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TREND OF PESTICIDE USE IN NEPAL

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ABSTRACT

This paper has attempted to analyze the trend of pesticide import, formulation and consumption in Nepal. Nepal has diverse agro-ecological conditions and different agro-climatic conditions necessitate varieties of approaches to crop cultivation and crop protection. The average national use of pesticides in Nepal is 396g a.i./ha with the highest use in the vegetable. This review used relevant secondary data, and information. The study found that the fungicides are the major form of pesticides used in Nepal for the pest control and the trend of pesticides consumption is increasing for agricultural purposes. The Nepal Government has signed different international treaties, made rules and regulations and initiated different types of programs to minimize the use of pesticides.

Key words: Pesticides, fungicides, consumption, Nepal, trend

INTRODUCTION

Agriculture is the main source of income, which contributes 27.76% to the Gross Domestic Product (GDP) of Nepal (MoF, 2018) and engaging 65.6% people in it (AICC, 2018). The pesticide uses in Nepal started since after the green revolution i.e. at early 1960 (Dahal, 1995). Since then, pesticides became one of the priority input in modern agriculture to raise production by tackling with ever-growing pests. It is estimated that Nepal losses 35% of production due to pests' attack in the field and at the storage condition (Palikhe, 2002; PPD, 2013). Occasionally, the pest outbreaks and epidemics may cause a complete failure of crop harvest. By reducing these losses, there would be a considerable increase in availability of food, contributing to the food security.

However, use of pesticides comes along with the adverse effect in the health of people, land and environment (Padmavathi, 2013; GC and Ghimire, 2018), yield loss due to non-target pesticide application resulting in pesticide-induced pest resurgence and increasing financial burden to farmers (Thapa, 2003). Farmers apply chemical pesticides at high dose and frequency, cocktail spray (Aryal, 2014) because of lack of awareness regarding the harmful effects such as cancer (Basil *et al.*, 2007) improper fetal development (Wickerham *et al.*,

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2012), Parkinson's disease (Yesavage *et al.*, 2004), birth defects (Garry *et al.*, 2002) altered growth, acute and chronic neurotoxicity (Savage *et al.*, 1998).

Nepal is signatory of several international conventions related to pesticide regulation. The Basel Convention on the Control of Trans boundary Movement of Hazardous Wastes and Their Disposal was entered into force on 5 May 1992 (approved on March 22, 1989). Nepal has ratified the treaty on August 15, 1992. Similarly, the Rotterdam Convention, which deals with Prior Informed Consent procedures for certain hazardous chemicals and pesticide in international trade, was came into force on September 11, 1998 (approved on September 11, 1998) and Nepal has ratified it on October 17, 2006. Likewise, the Stockholm Convention, which deals with Persistent Organic Pollutants (POPs), was came into force on May 17, 2004 (approved on May 22, 2001) and Nepal has ratified it on October 17, 2006 (signed on April 5, 2002). These international conventions have laid down several obligations to Nepal (PRMD, 2016b).

METHODOLOGY

A rigorous desk review was carried-out for the study. The major source of data and information were accessed from the publications and database of Pesticide Registration and Management Division (PRMD), which was established in BS 2051 (the name of the office was Pesticide Registration Office at that time) according to the provision of the Pesticide Act, 2048 and the Pesticide Regulation, 2050 (PRMD, 2016b). The PRMD is responsible for registration and deregistration of pesticides in Nepal. Besides publications and database of PRMD, the published reports and data by other relevant government organizations were considered as the major sources of data and information. Similarly, several independent research articles were reviewed for this study. All the available data and information were analyzed and presented.

RESULTS AND DISCUSSION

Pesticides consumption in Nepal

The national consumption of pesticide in Nepal is 396g a.i./ha (PPD, 2016 ; Sharma, 2015), which is higher than the previous record of 142g a.i./ha (Thapa, 1997 ; Sharma, 2015). However, lesser than the other Asian countries like India 0.5 kg/ha, Japan 12 kg/ha and China 14 kg/ha, Korea 6.6 kg/ha, and other countries like- USA (7.0 kg/ha) and Europe (2.5 kg/ha) (Arora *et al.*, 2011 ; Gupta, 2004).

On the ecological basis, the highest average pesticide used in the Terai region of Nepal i.e. 0.995 a.i. kg/ha followed by valley (0.470 a.i. kg/ha), hill (0.314 a.i. kg/ha) and lowest in the high hill (0.085 a.i. kg/ha) (PPD, 2015). According to a survey report, heavy pesticide use was found in the Central Development Region (1.015a.i. kg/ha) followed by Eastern Development Region (0.616 a.i. kg/ha), Western Development Region (0.276 a.i. kg/ha), Mid-Western Development Region (0.225 a.i. kg/ha) and least in the Far-Western

Development Region (0.146 a.i.kg/ha) (PRMD, 2014). A similar result was found among the development regions, the use of chemical pesticides was higher (31.9% of the total use) in the Central Development Region and the lowest (6.4%) in the Far Western Development Region in 2001/02 (Sharma *et al.*, 2012).

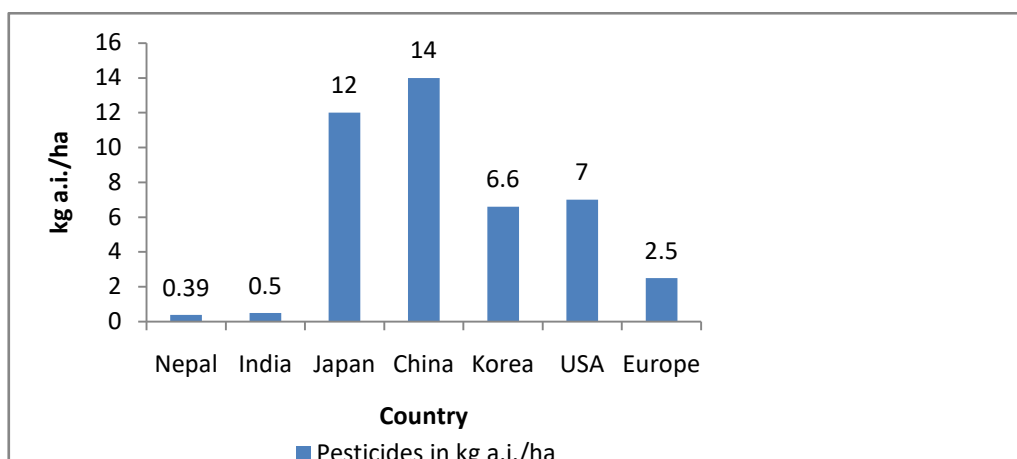


Fig. 1 : Pesticides use by Country (Source: Arora *et al.*, 2011)

In Nepal, the highest share of pesticide consumption are of insecticides i.e. 1064.07 mt. by formulation quantity, whereas by total active ingredient (a.i.) fungicides are one of the highly consumed pesticides i.e. 250.81 mt (PRMD, 2016a).

The uses of pesticides in different crop

The highest share of pesticides is of vegetables. It accounts for 89% of the total pesticide use followed by cash crops and found least in cereals as shown in Table 1.

Table 1. Pesticide use in crops

S.N.	Crops	Quantity a.i.kg/ha
1	Cereals	0.04613
2	Vegetables	1.60469
3	Cash crops	0.18654
4	Pulses	0.05075
5	Fruits	0.02919

(Source: Survey Report on National Pesticide Consumption Statistics in Nepal, 2014 and PPD, 2015)

The proportion of vegetable growers using pesticides increased from 7.1% in 1991/92 to 16.1% in 2001/2002 (CBS, 2006). In the 1980s, one percent of the wheat growers applied pesticides in their farming operations (CBS, 2006) while less than one percent of the rice,

maize, potato and sugarcane growers used pesticides during the same period (Sharma *et al.*, 2012).

Nepalese crop protection market split

To the date, 2,576 pesticides are registered by their trade name and 139 pesticides by their common name as mentioned in Table 2. Total 160 firms are registered for pesticide import 5 companies for pesticide formulations and 19 as pesticide applicator in Nepal (PRMD, 2016a). Till 2016, 11,777 licenses have been issued for pesticide resell and 11,159 certificate provided to safe storage and use of pesticides (PRMD, 2016a).

Table 2. Registered Pesticides up to 2016/17

S.N.	Pesticides	Trade Name	Common Name
1	Insecticide	1405	52
2	Acaricide	27	6
3	Fungicide	648	40
4	Bactericide	15	1
5	Herbicide	350	22
6	Rodenticide	33	2
7	Molluscicide	2	1
8	Bio-pesticide	90	12
9	Herbal	6	3
	Total	2576	139

(Source: PRMD, 2018)

Table 3. Banned Pesticides in Nepal till 2016

S.N.	Pesticides Name	Banned Year	Remarks	WHO group	Hazard level
1	Chlordane	2001	Persistent organic pollutants	II	Moderately Hazardous
2	DDT	2001	Persistent organic pollutants	II	Moderately Hazardous
3	Dieldrin	2001	Persistent organic pollutants	II	Moderately Hazardous
4	Endrin	2001	Persistent organic pollutants	O	Obsolete as pesticide, not classified
5	Aldrin	2001	Persistent organic pollutants	O	Obsolete as pesticide, not classified
6	Heptachlor	2001	Persistent organic pollutants	O	Obsolete as pesticide, not classified

S.N.	Pesticides Name	Banned Year	Remarks	WHO group	Hazard level
7	Mirex	2001	Persistent organic pollutants	O	Obsolete as pesticide, not classified
8	Toxafen	2001	Persistent organic pollutants	O	Obsolete as pesticide, not classified
9	Lindane	2001	Persistent organic pollutants	II	Moderately Hazardous
10	BHC	2001		II	Moderately Hazardous
11	Phosphamidon	2001		Ia	Extremely Hazardous
12	Organo Mercury Chloride	2001		II	Moderately Hazardous
13	Methyl Parathion	2006		Ia	Extremely Hazardous
14	Monocrotophos	2006		Ib	Highly Hazardous
15	Endosulphan	2012	Persistent organic pollutants	II	Moderately Hazardous
16	Phorate	2015 is in grace period		Ia	Extremely Hazardous

(Source: PRMD, 2016a and WHO/ICPS, 2009)

Total 16 pesticides were completely banned in Nepal. Similarly, in India 34 pesticides were banned as of 15th October 2015 (CIBRC, 2015).

Pesticide imports in Nepal

The trend of pesticide use is increasing in Nepal by about 20% per year and expenses on pesticide in market-oriented vegetables and fruits production has become a major cost factor (Jasmine *et al.*, 2008). Different forms of pesticides are imported, and their amount is increasing day by day in Nepal. According to the latest estimate, the annual import of pesticides in Nepal is about 562 mt. a.i. (PRMD, 2016a) with 32% insecticides, 44% fungicides, 23% Herbicides and 1% others. Insecticides (Organochlorines, Organophosphates, Carbamates, Synthetic-pyrethroids and others/mix) are the major types of the pesticides. Among them, organophosphates are the major constituents of insecticides imported in Nepal (Jasmine *et al.*, 2008). The graph shows that the use of insecticides increased remarkably after 2004/2005 as shown in Figure 2, which may be due to the pest like Brown planthopper outbreak occurred in Chitwan district and lost almost all the rice yields Farmers do not want to take risk of crop failure that's why dependency on pesticides is increasing day by day.

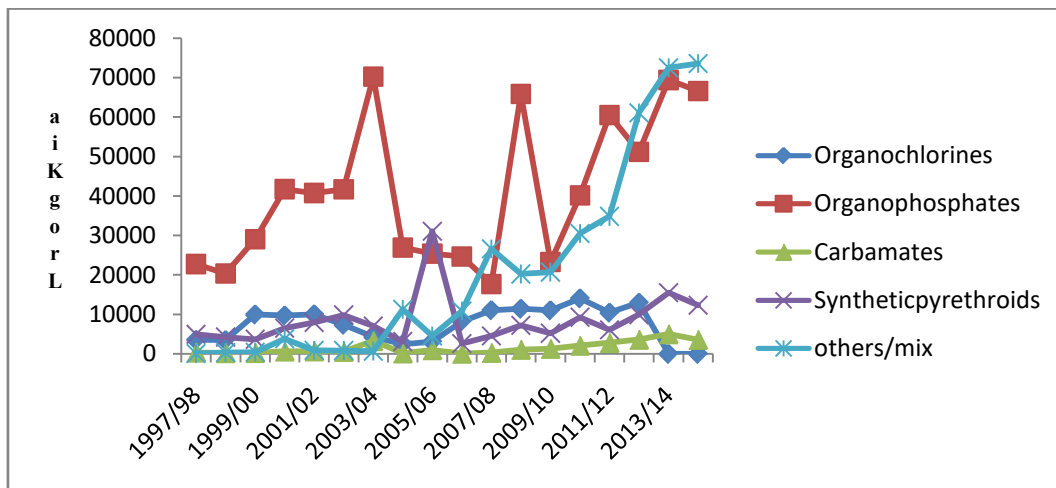


Fig. 2 : Trend of Insecticides (Source: PRMD, 2016)

Around twenty-two percent of the farmers apply pesticides before the incidence of disease pest, 51% after the incidence of disease pest and 27% at the later stage of disease pest development (PPD, 2016 ; PRMD, 2014). The studies have shown that more than 90% of the total pesticides are used in vegetable farming (Atreya and Sitaula, 2010). People are using pesticides as necessary evil, as there are no effective alternatives available for the pest control, in wrong way, due to weak monitoring and legal provision, open border situation, lack of awareness, training and knowledge among people regarding pesticide use and its management, no provision for integrated pest management and organic products certification, accumulation of date expired pesticides and weak co-ordination and co-operation among the different governmental organizations are the major cause of increased pesticide use (PRMD, 2016b).

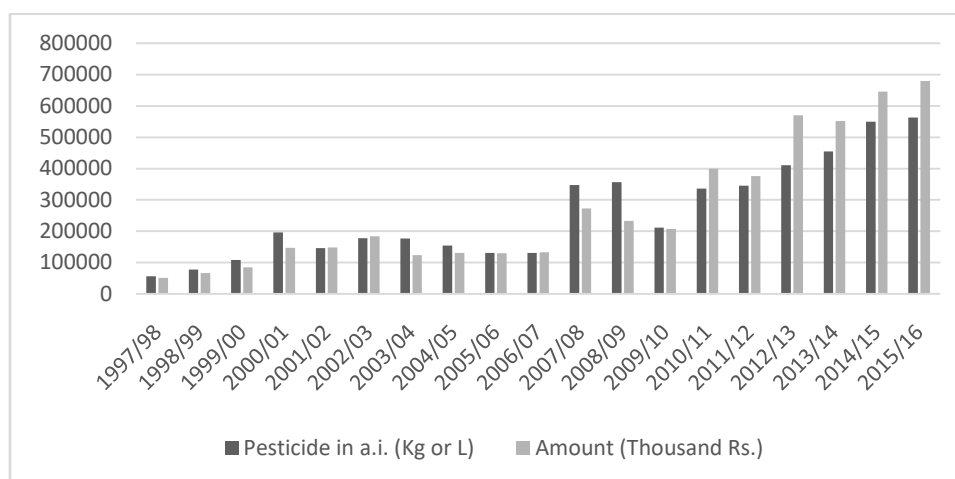


Fig: 3: Pesticide Import in Nepal in monetary term (Source PRMD, 2016a)

In 1997/98, the pesticide imported and formulated in Nepal was 50,000 kg, which was soared to about 562,000 kg in 2015/16, which is more than 11 folds increase. Regarding the expenditure for pesticide import and formulation, in 1997/98, 51 million Nepalese rupees (NRs.) was spent. This expenditure was rose to more than NRs 679 million in 2015/16. Likewise, in 2007/08 the amount of organochlorines and other/mix insecticides import was increased much higher than previous year and continued thereafter. Similarly, in 2008/09 organophosphates and other/mix insecticide amount import was increased. In 2009/10, the pesticide import was decreased rapidly perhaps due to integrated pest management (IPM) program running intensively in different districts of Nepal to minimize the harmful effects of pesticides. But the import of all firms of insecticides such as organochlorines, organophosphates, carbamates, synthetic-pyrethroids and other/mix were increased in 2010/11 because of no best alternatives available in place of chemical pesticides to control the pests. This might help in proving the increasing dependency upon the chemical to increase the agricultural productivity and there are no effective alternatives available to substitute chemical pesticides in Nepal.

Purposes of pesticide use

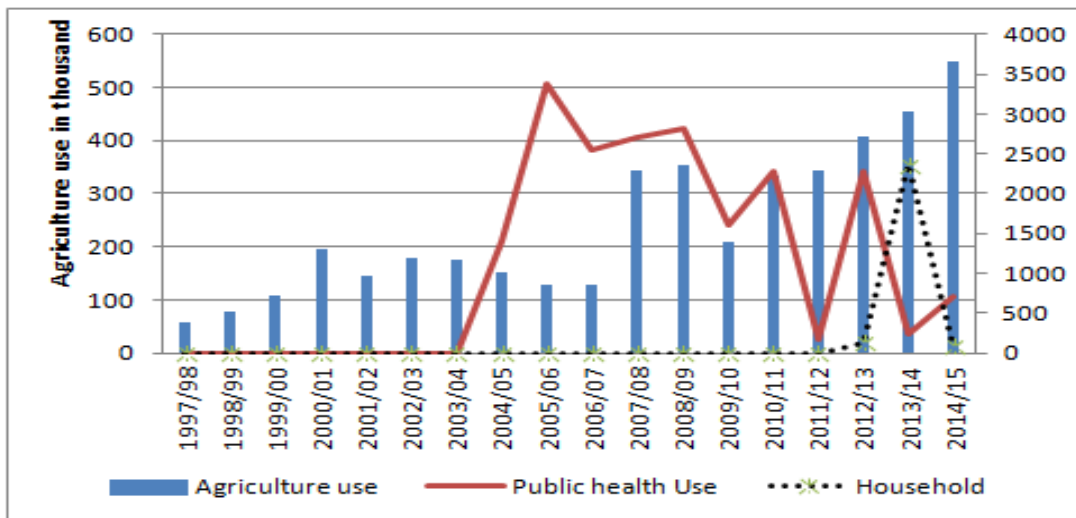


Fig. 4 : Pesticide use purposes (Source: PRMD, 2016a)

The pesticides are used not only with agricultural objectives but also with public health and household purposes (PRMD, 2016a). The maximum amount of pesticides, which includes insecticides, fungicides, rodenticides, bio-pesticides, acaricides, herbicides, bactericides, molluscicides and others are used in agriculture sector, mainly to control crop loss by insects, weeds, plant diseases, rodents, etc. The pesticides in public health purposes are primarily for vector control of public health diseases, like malaria , dengue, whereas for household purposes for cleaning, control of rodents, termites, bedbug, etc. The graph shows

the amount of pesticide use in the agricultural sector is increasing as time passes due to pest resistance to pesticides, a resurgence of pests, elimination of the natural enemies, and disruption of the ecosystem (Palikhe, 2002). The misuse of the pesticides, especially, the broad-spectrum ones in Nepal has caused pests to adapt and become resistant to the pesticides (Yadav and Lian, 2009), the most pesticides are then required at higher doses to achieve the same level of control. Similarly, the graph shows a significant decrease in the amount of pesticides use in the public health sector as the level of awareness in people regarding the harmful effects of the pesticides is increasing.

Summary of date expired pesticides accumulated in Nepal

Nepal had already disposed 74.28 mt. obsolete pesticides and 43 cylinders of methyl bromide (50kg) with the help of GIZ in 2011.

Table 4. Amount of date expired pesticides disposed in 2011

S.N.	Pesticide group	Amount (Mt)	% of total
1	Mixed (PoP and OC)	23.61	31.79
2	Organochlorine	10.48	14.11
3	POPs	10.05	13.53
4	OM	8.38	11.28
5	OP	7.95	10.70
6	Fungicides	4.45	5.99
7	Rodenticides	2.6	3.50
8	Fumigants	2.52	3.39
9	SP	1.86	2.50
10	Herbicides	1.84	2.48
11	CM	0.54	0.73
	Grand Total	74.28	100

(Source: GC, 2011 ; Sharma *et al.*,2012)

The Deutsche Gesellschaft für Technische Zusammenarbeit (GIZ) has completed their collection from Nepal in 2011 and disposal in Germany (Sharma *et al.*, 2012).

Approaches to reduce pesticide use in Nepal

- Pesticide Act 2048 and regulations 2050 for efficient handling, use and management of pesticides.
- Nepal is a signatory member of International treaties like Basal convention, Stockholm convention and Rotterdam convention.
- Awareness and campaign regarding "Pesticides are poison, not the medicine".
- Adoption of IPM technology to minimize the use of pesticides.

- Rapid bioassay of pesticide residue (RBPR) analysis has been established since June 18, 2014.
- Celebrating "No Pesticide Use Week" in every year from 3rd to 10th December since 2013.
- New Act, rules and regulations were made to regulate the misuse of pesticide.
- Different trainings like safe storage of pesticides, handling of pesticides and selling of pesticides were provided to train the pesticide resellers.
- Agro-vet, Pesticide reseller licensing processes in related to pesticide sale, storage and handling has been improved.
- Subsidy on the use of bio-pesticides.
- Awareness through different media likes - newspaper, television, radio, F.M., etc.
- E-plant clinic has been started to help farmers in controlling the pests and haphazard use of pesticides.
- District Agriculture Development Offices (DADOs) under Plant Protection Directorate (PPD) organize plant clinic every week regularly.
- Community IPM resource centers has been established.
- Promotion and export of organic products like coffee, an apple from Jumla, honey, etc.
- Regular monitoring from different organization like Department of Food Technology and Quality Control (DFTQC), Plant Protection Directorate (PPD), National Plant Quarantine Program (NPQP) to regulate the use of pesticides in agricultural produce.

CONCLUSION

In Nepal, the consumption of the pesticide is increasing for the agricultural purposes, though low national average as compared to other countries in the world. However, the risk and the hazards to the farmers are higher than other countries. Farmers need to be reminded that pesticides are not the only control measures for pest problems, bio-pesticides are one of the best alternatives. The proper and the scientific mechanism of pesticide disposal (should be listed in the Pesticide Act and Regulation) should be made and applied. The strengths of the Government, I/NGOs and other stakeholders should be utilized fully to check the pesticide misuse.

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