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Assessing Pesticide Sales Trends: An Agrovet Survey in Parasi, Rupandehi and Kapilvastu Districts of Lumbini Province

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Abstract

Study assesses practices related to the sale of pesticides and safety measures, the provision of licenses and training for pesticide retailers, and the status of the most traded pesticides in the Parasi, Rupandehi, and Kapilvastu districts. 69 agrovet respondents were selected through a simple random sampling method in the regions. Insecticides were found to be the most demanded type of pesticide (79.7%), followed by fungicides (20.3%). Among the available insecticides, the combination of Chlorpyrifos 50% + Cypermethrin 5% EC was the most traded with index value 0.85. For fungicides, mancozeb was the top choice, followed by the herbicide ammonium salt glyphosate, while aluminum phosphide was the most favored rodenticide. During the study, lack of policies for the proper disposal of expired pesticides was observed. Additionally, there was a low percentage (38.2%) of personal protective equipment (PPE) sales, indicating farmers' minimal attention to pesticide exposure safety. The survey also revealed challenges faced by retailers, including issues such as open borders, the rising number of agrovets in local areas, difficulties in convincing farmers to adopt safety measures, and a lack of pesticide knowledge among farmers. This suggests that the government should ensure stricter monitoring and more rigorous enforcement of regulations regarding the sales of pesticides.

Keywords : Borders, Insecticides, PPE, Retailer

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Introduction

Nepal is an agrarian country, where 60% of the population is employed in agriculture (AITC, 2022). Approximately, 23.95% of the country's GDP comes from the agriculture sector (Nepal Rastra Bank, 2022). However, over time, the contribution to the GDP has decreased due to an increasing trend of brain drain (Shrestha & Neupane, 2002). It takes a sustainable strategy that prioritizes productivity growth over lower yields and shrinking farm sizes to meet the food and nutrition needs of a growing population. Fertilizers, pesticides, micronutrients, and plant growth regulators are some of the most common agriculture inputs used in agriculture that aim to meet massive consumer needs. Retailers of agricultural and veterinary supplies, such as seeds, fertilizers, insecticides, herbicides, animal feed, vaccinations, and medications, are known as agrovets or agro-veterinary shops. They are becoming available even in comparatively rural areas and are active in all major markets in the nation (Pudasaini & Sthapit, 2018). Agro-vet businesses that deal in agricultural goods and services can operate as partnerships or as sole proprietorships. Farm inputs, insecticides, planting seeds, and animal feed are among the products (Kimutai et al., 2019). Pesticides have become an integral part of modern agriculture which demands high input for increased agricultural production (Nyaupane et al., 2023).

Pesticides are an essential piece of modern agriculture as well as substances (natural or artificial) used to manage plant diseases, undesirable plants, pests and various crop eating creatures like rodents and so on. They include insecticides, fungicides, herbicides, nematicides, acaricides, rodenticides, molluscicides, etc. (Nyaupane, 2021). There are four classes according to WHO which are classified as extremely dangerous, highly dangerous, moderately dangerous and slightly dangerous according to their toxicity level. It is moreover observed that between 15% and 25% of potential crop creation is lost because of vermin (parasitic worms) or insects, weeds, and diseases (Yadav & Dutta, 2019). In both developing and developed countries, the loss of crops due to insect pests is quite high. To target those harmful insect pests with the objective of management, pesticides are becoming a crucial tool. The advantages linked to the application of agricultural chemicals have led to a rise in the import of various agricultural chemicals in the nation (Nyaupane, 2021). Pesticides are used in a variety of ways, involving the precise, location-specific application of the resources at hand, based on their technical and operational viability, availability of resources and infrastructure. These methods should be utilized following the guidelines of integrated pest management, a decision-making approach based on scientific evidence tailored to the local context, which organizes the employment of pest control techniques and resources, and highlights the participation of the community (Pruszyński et al., 2017). Pesticide use and mishandling can lead to damage to the environment and other health

problems. Unfortunately, as pesticides are sprayed on a surface, they can spread beyond their intended area through the air, soil, or water (Nyaupane et al., 2023). This is a typical method by which chemical pesticides result in unintended harm, extending beyond their original purpose. Many pesticides have the potential to endanger human health. Human contact with pesticides can happen through consuming tainted food and water, and through the handling and use of pesticides by individuals. Additionally, pesticides can have adverse impacts on the environment, affecting water, soil, and air quality (Manea et al., 2017).

The United Nations 2030 Agenda for Sustainable Development was adopted in September 2015. It is supported by 169 objectives and 17 Sustainable Development Goals (SDGs) where second SDG is Zero hunger, which means to achieve food security and improve nutrition and promote sustainable agriculture. To fulfill the growing need for food and achieve the objectives of SDG 2, an urgent requirement exists to boost food production. In Nepal, more than 900 pesticides are applied to various crops and for treating the soil (GC & Neupane, 2019). Most of the regions where pesticide use is rising are those near markets or highway corridors. Pesticide usage has become essential in the agricultural sector in less developed nations like Nepal, where farmers want an affordable, fast, and effective way to eradicate pests and avoid pest problems in the field (Kalauni & Joshi, 2019).

Rupandehi district is a significant vegetable production area where pesticides are used excessively by farmers for vegetable cultivation. Most farmers in Rupandehi had a low level of awareness regarding the health effects of pesticides use. Many studies revealed that farmers were experiencing health issues due to pesticide exposure with symptoms like headaches, skin irritation, and burning eyes being commonly reported. Additionally, many farmers lack training on IPM and didn't use proper PEP (Personal Protective Equipment) while handling pesticides (Khanal et al., 2022).

Likewise, People of Banganga Municipality of Kapilvastu district have also shifted their farming pattern in a commercialized way and are producing vegetables in large scale to meet market demand. People of these areas depend on chemical pesticides prescribed by agrovets (Ghimire et al., 2022). It is observed in Nigalihawa, Kapilvastu. People claimed that a high moisture content makes it easier for bacterial and fungal diseases to spread to crops. Numerous individuals have stated that crop diseases are rising because of chemical overuse of fertilizers and pesticides. However, farmers of Parasi are more concerned about minimizing the practices of using chemical pesticides in the last 3 years (Kaphle & Bastakoti, 2018).

This study was designed to assess the pesticide sales trends, various issues related to safety measures, and problems faced by pesticide retailers at Parasi, Rupandehi and Kapilvastu district. Moreover, this study is also aimed at knowing about the availability

of banned pesticides in market, which have health and environment hazards in the above mentioned region.

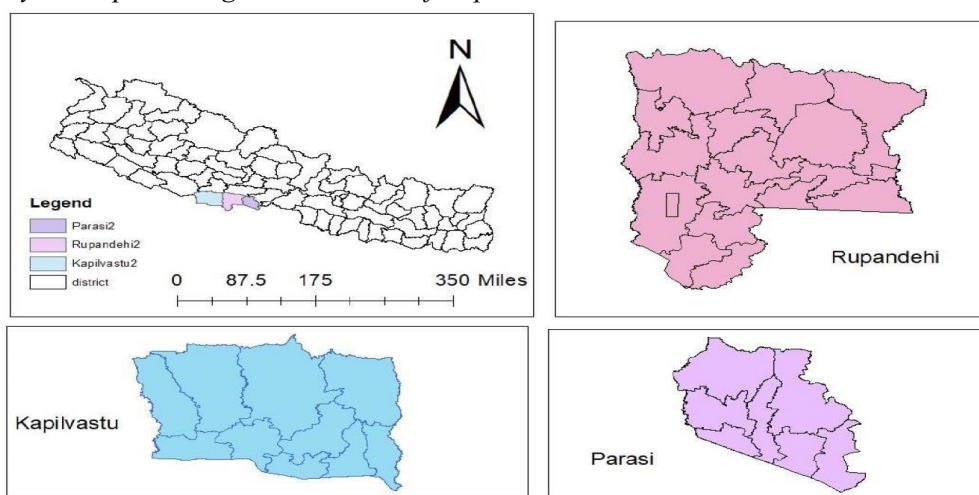
Research Methodology

Site Selection

The research was carried out in three districts of Lumbini Province: Parasi, Rupandehi and Kapilvastu having an area of 634.9 km², 1,360 km² and 1,738 km², respectively. Parasi lies in 27.533°N latitude, 83.667°E longitude which is home to 386,868 population according to Nepal census 2021. Similarly, Rupandehi has 1,121,957 population (2021 census) with a latitude of 27.5330°N and longitude of 83.3789°E. The district is bounded to the north by Palpa, to the south by India, to the west by Kapilvastu, and to the east by Parasi. Likewise, Kapilvastu lies in 27.5528°N and 83.0496°E having population 682,961 according to the 2021 Nepal census.

Figure 1

Study site representing three districts of Nepal



Source of Data

Primary data

Argovet level survey was conducted to collect the information on pesticides sales pattern where semi-structured questionnaires were asked to the respondents i.e. agrovet retailers. Face to face interviews, owners' empiricism and direct observation were done for primary data sources.

Secondary data

Various published research articles and reports from different national agriculture organizations were taken as the secondary source of data.

Sample size and sampling technique

Three districts from Lumbini Province- Parasi, Rupandehi, and Kapilvastu were selected. From the total population (229) of registered agrovet in these districts, 69 agrovet were chosen as a sample through a simple random sampling technique. Thirty percent of the total population from each district was taken: 30 agrovet from Rupandehi, 27 from Kapilvastu, and 12 from Parasi. A 30% sample size is considered appropriate for populations less than 1000 (Memon et al., 2020). Rao soft sample size calculator was used with a margin of error set at 10% for the estimation of number of samples.

A preliminary agrovet visit was conducted to obtain general information and background about the study area, which was then used to prepare the survey schedule. The questionnaire was pre-tested prior to the field survey to check the reliability and validity of the interview schedule by interviewing 8-10 retailers. Based on the respondents' comments, some necessary changes were made to the questionnaire.

Data Analysis and Techniques

Raw data were recorded, entered in Kobo Toolbox, and stored in MS Excel. Socio- demographic and economic data provided by respondents, such as age, gender, education, ethnicity, working experience, and income from pesticide sales were analyzed using descriptive statistics, such as chi- square tests. Descriptive and inferential analyses were performed using SPSS, while graphs were presented using MS Excel.

Available pesticides, challenges and suggestions from retailers were ranked using a forced ranking scale. In this technique, priorities were identified using a five-point scale, each with its respective score.

Forced ranking scale

The prioritization of pesticide demand in the districts of Rupandehi, Parasi, and Kapilvastu, along with the identification of associated problems and suggestions, has been ranked using this index. In the forced ranking scale, priority has been identified by using five scales using their respective scores. The following formula has been used to find the index:

$$I_{imp} = \sum s_i * f_i / N$$

Where,

I_{imp} = Index value of importance

\sum = Summation

S_i = Scale value of ith intensity

f_i = Frequency of ith response

N = Total number of respondents

Results and Discussion

Demographic and socio-economic status of retailers

Age group of respondents

The respondents were categorized into three age groups: less than 30 years, 31-60 years, and more than 60 years. Among them, the majority belongs to the age group of 31-60 years, with a substantial 85.7%. Survey research showed that 7.1% of respondents belong to the age more than 60 years with frequency (n=5) (Table 1). Conversely, a minor population was found in the age group less than 30 having only 4.3% respondents.

Table 1

Age group of respondents

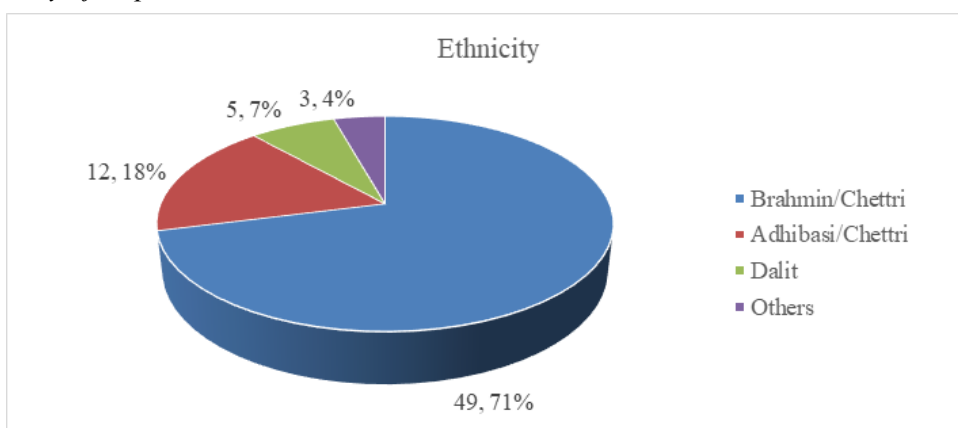
Age	Frequency	Percentage
Less than 30	4	4.3
31-60	60	85.7
More than 60	5	7.1
Total	69	97.1

Ethnicity of the respondents

This study showed that most of the respondents belong to the Brahmin/Chhetri ethnic group. Out of 69 respondents, 71% (49) were found to be Brahmin/Chhetri, followed by 18% (12) Adivasi/Janajati, 7% (5) Dalit, and the remaining 4% (3) from other ethnic groups, as shown in Figure 2.

Figure 2

Ethnicity of respondents



Respondents' demographic and socio-economic relation

Table 2 shows the involvement of male and female individuals in the pesticide business, representing their education levels. It indicates that 5.8% (n=4) of females

are retailers, while 94.2% (n=65) are male. Additionally, 50.7% (n=35) of participants have attained a high school education, followed by 27.5% (n=19) who have attended university, and only 21.7% (n=15) who have attained secondary-level education. This study shows that only a small percentage of females are knowledgeable about the pesticide business, and a minor percentage have attained university education.

The family size of the respondents was classified into two groups: joint family and nuclear family. It was found that 72.5% (n=50) of them have a nuclear family living in the city area, and a minor population of about 27.5% (n=19) live in a joint family. The working experience of the respondents was grouped into four categories: respondents having 5-10 years of experience, which includes about 40.6% (n=28); followed by 29% (n=20) with 10-15 years of experience in selling pesticides; followed by 20.3% (n=14) with 15-20 years of experience; and only 10.1% (n=7) with more than 20 years of experience. Retailers' education, gender, working experience, and sales or income from pesticides are found to have positive relationships. As working experience increases, there might be higher chances of effective marketing and a larger customer base. Additionally, the education level indicates knowledge of pesticides, safety, the market, and how marketing works.

Table 2

Respondent's demography and socio-economic relations

Category	Frequency	Percentage	Chi square	P value
Gender			52.941	<.001
Female	4	5.8		
Male	65	94.2		
Family Type			15.059	<.001
Joint	19	27.5		
Nuclear	50	72.5		
Education Level			8.853	0.012
Secondary	15	21.7		
High School	35	50.7		
University	19	27.5		
Working Experience			12.824	0.005
5-10 years	28	40.6		
10-15 years	20	29.0		
15 – 20 years	14	20.3		
More than 20 years	7	10.1		

Yearly income from Pesticides		19.043	<.001
1-5 Lakh	30	43.5	
6-10 Lakh	33	47.8	
More than 10 Lakh	6	8.7	

License and training received by the pesticide retailers

As the study was carried out in the registered agrovet in the AKC of the respective districts, all the respondents were aware of the requirements for a pesticide selling license. However, only 98.5% (n=68) were trained, while the remaining 1.5% (n=1) were found to be untrained in the field of pesticides. Additionally, 91.2% (n=63) of the respondents had licenses for pesticides and seeds, while 4.4% (n=3) had licenses for pesticides, seeds, and veterinary products as shown in table 3.

Table 3

License and training of respondents

Aware of pesticides selling license	Frequency	Percentage
Yes	69	100.0
Trained professional		
No	1	1.5
Yes	68	98.5
Specialization		
Pesticides	3	4.4
Pesticides and seeds	63	91.2
Pesticides, seeds and veterinary products	3	4.4

Training provider

Table 4 shows that 80.9% (n=56) of retailers received training from the Plant Quarantine and Pesticide Management Center (PQPMC), while 19.1% (n=13) received training from the Agriculture Knowledge Center (AKC).

Table 4

Training Provider to the respondents

Training provider	Frequency	Percentage
AKC	13	19.1
PQP	56	80.9

Available pesticide in the agrovet

This study provides insight into the most sold pesticides in the agrovet of Parasi, Rupandehi, and Kapilvastu districts of Lumbini Province (Table 5). Respondents were asked to rank insecticides based on the problems frequently reported by farmers as well

as the most sold insecticides in the market. While ranking these insecticides based on the weightage given by respondents, it was found that the most demanded was chlorpyrifos 50% + cypermethrin 5% EC. Likewise, in decreasing order, imidacloprid, dimethoate, acetamiprid, and alphacypermethrin were sold respectively. From this data we can say chlorpyrifos 50% + cypermethrin 5% EC is easily available in most of the agrovet. Similar results were found during the agrovet visit in Birendranagar and Nepalgunj (USAID Nepal & USAID, 2017).

Table 5

Most demanded insecticides in the agrovet, 2024

Most demanded insecticides	Rank Index	Rank
Chlorpyrifos 50% + Cypermethrin 5% EC	0.85	I
Imidacloprid	0.74	II
Dimethoate	0.52	III
Acetamiprid	0.49	IV
Alphacypermethrin	0.38	V

Table 6 shows that the leading fungicide was Mancozeb, as indicated by the forced ranking scale. This broad-spectrum contact fungicide is used to treat early blight, late blight, downy mildew, black rot, rust, gray mold, leaf spot, anthracnose, and so on (Naim & Cohen, 2023). From this, we can assume that farmers are facing the above-mentioned problems in their fields. The second-ranked fungicide is Carbendazim + Mancozeb, while Mancozeb + Metalaxyl is ranked third. Tebuconazole + Trifloxystrobin is ranked fourth, and lastly, Hexaconazole is ranked fifth by the respondents. A visit to agrovet in Surkhet district also reported the fungicides Mancozeb, Carbendazim to be the most used fungicides (USAID Nepal & USAID, 2017).

Table 6

Most demanded fungicides, 2024

Most demanded fungicides	Rank Index	Rank
Mancozeb	0.81	I
Carbendazim 12% + Mancozeb 63%. WP	0.79	II
Metalaxyl 8% + Mancozeb 64% WP	0.55	III
Tebuconazole 50% + Trifloxystrobin 25% WG	0.50	IV
Hexaconazole	0.33	V

Table 7 results revealed that while ranking herbicides, respondents ranked Glyphosate as the most popular herbicide among farmers which was followed by Paraquat Dichloride as second predominant herbicide. Pretilachlor, Pendimethalin and Atrazine 50% WP were ranked by the respondents as third, fourth and fifth major sold

herbicides. Glyphosate is a non-selective systemic herbicide which is the number one ranking herbicide in terms of sales. Also, first registered herbicides for use in the U.S. in 1974 (Kudsk & Streibig, 2003).

Table 7

Most sold herbicides

Most sold herbicides	Rank Index	Rank
Ammonium Salt Glyphosate	0.83	I
Paraquat Dichloride	0.72	II
Pretilachlor	0.59	III
Pendimethalin	0.42	IV
Atrazine 50% WP	0.41	V

Table 8 depicts the ranking of the most sold rodenticides in three terai districts of Lumbini province: Parasi, Rupandehi, and Kapilvastu. This study showed that Aluminum Phosphide was ranked first among the rodenticides. Difenacoum was ranked second, Zinc Phosphide was third, Brodifacoum was fourth, and Bromadiolone was fifth, as reported by the respondents.

Meanwhile, within 24 hours after consumption, individuals with aluminum phosphide poisoning experienced systemic symptoms. The occurrence of low blood pressure demonstrated the severity of these symptoms, including hypertension, reduced oxygen saturation, increased liver enzymes, metabolic acidosis, and elevated lactate levels (Shrivastav et al., 2023). Moreover, rodenticides are labeled red and are extremely toxic to humans. Aluminum Phosphide 56% TAB is one of the banned pesticides in Nepal (Nyaupane, 2021).

Table 8

Most sold rodenticides

Rodenticides	Rank Index	Rank
Aluminum Phosphide	0.82	I
Difenacoum	0.77	II
Zinc Phosphide	0.47	III
Brodifacoum	0.45	IV
Bromadiolone	0.43	V

Pesticides and safety measures

This study also explored some of the most preferred pesticides and the crops in which pesticides are frequently used. Farmers often seek suggestions or solutions to their field problems from retailers. During the field survey, we tried to learn what respondents

do with expired pesticides, their knowledge about trade and scale of business, the process of disposing of empty pesticide containers, and the ways they monitor the effectiveness of their products. According to the survey table 9, insecticides were the most preferred (79.7%, n=55), followed by fungicides (20.3%, n=14). A similar result shows that around 500 different brands of insecticides and 229 brands of fungicides are used in the country (Parajuli et al., 2021). These data show that most farmers deal with insect infestation on agricultural crops year-round, with fungal pathogens predominantly affecting crops in the winter. 84.1% (n=58) of respondents consider vegetables as the major crop they were dealing with and recommending pesticides for. Additionally, 14.5% (n=10) of respondents said most of the pesticides they sell are used for cereals. A minor group, 1.4% (n=1), said pesticides are mostly used for fruits in their area. The highest usage of pesticides was seen in vegetables, followed by cereals and fruits, indicating that vegetables have the largest share of pesticide usage (Ghimire & GC, 2018). On the other hand, 54.4% (n=3) of respondents stored expired pesticides separately, 36.8% (n=26) returned the expired products to the dealer, and only a few, 8.8% (n=6), considered safe disposal of expired products as Nepal lacks policies and regulations for safe disposal.

The study also provided insights into the sales of safety measures. Only 38.2% (n=27) of respondents sold PPE, which is crucial for protecting farmers against the harmful effects of pesticides. The remaining 61.8% (n=42) of respondents did not have any PPE items. This study can be supported by the report of Rupandehi district where farmers simply are very careless, handle pesticides haphazardly and more than 50% of farmers do not even use gloves and mix pesticides with their bare hands (Khanal et. al., 2022). Additionally, 96.2% (n=25) of respondents said that PPE had a low selling rate, so they didn't sell it, while only 3.8% (n=1) said that most farmers in their area asked about PPE and that there was a good sale for it. Similarly, 89.9% (n=62) suggested burying the empty bottles of pesticides as the country lacks safe disposal policies, while 10.1% (n=7) suggested disposing of the items away from water sources.

Moreover, table 9 revealed that 55.9% (n=38) of respondents measured their products' effectiveness through farmers' feedback. Additionally, 30.9% (n=21) visited farmers' fields and considered their feedback for product reviews. The remaining 13.2% (n=9) of retailers sought feedback from neighboring agrovets before stocking pesticide items. Retailers buy their products in five different ways: 47.1% (n=32) called the dealers for pesticide items, followed by 27.9% (n=19) who sometimes had dealer representatives visit and sometimes called the dealers. Additionally, 8.8% (n=6) of respondents visited the dealers, and a minor 1.5% (n=2) of respondents used all the methods to stock pesticide products. Only a few, 13.4% (n=9), were found to provide training to the farmers, while the majority, 86.6% (n=60), were not engaged in educational programs and training for farmers.

Table 9

Pesticides sales, major target crops and safety measures of pesticides retailers

Particulars	Frequency	Percentage
Most selling pesticide		
Insecticides	55	79.7
Fungicides	14	20.3
Crop		
Cereals	10	14.5
Vegetables	58	84.1
Fruits	1	1.4
Expired pesticide		
Return to dealer	26	36.8
Safe disposal	6	8.8
Store separately	37	54.4
Trade of PPE		
Don't do	42	61.8
Do	27	38.2
Scale of business of PPE		
Only few buy	25	96.2
Most of them buy	1	3.8
Disposal		
Buried in soil	62	89.9
Dispose in place away from water source	7	10.1
Practices of monitoring effectiveness of pesticide		
Feedback from farmer	38	55.9
Field visit & feedback from farmers	21	30.9
Review from other agrovet	9	13.2
Buy product		
Through call to dealer	32	47.1
Dealer persons visit the retailers	10	14.7
Retailers visit the dealers	6	8.8
Sometimes dealers visit & sometimes through call	19	27.9
All of the above	2	1.5
Training / educational program		
Don't provide	60	86.6
Provide to farmers	9	13.4

Factors preferred by farmers while buying pesticide

Table 10 reveals the factors considered by farmers when buying pesticides from agrovet. Recommendations by retailers were ranked first, followed by the effectiveness of pesticides, which was ranked second. Safety, price, and brand were ranked third, fourth, and fifth, respectively. Most farmers relied on retailers' recommendations and experience due to lack of sufficient extension service (Paghadar & Thakkar, 2023).

Table 10

Factors preferred by farmers while buying pesticides ,2024

Factors	Rank Index	Rank
Recommendation by Retailers	0.80	I
Effectiveness/Experience	0.70	II
Safety	0.63	III
Price	0.42	IV
Brand	0.42	V

Pesticide's inspector and inspection

Table 11

Knowledge of respondents about pesticides inspector and inspection practices

Knowledge about pesticides inspector	Frequency	Percentage
Aware	69	100
Visit of the inspector		
Don't visit	1	1.4
Do visit	68	98.6
Concern area of the inspector		
Expiry date	15	21.7
License	16	22.1
Management of pesticide in shop/store	2	2.9
Renew of license & expiry date of pesticide	12	17.4
All of the above	24	34.8

From Table 11, we can say that almost all the respondents were aware of the pesticide inspectors in their respective districts. 98.6% (n=68) of respondents said inspectors used to visit their shops, and only 1.4% (n=1) reported a lack of inspection by pesticide inspectors. According to 34.8% (n=24) of respondents, inspectors are more concerned about the expiry date of pesticides, the license of retailers, the management of pesticides in stores, and the renewal of licenses with the expiry date. However, 22.1% (n=16) said inspectors are only concerned about the pesticide selling license. Likewise, 21.7% (n=15) of respondents said inspectors looked after the expiry date of pesticides,

while 17.4% (n=12) of respondents were asked to show the renewal of licenses and expiry dates. Only a few, 2.9% (n=2), were asked about the pesticide keeping practices in stores.

Challenges faced by retailers

Table 12 depicts the ranking of problems faced by retailers in three districts: Parasi, Rupandehi, and Kapilvastu. The low selling rate due to the open border was ranked first by respondents, followed by the low selling rate due to the increasing number of agrovet, lack of pesticide knowledge among farmers, farmers' interest in organic agriculture, and the difficulty in convincing farmers to adopt safety measures. Similar, result was found where formulators of Nepal also import pesticides from India (GC & Neupane, 2019).

Table 12

Challenges faced by pesticide retailers

Challenges	Rank Index	Rank
Low selling rate due to open border	0.84	I
Low selling rate due to increasing rate of agrovet	0.76	II
Lack of Pesticides knowledge in farmers	0.48	III
Difficult to convince about importance of waiting period	0.46	IV
Difficult to convince farmers for safety measures adaptation	0.43	V

Suggestions by retailers

Some of the strategies are suggested and ranked by retailers to solve the problems mentioned in table 13. Strict rules regarding pesticide sales and trade with ensuring security to open borders were ranked first by the respondents, followed by limited training to limited people, banned pesticides which were found effective previously should be unbanned, awareness among farmers about pesticides and awareness among farmers about importance of PPE.

Table 13

Suggestions by pesticide retailers

Suggestions/Strategies	Rank Index	Rank
Strict Rules /security to open border	0.88	I
Limited training to limited people	0.77	II
Banned effective pesticides should be unbanned	0.52	III
Awareness among farmers about pesticides	0.42	IV
Awareness among farmers about importance of PPE	0.41	V

Summary and Conclusion

The study was conducted in three districts of Lumbini Province: Rupandehi, Parasi,

and Kapilvastu. The research focused on retailers in these districts, with 69 samples studied from the total population of registered agrovets in the respective districts. An interview schedule was administered with semi-structured questionnaires, and data was collected based on observation, questionnaires, and retailers' empiricism. The collected data was analyzed using various tools such as Kobo Toolbox, MS Excel, and SPSS. Descriptive and inferential statistics, along with a forced ranking scale, were applied.

In terms of socio-demographic characteristics, it was found that 94.4% of the retailers were male, while only 4.8% were female. The age group was divided into three classes: less than 30, 31-60, and more than 60. Most of the agrovets were between the ages of 31-60, making up 85.7% of the total. Ethnic distribution highlighted that 71% were Brahmin/Chhetri, followed by 18% Adibasi/Janajati, 7% Dalit, and the remaining 4% from other ethnic groups. Most of the retailers were educated up to high school, accounting for 50.7%, followed by 27.5% with a university education, and 21.7% with a secondary education. Education, working experience, family type, and gender are supposed to increase the income of the agrovets, with their relationships showing 1% and 5% significance.

The study employed a forced ranking scale to rank the available and most sold pesticides in the study area. Chlorpyrifos 50% + Cypermethrin 5% EC was found to be the most demanded insecticide, followed by Mancozeb fungicides. Respondents ranked Ammonium Salt Glyphosate as the most preferred herbicide by farmers. People in these three districts mainly used Aluminum Phosphide to kill rodents. Almost all respondents were aware of pesticide selling licenses and had been trained by PQPMC and AKC. Respondents reported insecticides as the predominant pesticides at 79.7%, and vegetables as the major crop in which pesticides were frequently used at 84.1%. To enhance safe disposal, respondents suggested that farmers bury empty containers in soil and dispose of them away from water sources, while expired pesticides are returned to the dealer or stored separately. In case of product requirements for the retailers, either they call the dealer or the dealer's representative visits the store. About 13.4% of respondents were involved in providing training and educational programs for farmers. The illiterate population engaged in agriculture in Nepal results in farmers depending on agrovets for information on waiting periods, doses, and PPE. Only 38.2% of agrovets had PPE, and a minor population asked for and preferred PPE. Regarding pesticide inspectors, all respondents were aware of the provision of a pesticide inspector in the district. They also added that the inspectors visit the stores and are concerned about licenses, renewal of licenses, expiry dates of pesticides, and the management of pesticides in the store. Furthermore, the study highlights the problems faced by retailers and ranked the suggestions using a forced ranking scale. Respondents ranked the open border as the major problem, whereas enforcing strict rules at the border was ranked as the top solution.

The increased use of pesticides and porous geography has increased the risk of using banned pesticides by farmers. From our study, it was found that insecticides are the major pesticides agrovet sold to the farmers, indicating that farmers frequently face insect problems in their fields. This is followed by fungal diseases, and herbicides are mostly preferred during the monsoon according to retailers.

The findings of the survey indicate a significant gender imbalance in the industry, with an overwhelming majority of retailers being male. The study highlights a high level of awareness among retailers regarding pesticides regulation and licensing, but it also uncovers significant gaps in the use and promotion of safety measures such as Personal Protective Equipment (PPE). Pesticide use was common, and according to retailers' people did not know much about other options for controlling pests and how they might affect people's health. All three districts had easy access to red – label pesticides, including rodenticides pointed out that there were no regulations or policies in place to ensure the safe disposal of unwanted pesticide and empty containers. Essential are enhanced training programs that emphasize safe pesticide handling, application, and integrated pest management (IPM) methods. Regulatory enforcement is needed through which negative outcomes can be mitigated by strengthening the enforcement of pesticide regulations and ensuring compliance by all agrovet operators.

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Informed Consent Statement: Personal field visits were conducted to collect information from the agrovet about pesticides. Registered agrovet from the designated districts answered the survey questions.

Data Availability Statement: The research data are shared in the manuscript.

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Abbreviations

The following abbreviations are used in this manuscript:

%	: Percentage
a.i	: active ingredient
AKC	: Agriculture Knowledge Center
DDT	: Dichlorodiphenyltrichloroethane
FWU	: Far Western University
GDP	: Gross Domestic Product
IPM	: Integrated Pest Management
Kg	: Kilogram
MS Excel	: Microsoft Excel
MS Word	: Microsoft Word
PPE	: Personal Protective Equipment

PPD	: Plant Protection Directorate
PQPMC	: Plant Quarantine and Pesticides Management Center
SDG	: Sustainable Development Goals
SPSS	: Statistical Package for The Social Sciences
Sq. Km	: Square Kilometer
WHO	: World Health Organization

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