploited by these functionaries in two ways: i) by advancing kind loan as pesticides, often suspected for their quality, at relatively higher prices, and ii) through distress sales of farmers' produce. It was observed that these contractors (unlicensed functionaries) quoted 15 per cent more price for pesticides compared to prices offered by registered retailers. Not only this on entering into contract with farmers, they quoted lower than actual yield per unit area of standing crop. It was observed that 53.5 per cent of the pesticide dealers offered pesticides on credit to farmers and it was found associated with malpractices like supply of spurious/sub-standard pesticides.

An attempt was made to arrive at some approximation about the availability of sub-standard/ spurious pesticides to the farmers. It could be seen from the Table 8 that a good proportion of pesticides available to farmers were spurious. The proportion of sub-standard/spurious chemicals varied from 12.5 to 62.2 per cent of total quantity of Triadimefon and Hexaconazole pesticides by weight purchased in the season, respectively (Table 8). As high as 91 per cent of farmers reported that over 60 per cent of Hexaconazole fungicide available in the market was substandard/spurious. Likewise, 58.8 per cent of Zineb, a fungicide, was reported to be spurious. On an average, over 34 per cent of agro-chemicals available in the market were spurious/sub-standard, as worked out on the basis of responses obtained from stakeholders including famers. The skilled labour employed in spraying of pesticides also reported that major quantity of pesticides available in the markets around apple growing belt were either sub-standard or spurious. This scenario is being further aggravated by the existence of unlicensed dealers/retailers in the markets. About 29 per cent of dealers/retailers were found not possessing registered license in the surveyed area. Even most of them were reluctant to provide information on sales and turnover which they are actually supposed to furnish under the Insecticide Act. It was seen that the multinational companies did not offer pesticides on credit to the dealers. As a result, less proportion of dealers working with the multinational companies offered pesticides on credit to the growers. Moreover, the multinational companies offered reasonable profit

Table 8. Magnitude of sub-standard/spurious pesticides in the market as reported by farmers

(Per cent)

Pesticide	Sub-standard/ spurious chemicals available in market	Farmers responded
	Fungicides	
Dodine	29.5	62.5
Myclobutanil	23.2	57.5
Bitertinol	21.1	48.5
Captan	36.7	49.5
Propineb	25.6	52.5
Hexaconazole	62.2	91.0
Difenoconazole	35.5	66.0
Flusilazole	22.5	62.5
Carbendazim	50.1	77.5
Mancozeb	21.6	48.0
Ziram	19.4	55.5
Zineb	58.8	52.5
Penconazole	32.3	67.5
Triadimefon	12.5	60.0
Fenarimol	26.7	75.0
	Insecticides	
Chlorpyrifos	51.0	81.5
Quinalphos	46.5	59.0
	Acaricides	
Fenazaquin	39.5	79.5

margins on the sale of pesticides, whereas the local companies offered very lucrative profit margins through different incentive schemes, as a result the risk of the unrecoverable amount from unfair growers was met with the hefty profits made on the recoverable amounts of credit. This scenario calls for a need to regulate pesticide markets, especially to check the supply of spurious pesticides.

Conclusions and Policy Implications

The delivery of pesticides is a complex system due to the existence of a number of functionaries between manufacturing company and user-farmers. It is compounded further by the presence of a number of analogues agro-chemicals and the existence of unlicensed functionaries in the market. The state has made a commendable progress on the front of expansion of area under apple and its productivity.

Apple production is a capital-intensive venture and the expenditure on pesticides constitutes a major portion of total cost of apple cultivation. Pesticides applied on apple together constituted about 83 per cent of all the agro-chemicals utilized in the state. The pesticide delivery system in the state is largely unorganized owing to an extensive network of pesticide companies and their authorized distributors/dealers that popularize and sell agro-chemicals in the rural areas. The total sale of pesticides by weight was 1828 thousand kg/litres that amounted to ₹ 369 million in terms of value, in which the share of the multinational and national companies was 33.6 per cent and 52.3 per cent, respectively. Fungicides alone accounted for 71.1 per cent of the total pesticide sale in the state, followed by insecticides (15.4%) and acaricides (7.7%). Mencozeb was the highest valued pesticide fetching about 86 million rupees, followed by Captan (₹49 million) and Fenzaquin (₹25.5 million). It was observed that as the number of intermediaries increases, the farmer has to pay more prices for pesticides and the company's share in it decreased. Traders-cum-contractors were reported to exploit small/marginal farms by way of supplying spurious pesticides and distress sales against credit. On an average, over 34 per cent of agro-chemicals available in the market were reported to be either sub-standard or spurious. This scenario is being further aggravated by the existence of unlicensed dealers/retailers in the markets. About 29 per cent of dealers/retailers have been found not possessing a registered license in the surveyed area. Based on these discussions, following policy options have emerged:

- There is a need for an effective regulation of pesticide trade in view of the availability of spurious/sub-standard pesticides in the market. Establishment input check posts at each production centre equipped with chemical testing facilities is needed and it should be mandatory that each imported container of pesticides should undergo registration at this check post with sample based testing.
- All pesticides need to be labelled in local/common language and should contain information regarding proper handling of these toxic chemicals. Human resource development for pesticide application is also required along with pesticide development. For issuing of a license, the government may prescribe some minimum educational qualifications including competence in the field of plant protection chemicals.
- Concrete measures are required to check the illegal imports of agro-chemicals in the state. The financial institutions should be directed to enhance credit limit without discrimination of small/ marginal farmers. The credit limit under Kisan Credit Card scheme should also be expanded.
- The cost on pesticides being a major share of total cost of apple cultivation, effective measures like dissemination of IPM modules should be adopted to prevent the disease and insect/pest incidence in apple crop.
- Companies/R&D institutions need to promote/ identify those chemicals, which are efficient and environmentally safe. Companies should also rule out the play of misguiding representatives/dealers to keep up the faith of farming community on particular brand of pesticides.

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