

AN OVERVIEW OF PESTICIDE MANAGEMENT IN NEPAL

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ABSTRACT

Agriculture is a wider sector where 54% people are engaged and one-third GDP contributed to the nation. Due to diverse climatic regions, farmers grow different types of agricultural commodities and presence of different pests reduces their production and thus need to apply pesticides. Pesticide Registration and Management Division under the Department of Agriculture is a legal authority to register as well as restrict or ban certain pesticides used in the agricultural sector in Nepal. The paper also emphasizes how Nepal has doing pesticide reduction for the pest management in agriculture considering the food safety, animal and human health and environment protection. And it also focuses on the legal aspects on pesticide management and status of registered, restricted and banned pesticides in the context of neighboring countries and addresses to fulfill the obligations of the international convention related to pesticides and industrial chemicals.

Key words: Agriculture, banned pesticides, pesticides, pests, pesticide management

INTRODUCTION

Nepal a land locked country where 54% population is engaged in agriculture and one-third GDP contributed to the nation (ADS, 2016; NPC, 2016). Nepal has a diverse climate- from sub-tropical to alpine climate, but a number of factors explain the weak growth performance of agriculture as compared to the neighboring countries. Variety, irrigation, use of chemical fertilizer, pesticide, and intercultural operations play an important role to increase the productivity of crops. About 15-25% food products are being lost annually in pre and post harvest activities caused by pests and if the loss is minimized, it can play a significant role in food security.

Certain industrial chemicals and pesticides used in human health and agriculture sector cause harmful effect on human health, wild lives and pollute environment when they are not handled properly. International organizations and national legislative measures play an important role for the management of industrial chemicals and pesticides.

METHODOLOGY

The study have done on the basis of reviewing of published reports, documents, articles and presentation by the government of Nepal and other international organizations working in the fiels of pesticide management.

FINDINGS

PESTICIDE management

Institutional arrangements for the enforcement of law

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Nepal imports pesticides from India, China and other countries and those pesticides are used for vector control, external parasites in animals and pest management in agriculture. For the better management of pesticides, country has prepared the Pesticide Act, 1991 and Pesticide Regulation, 1993 and enforced them from July 16, 1994.

The pesticides either in use, production, formulation, distribution or professional applicators, should be registered or regulated under the Pesticide Act and Pesticide Regulation of Nepal. Under the Act, there is provision of Pesticide Management Board. The board advises to the government in the formulation of a national policy regarding pesticides to maintain co-ordination between private and government in production and distribution of pesticides, regulate and control the quality of pesticides, and prepare standard of pesticides. Under the Board, technical, legal and pesticide disposal implementation sub-committees have been established. Pesticide Registration and Management Division (PRMD), under Plant Protection Directorate is responsible for pesticide registration, monitoring and management in central and 75 pesticide inspectors are responsible in district level (Pesticide regulation, 1993).

Monitoring and supervision mechanism

There is provision of Pesticide inspectors and district pesticide management committee in the Act for the management of pesticides in the districts. Act has given the legal authority to the pesticide inspectors for pesticide import and check the pesticide shop, go down and factories to monitor the quality and valid license.

Requirements for pesticide registration

At present, due to lack of pesticide quality checking laboratory facilities and experts, Nepal has to rely on foreign analysis result of pesticides. The pesticides are registered on the basis of trade name. Pesticide Registration and Management Division demands the following documents during the registration:

- a. Summary of intended use pattern
- b. A statement of the need to use in Nepal
- c. Evidence that the product is registered overseas (copies of registration certificates, affidavits or approved labels)
- d. Three copies of the original label of the product to import and sale
- e. Report of EIA (Environmental Impact Assessment) for more than 10 mt
- f. For research no attachments are necessary

Any persons, institutions, or companies can submit by attaching the required documents for the registration of pesticides, the board may make necessary inquiry during the process of registration and grant the retailer license.

Notified pesticides

According to the Pesticide Regulation Section 9, the government should publish the name of the registered pesticides in the Nepal Gazette after recommendation by the board. Those pesticides other than notified ones, are not to be imported, exported, produced, used and distributed (Pesticide Act, Section, 11). All the terms and conditions are specified in the license and should meet required minimum standard.

Registration situation

The pesticide registration situation varies country wise in the world. Generally, pesticide is registered after evaluation of country specific risk analysis. Pesticide handling, disposal and management training is provided to the technicians and resellers. The registered pesticides and information related to pesticide management in Nepal is presented in Table 1 and 2, respectively.

Table 1: Pesticides registered in Nepal

	Commonname	Trade name
Insecticides	51	1288
Acaricides	6	23
Fungicides	38	564
Bactericides	1	13
Herbicides	22	288
Rodenticides	2	29
Molluscides	1	2
Biopesticides	9	78
Herbal	3	4
Total	132	2289

Source: PRMD, 2016

Table 2. Information related to pesticides management

Particular	Number
Registered pesticides (trade name)	2289
Registered pesticides (common name)	132
Pesticide handling training for reseller	11242
Pesticide license	9954
Pesticide formulators	6
Pesticide applicators	15
Pesticide importer	160

Source: PRMD, 2016

PESTICIDE IMPORT AND CONSUMPTION

Use of pesticides

Pesticides are mainly used in vector control external parasites of animals and agriculture for pest control for pre- and post- harvest loss reduction. The total area covered by agriculture is 35912 square kilometer and use of pesticide amount depends upon the crops. Pesticides are used mainly in vegetables, tea, legumes, rice and maize. About 80% pesticides are used in vegetables. A recent study shows that the average pesticide used in Nepal is about 396 gm/ha (PPD, 2014), which was only 142 gm/ha in 1995 (IUCN, 1995).

Table 3: Cultivated area by different geographical regions

SN	Geographical region	Area of the country (km ²)		Total cultivated area of the country (%)	Percent of cultivated area
		Total	Cultivated		
1.	Himalayan	51313	1436	4.0	2.8
2.	Hills	61816	9337	26.0	15.0
3.	Terai	33851	25138	76.5	17.0
Total		147181	35912	100.0	24.0

Source: MoAD, 2014

Table 4: Pesticide consumption by crops

SN	Crops	Total cultivated area (ha)	Total pesticide used (a.i. kg)	Pesticide quantity (a.i.kg/ha)
1.	Cereals	953.379	43.975	0.046125
2.	Vegetables	320.290	513.967	1.604693
3.	Cash Crops	69.266	12.921	0.186542
4.	Pulses	42.916	2.178	0.05075
5.	Fruits	66.880	1.952	0.029187
Total		1452.730	574.993	

Source: PPD, 2015

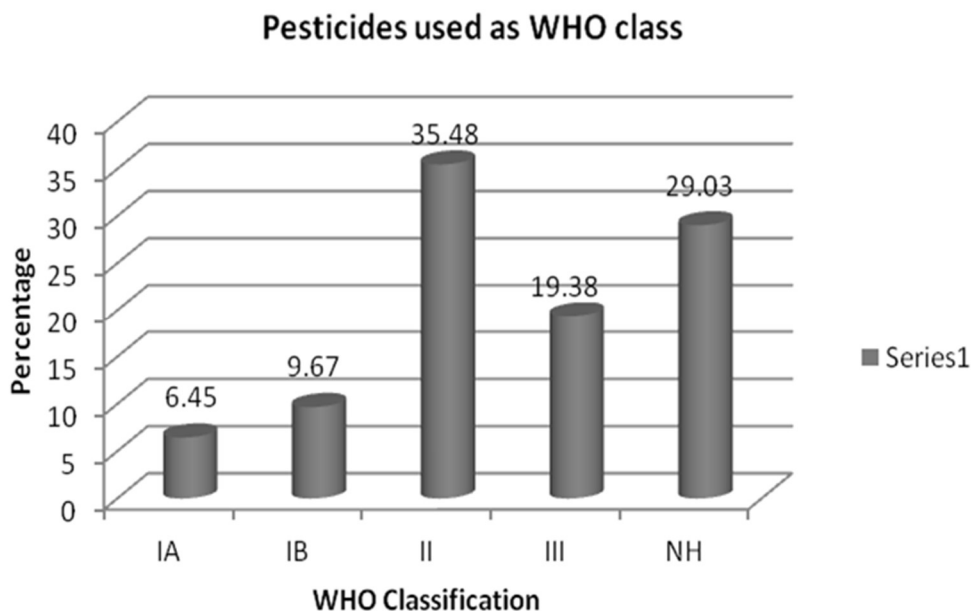


Figure 1. Pesticide used by WHO classification (Source: Sharma, 2014)

According to WHO classification, Nepal has registered Ib, II, III and U pesticides, and try to reduce the register and use of highly hazardous (Ib) and moderately hazardous (II) pesticides by advocating the consequences of pesticides and promotion of IPM and use of bio-pesticides.

Table 5: Pesticide consumption in Nepal

SN	Pesticides	Total quantity (mt)	Total quantity a.i. (mt)	Value ('000 US\$)
1.	Insecticide	113.88	162.32	2855.56
2.	Fungicide	27.69	19.22	1315.29
3.	Bactericide	0.03	0.0031	8.96
4.	Herbicide	19.27	9.01	859.49
5.	Rodenticide	1.45	0.98	89.47
6.	Bio-pesticide	0.63	0.0071	34.84
Total		1629.50	454.5	5163.61

Source: PRMD, 2014 (1 US\$ = NRs 106.9)

Misuse/overuse of pesticides

The proper use of pesticide give results increase in agriculture production and vector control while misuse effect on health and environment. Baker and Gyawali (1994) highlighted the misuse of pesticides in four thematic issues, viz. health effect, environment damage, yield reduction and financial expenses. Within in these issues, there are many such consequences in case of Nepal.

GOVERNMENT STRATEGY

Especially during the 1970s, pesticide use increased with the beginning of agricultural technology transformation in the farmers to increase production for food security. Cotton Development Committee, Agricultural Inputs Corporation, Government Agriculture farm and Research Stations, District Agriculture Development Offices and Frontline Extension Workers are the main promoters of pesticide in Nepal. Besides, sectorial plans, programs and activities also emphasized the promotion of pesticides.

In 1996, when brown planthopper (*Nilaparvata lugens*) outbreak occurred in rice and caused an estimated loss of US\$ 212201. Then government of Nepal emphasized integrated pest management (IPM) strategy for the management of such pests by educating the farmers through farmer field school (FFS) in their own community. Nepal has been emphasizing the IPM from the beginning to date with the technical and financial support of FAO and some outputs are as follows:

- Technical Cooperation Project (FAO/TCP): 1997-1999
- Community IPM program : 2000
- National IPM Program -Phase I : 2003 - 2007
- National IPM Program -Phase II: 2008- 2013

Due to climate change, new and secondary pests have been increased (*Mythimna seperata* or *Spodoptera mauritia*), causing severe damage to crops, vegetables and fruits, giving birth to the climate field school in climate vulnerability communities.

The National Plant Quarantine Programme (NPQP) has developed 33 national standards harmonizing with ISPM, starting to build fumigation chamber (ISPM 15), pest database and beginning preliminary database of 20 tradable crops, pest risk analysis of some important crops, initial work on pest free areas (ISPM No. 4), and conducted training for plant health inspectors.

The new Plant Protection Bill 2017 has been prepared harmonizing with IPPC guidelines, Protocols and the WTO/SPS Agreement and is in the process of discussion in parliament for approval.

Community IPM

Table 6: Participation in different programs

SN	Training/workshop	No	Participants/Organization
1.	Strategy development, policy, and curriculum workshop	3	MOA, DOA, PPD, NARC, FAO
2.	Season long Rice IPM TOT officer level	1	30 APPOS, 1 NARC, NGOs
3.	Vegetable IPM TOT	1	30 GOs and 4 NGOs officers
4.	Season long Rice IPM TOT (JT level)	1	17 JT/As (GO) and 17 JTs NGO
5.	Training on Participatory planning	2	39 IPM trainers
6.	Training on Science by farmers	2	36 IPM trainers
7.	Farmer TOT	5	156 farmers
8.	Rice FFS by official trainer	404	10100 farmers
9.	Vegetable FFS by official trainer	23	575 farmers
10.	Farmer to farmer FFS	246	6150 farmers
11.	Farmer Science	14	350 farmers

Source: PPD, 2015

Table 7: IPM training

SN	Major activities	Numbers (Up to 2015)
1.	Officer level IPM ToF(Subject Matter Specialist)	179
2.	Non officer levels IPM ToF (JT/JTA)	276
3.	Farmers Facilitators	882
4.	Season Long IPM FFS	4425
5.	Yearlong IPM FFS	196

Source: PPD, 2015\

Production and use of bio-pesticides

Due to the negative effects of chemicals pesticide in crops, residue in foods, and environment pollution, use of bio-pesticides has been gradually increasing their use in vegetables at FFS conducted communities and started to register such eco-fiendly products. Farmers have started plant based bio-pesticides who learnt from the FFS and training. The amount of use of bio-pesticide is negligible as compared to chemical pesticides.

Table 8: Registered bio-pesticides

SN	Bio-pesticide	Trade name	Category
1.	Azadirachtin	10	Plant based
2.	Beauveria bassiana	8	Fungus
3.	Metarhizium anisopliae	3	Fungus
4.	NPV	2	Virus
5.	Pseudomonas fluorescene	6	Bacteria
6.	Trichoderma viride	8	Fungus

7.	Trichoderma harzianum	1	Fungus
8.	Verticillium lecani	4	Fungus
Total		42	

Source: PRMD, 2014

Five community IPM Resource Centers were established in districts to support the IPM farmers and 21 farmers were trained on lab handling and bio-agent rearing. The products are used by the group members and sold as per need within the district. Such local measures used to control pests have been found effective and cheap.

Disposal of obsolete pesticides

Nepal was facing a problem for disposal of pesticide and even in 1990, about 150 mt of obsolete pesticide were stored in different locations of Nepal, of which 114 mt were disposed, including 16 mt reused, 23 mt reformulated and 75 mt disposed by land spreading and buried. Later in 2007, Nepal disposed 74.5151 mt of date expired pesticides including POPs (33.668 mt) and 43 cylinders (50kg each cylinder) methyl bromide with the help of German government (MoEST, 2007).

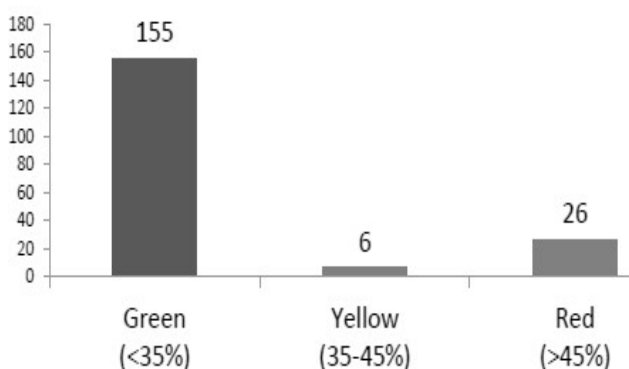
Establishment of RBPR analysis laboratory

The Government of Nepal is decided to establish the Rapid Bioassay of Pesticide Residue (RBPR) laboratory in Kalimati fruits and Vegetable Market to check the pesticide residue in vegetables before sell. The laboratory is established in 18 June, 2014 under the supervision of Plant Protection directorate. RBPR technology is developed by Taiwan Agriculture Research Institute in 1985 to check the residue of organophosphate and carbamates groups of pesticides and fungicides residue in certain level through Enzymatic reaction: AchE (Acetyl cholinesterase) Test to screen the residues of acetyl cholinesterase-inhibiting in fruits and vegetable. Test gives only inhibition percentage from which the result is withdrawn below 35% is edible, 35- 45% need quarantine for few days and warning and more than 45% considered as not edible in toxicological sense. The RBPR/TARI program pack is recorded the AchE reaction and calculated the inhibition percentage through Spectrophotometer. The increasing absorbance for sample at 412 nm is recorded and compared to the insecticide free blank (normal) AchE reaction, and the inhibition percentage is calculated.

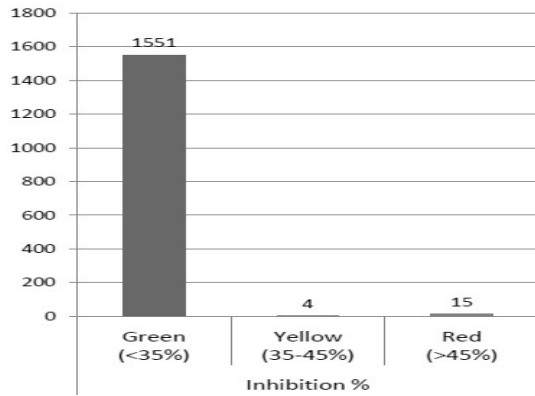
$$\%inhibition = \frac{Absorbance(normal) - Absorbancechange (Sample)}{Absorbancechange(normal)} \times 100$$

We have got the following result of residue of pesticides in fruits and vegetables in Kalimati fruits and Vegetable Market in three year after establish the RBPR laboratory.

In 2014, out of 187 samples, the inhibition percentage of 155 samples (82%) found below 35%(edible), 6 samples (3%) found in 35- 45% (quarantine) ie need to wait for some days to consume and rest 26 samples (14%) above 45%(non edible) to be dump.

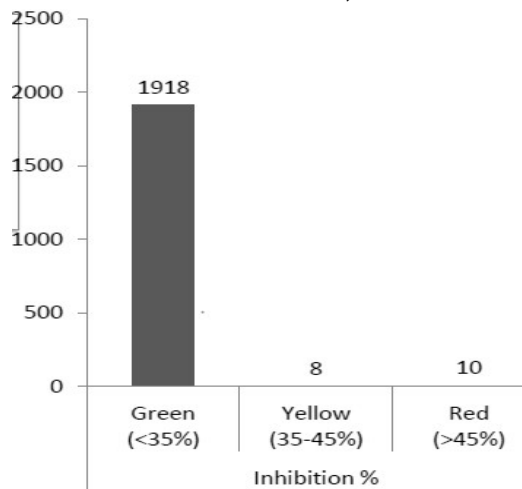


Source: PPD, 2016



In 2015, out of 1570 samples, the inhibition percentage of 1551 samples (98.7%) found below 35%(edible),4 samples (0.2%) found in 35- 45% (quarantine) ie need to wait for some days to consume and rest 15 samples (1%) above 45% (non edible) to be dump.

Source: PPD, 2016



In 2016, out of 1918 samples, the inhibition percentage of 1918 samples (99.1%) found below 35%(edible),8 samples (0.4%) found in 35- 45% (quarantine) i.e. need to wait for some days to consume and rest 10 samples (0.5%) above 45% (non edible) to be dump.

The three year analysis result showed that the farmers have increased the knowledge of waiting period pesticide or they used the safe level of pesticide in vegetables, fruits and potato. The region may be those marketing commodities which may have higher pesticide residue may be sold another market rather than the Kalimati.

Source: PPD,

Source: PPD, 2016

We can draw the conclusion by the three year analysis report of RBPR laboratory Kalimati, farmers have aware the safe use of pesticide for market their products, District Agriculture Offices and Regional Training Centers also have conducted the safe use of pesticide and consciousness raised in the consumer level. So due to its positive impacts on the program, Government of Nepal have started to establish RBPR laboratory in Jhapa (Birtamod),Sarlahi (Nawalpur), Kaski (Pokhara), Rupandehi (Butwal), Banke (Nepalgunj),Kailali (Attaria).

National action of the Rotterdam Convention

Nepal is a party of Basel, Rotterdam and Stockholm Conventions and should fulfill the obligations. Ministry of Agricultural Development has Designated National Authority (DNA) of industrial chemicals and pesticides of Rotterdam Convention. The Government of Nepal has decided to band fifteen following pesticides and chemicals for their import, production and use.

Table 9: Banned pesticide in Nepal

SN	Name of pesticide	Category on RC	SN	Name of pesticides	Category on RC
1.	Aldrin	Annex A	9.	Organo mercury compound	
2.	BHC	POP	10.	Mirex	Annex B
3.	Chlordane	Annex A	11.	Phosphamidon	SHPF
4.	DDT	Annex B	12.	Toxaphene	Annex B
5.	Dieldrin	Annex A	13.	Methyle parathion	SHPF
6.	Endrin	Annex A	14.	Monochrotophos	
7.	Heptaclor	Annex A	15.	Endosulfan	
8.	Lindane	Annex B			

Source: PRMD, 2012, MoAD, 2015

The important source of information on pesticides in Asia and Pacific is pesticide database of Asia Pacific Plant Protection Convention (APPPC) website, which contains among others information on the list of registered pesticide and the list of banned and restricted pesticide in Asia. According to the recent report developed by the Asia Pacific Plant Protection Convention, the statuses of banned pesticides in the region are as follows:

Table 10: Prohibited and banned pesticides in listed countries of Asia

Countries	Number of prohibited and banned pesticides
China	58
India	72
Indonesia	101(Including pesticides banned in rice)
Laos	55
Malaysia	45
Nepal	15
Srilanka	40
Thailand	40
Vietnam	203 (including industrial chemicals)

Source: Paper presented on “Sub -Regional Workshp for the Designated National Authorities on the Rottardam Convention focusing on Increasing Notification “at Surabaya, Indonesia on March 13-17, 2017 and organized by FAO/APPPC, Rottardam Convention Secretariate and Ministry of Agriculture, Indonesia

Obligations to international plant protection convention

Members of International Plant Protection Convention have to submit reports on national obligations, viz. description of NPPO, legislation (phytosanitary requirements, restriction,

prohibition), entry points, list of regulatory pests, pest reports (33 commodities), organizational arrangements of plant protection, rational for phytosanitary requirements, non-compliance, pest status, emergency actions. Organizational arrangements of plant protection, rational for phytosanitary requirements, non-compliance, and emergency actions. In this line, in 2005, a list of banana (*Musa sapientum* L.) diseases of regulated pests, in 2011, new insect in mango, red banded mango caterpillar (*Deanolis sublimbalis*), and in 2016, South American tomato leaf miner (*Tuta osbsoluta*) have been observed and reported to IPPC.

3.7 Pesticide Association of Nepal

Pesticide Association of Nepal (PAN) is an umbrella organization of pesticide professionals established in 1977 to integrate the Nepali firms, companies and individuals involved in the import, distribution and marketing of pesticides. The association specially focuses to aware on the safe use, handling and disposal of pesticides through training and mass communication and facilitates the licensing training for participants. This organization has been involving in most of pesticide activities conducted by the PRMD.

NATIONAL CHALLENGES

Most of the pesticides used in Nepal are imported from India and China. The government has not provided any subsidy in pesticides. The pesticide market has been taken over by whole sellers and retailers. More than 60% farmers are consulting the pesticide resellers for seeking advice to their problems while most of the resellers are non-technical persons, and so increase chances of misuse and improper handling of pesticide. Different kinds of national challenges on the national prospective are as follows:

- Landlocked country and porous border where pesticides can easily penetrate.
- Illegal entry of pesticides and distribution in local market.
- Pesticide whole sellers and retailers have not sufficient knowledge on agriculture and pesticide transport, storage, use and disposal.
- Due to open and porous border situation, there may be chances of movement of non-registered and banned pesticides as well.
- Disposal problems of date expired pesticides.
- Lack of laboratory facility for identification and quality residue and analysis.
- Lack of knowledge of farmers about the pesticides handling, use and disposal.
- Resellers cannot supply standard bio-pesticides in sufficient quantity.

WAY FORWARD

Afer the development of high yielding new varieties of crops, vegetables, and fruits the use of pesticides have increased due to succceptability of disease and pests in those varieties. Off-season vegetable and year round production of other crops also increased the demand of pesticides. Pesticide Registration and Management Division has doing for the registration, monitoring, banned of highly peaticides and resion of program in the management of pesticides with in the country. Some immediate and urgent actions to be taken in the field of pesticide managent are:

- The new pesticide management bill in the parliament with appropriate decision might help to manage the pesticide in the new perspective.
- Highly hazardous pesticide (Ia) of WHO class are to be replaced by other alternatives and prohibit their registration in coming days.
- Mass campaign and advocacy is necessary on the safe production, safe selection, and safe use, personal safety during application, enough waiting period, and proper disposal of pesticides.
- Timely actions are required for the promotion of organic production, IPM technology, use of biochar, bio-pesticide, lures and pheromones for the pest management and reduction in pesticide residues.
- Good linkage and coordination is needed with relevant Regional and International organizations for technical and financial support in pests and pesticide management.

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