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RESEARCH ARTICLE

SCENARIO OF PESTICIDE IMPORT, FORMULATION, CONSUMPTION AND THE RESIDUE STATUS AMONG AGRICULTURAL CROPS IN NEPAL

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ABSTRACT

The haphazard and unsystematic pesticide use has marred the existing conventional agriculture system of Nepal and Nepalese agriculture is also impinged from its impact to a great extent. Pesticide use being less tedious, more economic, and easy to use in one hand and high import of the pesticides through pervious border on the other has made farmers to embrace pesticide dependent farming practices more often. The study is focused on assessing the pesticide use status of the country, import and formulation, pesticide residue on agricultural produces from few years back to present, and the dire economy supposed to be forecasted in Nepalese agriculture in near future as a result of these scenarios. The chemical pesticides were imported in the country during 1950s for the first time. The national average of pesticide use is 396gm a.i/ha. The terai region of the country is hotspot of excessive pesticide use (995 gm a.i/ha). Among the pesticides used in agricultural produces, vegetables dominate the most (90%). The highest percentage share of the pesticide on total pesticide use is fungicide (49%). Reviewing the trend of 20 years scenario of pesticide import from 1997/98 to 2017/18, the result seems transcending surprisingly. The increment of pesticide residue in agricultural produce such as fruits and vegetables is challenging the human and animal health as well as encumbering the goal to food security and sustainability. This scenario directs the need of healthy agricultural practices to abate the impacts of excessive pesticide use so as to ensure food and nutritional security and agricultural sustainability.

KEYWORDS

agriculture, food, pesticide, sustainability.

1. INTRODUCTION

Pesticides are substances or mixture of substance deliberately used for preventing, eradicating, repelling or minimizing the damage of any pest (Eldridge, 2008) . The sectors where most common pesticides belong are agriculture and health (Yadav, et al., 2015). Pesticides can be classified as insecticides, herbicide, nematicides, bactericides, rodenticides, molluscicides, algaecides, acaricides, repellents, larvicides, virucides, termiticides etc (PAN, 2012). Pesticides have been used as an important tool for controlling pest with the aim of reducing yield loss due to pest infestation (Khanal, 2016). The use of such agrochemicals or pesticides in the agriculture sector has created four-fold problems through tropic levels: health related problems, environmental problems, yield loss due to non-target pesticide application resulting in pesticide induced pests resurgence and finally financial burden to the farmers (Koirala, et al., 2009). Headache, blurred vision and back pain are the acute effects experienced by farmers due to pesticide use (Aryal, et al., 2014). The exposure of pesticides and the incidence of human chronic diseases have been linked by a number of findings and studies that effect nervous system, renal system, reproductive system and cardiovascular system (Mostafalou & Abdollahi, 2012). The continuous and unsystematic use of pesticides cause serious issues and effects on environment, such as deterioration of soil surface and ground water, micro and macro flora and fauna, crop productivity (Pimental, 2005).

(Adhikari, 2018) suggested that Nepal is predominantly an Agricultural country. The remittance share of the country is 52.4% while the AGDP share is 26.9% (MoF, 2019). The quality of soil and agricultural products has been deteriorated due to the haphazard pesticide use (PQPMC, 2019). According to (PQPMC, 2019) The Government of Nepal has banned 21 pesticides at present. Pesticide application is practiced in agricultural crops by majority of the commercial farmers of the third world nations including Nepal and they grant pesticide as panacea to the infirmities created by insects, diseases and weeds in agriculture crops, particularly vegetables. It has also challenged the existence of non-target organisms in the nature (Atreya, et al., 2011). More than 90% of the pesticides are used in vegetable production which has been revealed by several studies (Atreya & Sitaula, 2010). In Nepalese context, higher pesticide using districts are Kavre, Morang, Chitwan, Dhading, Siraha, Rautahat, Kaski, Dang, Banke, Kailali, Kanchanpur, Sindhuli, Dhading, Makawanpur, Parsa, Bara, Rautahat, Kaski, Dang, Banke, Kailali, and Kanchanpur featured with a large commercial vegetable production area (G.C, 2012). On ecological basis however, the highest average land using pesticides is of terai (12%), hilly (4.9%) and mountain (0.7%) and mostly in the rice, wheat. Maize, potato and vegetables (Kanshakar, et al., 2002).

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Table 1: Registered pesticides of Nepal (upto December 15, 2018)

S.N	PESTICIDES	TRADE NAME	COMMON NAME
1	Insecticides	1635	60
2	Acaricide	28	6
3	Fungicide	746	42
4	Bactericide	17	1
5	Herbicide	436	30
6	Rodenticide	38	2
7	Molluscicide	2	1
8	biopesticide	113	14
9	Nematicide	1	1
10	Herbal	19	13
	Total	3035	170

(PRMD, 2018)

At present, there are 219 license owned pesticide importers and 5 formulators (PRMD, 2018). About 11,908 resellers out of the total resellers of the country have received training on storage management and safe use of pesticides, 12,887 license holders have been selling pesticides through agrovets. Under Pesticides Act 1991 and Pesticides Rules 1993, 139 pesticide types by common name and 2,576 pesticide types by trade name have been registered for use (PRMD, 2018). The Plant Protection Directorate (PPD) carries the implementation of the programs and policies regarding pesticide use. (Kafle, et al., 2014) mention that Plant Protection Act 1972 and Regulation 1974 and Pesticide Act 1991 and Regulation 1994 mentioned that plant protection activities are carried out by PPD. As an alternative to chemical pesticides, Integrated Pest Management (IPM) is suggested by a number of scholars for controlling the pest infestation in developing world like Nepal (Pretty, 2015). However, the speculation of "if little is good, a more will be better" regarding pesticide has created havoc in human and other life forms hurdling the goal to sustainable agriculture.

2. Materials and Methods

The study is primarily based on the number of literature reviews with plethora of materials regarding pesticide use status on global and Nepalese context. The sources of information which I have gone through thoroughly such as journal articles, conference proceedings, book sections, websites, report etc., have been cornucopia of information to complete and embellish the article.

3. Result and Discussions

3.1 Glimpse on global pesticide use scenario

Globally, Asia holds a higher market for agrochemicals and accounts for 43.1% revenue in 2008 (Agronews, 2009). The use of pesticides is increasing in rapid pace in developing countries, mostly of South-East Asia (Kunstadter, 2007) (Schreinemachers & Tipraqsa, 2012). The sale of pesticides reached to U.S $ 32.9 by 2006, and it was expected to increase by 0.85% annually (Agrow, 2007). The major producer, user and exporter of pesticides in the world is China(Yang, 2007) where India, our neighboring country, is the second largest manufacturer of pesticides in Asia after China with 12th rank globally (Mathur, 2010).

Table 2: Annual pesticide consumption in different Asian countries.

S. N	Country	Pesticide used (tones)
1.	China	1,807,000
2.	India	56,120
3.	Malaysia	49,199
4.	Pakistan	27,885
5.	Thailand	21,800
6.	Vietnam	19,154
7.	South korea	19,788
8.	Bangladesh	15,833
9.	Myanmar	5,583
10.	Nepal	454
11.	Bhutan	12

(FAO, 2017)

3.2 Pesticide import in Nepal

Chemical pesticide was introduced in Nepal during the 1950s (Dahal, 1995) when there was the import of Gammaxene, Paris-Green and Nicotine Sulfates from the USA to control malaria. DDT, however made the first impact in the year 1956 and was followed by organochlorines (such as chlordane, BHC, Dieldrin) in 1950s, organophosphates(like methyl parathion, ethyl parathion, malathion and oxydemeton methyl), carbamates and finally synthetic pyrethroides (Atreya, 2008; K.S, 2000). The import and formulation of pesticides in Nepal in the year 1997/1998 was about 50 thousands kg which has surged to about 350 thousands kg in the year 2011/2012 that is more than 6 folds increase and showing the increase in dependency of vegetable growers on pesticide for increasing productivity (Kafle, et al., 2015). In the year 2011/2012, the expenditure rose to more than 374 million NRs (Dhital, et al., 2015). The 2017/18 data revealed that the total pesticide imported and formulated in Nepal for insecticides, fungicides, bactericides, herbicides, rodenticides, molluscicides, biopesticides and herbal were worth 43,17,32,760, 22,35,71,195, 12,97,585, 16,29,94,089, 1,14,67,197, 11,00,452, 22,60,388, and 13,57,300 NRs respectively (PRMD, 2018).

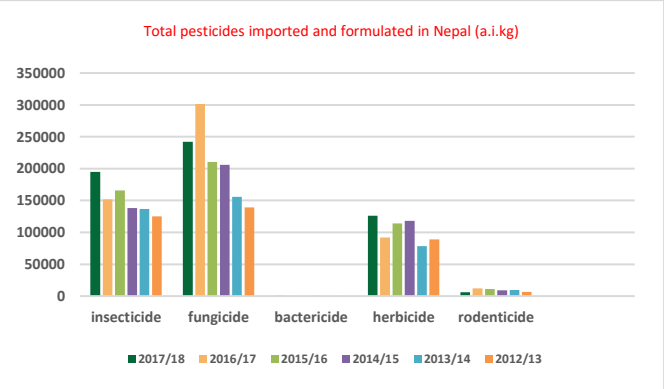

Figure 1: Total pesticides imported and formulated in Nepal from 2012/13 to 2017/18.

(PRMD, 2018)

Reviewing the trend analysis on import of chemical pesticides, it was found to have a proportionate increment after 2006/07 and was probably due to increase in application of pesticides on high value vegetable production that has replaced low-earning cereal crops in hills (International, 2014). According to the economic survey (2007/08), the extensive malaria and kala-azar control program running in 11 districts of Nepal also facilitated the use of pesticides in Health sector. The stimulation of chemical pesticide use for increasing production was also abetted by the extension services of Department of Agriculture (DoA) (NPC, 2004).

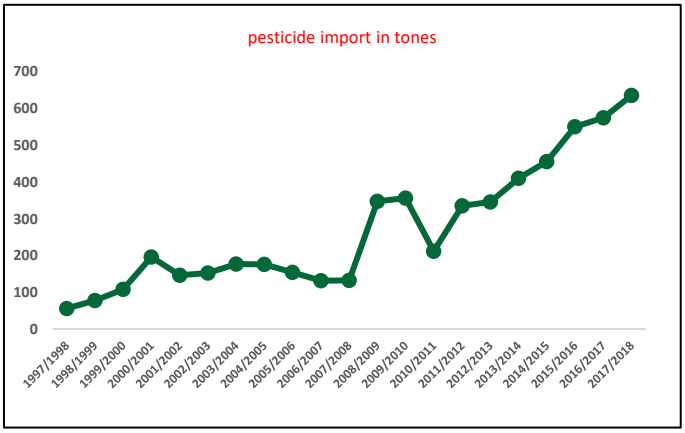

Figure 2: Pesticide import (in tones) trend from 1997/98 to 2017/18

(PRMD, 2018)

3.3 Share of different pesticides on total pesticide use

The country imports several types of pesticides each year for the use in agricultural crops like cereals, vegetables, cash crops, pulses, fruits and so on. In the context of least developed countries like Nepal, pesticides use in the field of agriculture become inseparable where farmers need a quick, efficient and cheap method to get rid of the pest and to reduce pest problems in the field (Aatreya, et al., 2011). The various types of pesticides used in Nepal include insecticide, fungicide, herbicide, bactericide, acaricide, rodenticide, molluscicide, biopesticide and herbal product (PRMD, 2018).

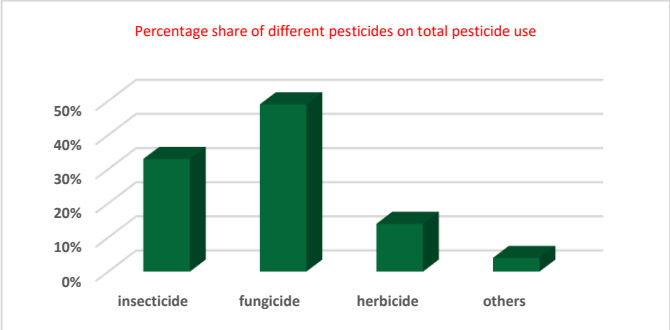

Figure 3: Share of different pesticides (%) on total pesticide use.

(PRMD, 2018)

According to the report of the Pesticide Registration and Management Division, 2018, the highest share of the pesticide on total pesticide use is fungicide, followed by insecticide, herbicide, rodenticide and so on. The data also shows that the share of fungicide, insecticide, herbicide and others on total annual pesticide use was 49%, 33%, 14% and 4% respectively.It is also reported that they are fungicides which are used most in the country followed by insecticides, herbicides, bio-pesticides, rodenticides and acaricides (GC, 2018). These data signify that majority of the farmers experience the infestation of fungal pathogens on agricultural crops followed by the insect pest and so on.

3.4 Pesticide consumption scenario

The domestic consumption of pesticide in Nepal was very low 0.142 a.i. kg/ha as studied by International Union for Conservation of Nature (IUCN, 1995) comparing with other countries like India (0.5 kg/ha), Mexico (0.75 kg/ha), Germany (3 kg/ha), UK (5 kg/ha), USA (7kg/ha), Netherlands (9.4kg/ha), Japan (12 kg/ha), China (14 kg/ha) and Taiwan (17kg/ha). The recent report of Plant Protection Directorate (PPD) revealed that the national average consumption of pesticides is 0.396 kg a.i/ha. In the year 2011/2012, more than 48% of pesticides were used in the form of fungicides (PRMS, 2012). The total active ingredient used in the pesticide during the year 2011/2012 was about 345 thousands kg or liters of which very minimal amount has been used for public health use (Dhital, et al., 2015). In Nepal, the consumption of pesticide is increasing by about 10%–20% per year. About 500 different brands of insecticides, 7 acaricides, 229 brands of fungicides, 6 bactericides, 88 herbicides, 10 rodenticides, and 19 biopesticides are used in the country currently (Khanal & Singh, 2016). The initiation of the pesticide consumption started during 19th century where population growth influenced the agriculture intensification of terai region leading the virgin land to cultivation (Joshi, et al., 2012). The clearance of forest land of hill and the mass exodus from India to the Terai region increased the population of the terai region and at that time, pesticide made their first impact in public health (Fernandez-Alba & Garca-Reyes, 2008). The recent report of Plant Protection Directorate (PPD) revealed that the national average consumption of pesticides is 0.396 kg a.i/ha.

Table 3: Pesticide consumption based on ecological region.

Ecological Belt	Total Pesticide applied (Kg a.i)	Percentage	Quantity (Kg a.i/ha)
High hill	23.83	4	0.08
Hill	114.4	20	0.314
Terai	392.4	59	0.995
Valley	94.22	17	0.470
Total	574.9	100	

(PPD, 2014)

Table 4: Pesticide consumption by crop.

Crops	Total Pesticide (Kg a.i)	Total area (ha)	Quantity (Kg a.i/ha)
Cereals	43.96	953.38	0.046
Vegetables	513.97	320.29	1. 60
Cash crops	12.92	69.27	0.19
Pulses	2.18	42.91	0.0
Fruits	1.95	66.89	0.03
Total	575	1452.73	

(PPD, 2014)

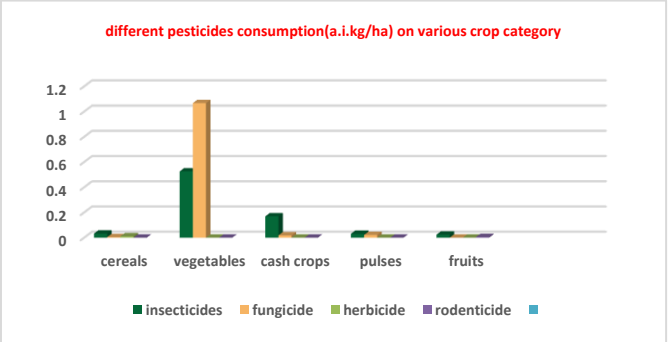

Figure 4: Different pesticides consumed (a.i.kg/ha) on various crop category.

(PRMD, 2018)

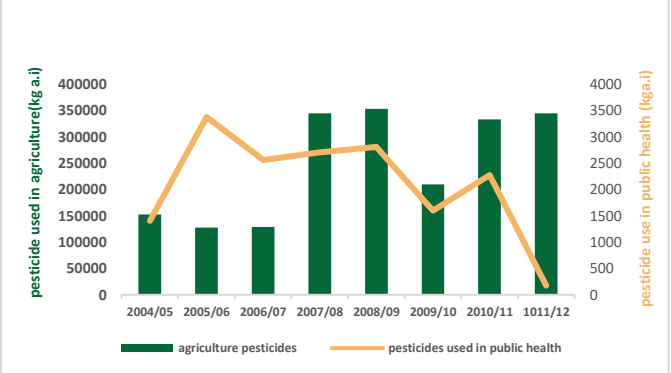

Figure 5: Pesticide used in Agriculture and Public health (a.i.kg/ha)

(PRMD, 2018)

3.5 Pesticide residue on agricultural produces

In Nepal, the investigation of DDT residue levels in common cereals, pulses, oil seeds, milk, fruits and vegetables seem to be initiated in 1981 (Joshi, 1988). The investigation on pesticide residue, particularly on vegetables and some exportable agricultural produces was started by the Entomology Division, NARC since 1998 and in this context, the very division has generated data on insecticides (organochlorines and organophosphates) on vegetable crops (Anonymous, 1998). Department of Food Technology and Quality control regulates the pesticide residue in food products in Nepal (Koirala & Tamrakar, 2008). Currently, Rapid Pesticide Residue Analysis Laboratory, Kalimati is also actively working in sector of regulation of pesticides. While testing for the pesticide residue on tomato in 2004/05, the concentration of Dimethoate, Chlorpyrifos, Monocrotophus and Methyl parathion on 1st, 3rd, 7th and 15th day were found to reduce from 0.63ppm to 0.025ppm, 0.24ppm to 0.116ppm, 0.178ppm to 0.087ppm and 1.43ppm to 0.005ppm (Anonymous, 2005). Similarly, the same treatment on same day difference on tomato in 2005/06 was found to reduce from 0.6383ppm to 0.0622ppm, 3.0375ppm to 0.7239ppm, 0.7588ppm to 0.3284ppm and 1.1325ppm to 0.0166ppm respectively (Anonymous, 2006). This signifies the waiting period as mandatory to attenuate the residue impact on Human health. After the establishment of Laboratory centre Kalimati on 5th Ashad, 2071, the pesticide residue test was started. The lab report of Kalimati reported that there is excessive pesticide residue on agricultural produces, particularly on vegetables (tomato, beans and cauliflower)

Table 5: Report on pesticide residue on tested vegetable samples of Kalimati Laboratory

Fiscal year (B.S)	Number of samples tested	Samples with pesticide residue
2071/72	1570	4
2072/73	1936	10
2073/74	1930	22
2074/75	1850	3
2075/76	3124	2
2076/77 (upto Magh 20)	1402	12 (with extreme pesticide residue)

(Kalimati laboratory, 2020)

A number of pesticides were banned in many countries after the Rotterdam convention and majority of them were of moderately hazardous categories. Nepal has banned 21 pesticides (16 pesticides previously and 5 recently) at present (Diary, 2019).

Table 6: Banned pesticides in Nepal

SN	Common name	WHO group	Hazard level	Banned Year
1	Chlordane	II	Moderately Hazardous	2001
2	DDT	II	Moderately Hazardous	2001
3	Dieldrin	O	Obsolete as pesticide, not classified	2001
4	Endrin	O	Obsolete as pesticide, not classified	2001
5	Aldrin	O	Obsolete as pesticide, not classified	2001
6	Heptachlor	O	Obsolete as pesticide, not classified	2001
7	Mirex	O	Obsolete as pesticide, not classified	2001
8	Toxaphene	O	Obsolete as pesticide, not classified	2001
9	BHC	II	Moderately Hazardous	2001
10	Lindane	II	Moderately Hazardous	2001
11	Phosphamidon	Ia	Extremely Hazardous	2001
12	Organomercuric compound	II	Moderately Hazardous	2001
13	Methyl parathion	Ia	Extremely Hazardous	2007
14	Monocrotophos	Ib	Highly Hazardous	2007
15	Endosulphan	II	Moderately Hazardous	2009
16	Phorate			2015
17.	Carbofuran	II	Moderately Hazardous	2019
18.	Carbaryl	II	Moderately Hazardous	2019
19.	Dichlorovus	Ib	Highly Hazardous	2019
20.	Triazophus	II	Moderately Hazardous	2019
21.	Benomyl	III	Slightly Hazardous	2019

(PRMD, 2018) (Diary, 2019)

4. What's Next?

While shifting from the traditional farming system to the present day conventional system, the potent use of agrochemicals and their hazard on human health and environment have rose in tandem. In order not to blemish the existing farming system protocol and the agricultural practices, promotion of environment friendly farming techniques embracing the organic farming system is utmost necessary. Green manures, biopesticides, biofertilizers, biofungicides, botanical pesticides and trap crops can be suitable option to supersede the existing pesticide dominated conventional farming system. Regarding the potential to improve soil fertility and nutrient recycling, organic farming suits a better option (IFOAM, 2008). Organic farming is far better than conventional agriculture when it comes to building, maintenance and replenish the soil health (RI, 2011). Various evidences suggest the need to improve the existing conventional agriculture with ecologically sound practices like organic agriculture. On the basis of direct energy consumption (fuel and oil) and indirect energy consumption (synthetic fertilizers and pesticides), organic agriculture surpasses conventional agriculture (Scialababa & Hattam, 2002). Such practices can also be used to minimize pest infestation in crucifers (cabbage). (Parajul & Paudel, 2019) reviewed the option to reduce infestation of Diamondback moth of cabbage using eco friendly measures rather using agro-chemicals. Thus, the need of environment friendly agricultural practice is inevitable to transcend the existing agricultural system of Nepal to ensure food and nutritional security.

5. Conclusions

The trend of pesticide import and formulation are surpassing each successive year which is manifests a serious havoc challenging food security and sustainability in near future. Quick response, easy to use and handle, minimum awareness level and more economic are probably the major reasons for choosing pesticides over bio-control farming in Nepal Among the various pesticides, fungicide is the major one used in the context of our country followed by insecticide. The terai region among the ecological regions of the country is dominated by the excessive and haphazard pesticide use in agricultural commodities followed by valley, hill and high hill. The use of pesticides on public health sector too is melancholic. Vegetables are dominated by the heavy use of pesticides among agricultural produces and thus, the residue limit is exceeding on it each year. There are very limited institutions and laboratories to examine the analysis of pesticide residue on fruits, vegetables, cereals , cash crops, pulses and oil seeds and so on and the manpower to handle these institutions is scant.

Recommendations

The prime concern for descending the pesticide use in agricultural commodities should be addressed through the grass-root level. Thus, proper primary pesticide knowledge to the farmers should be given regarding 'why pesticides?'.As consumers are becoming more aware of pesticide externalities and demanding pesticides free agricultural produces, many national and international policies are trying to regulate pesticide use. Effective national policies regarding minimization of the pesticide use and alternatives to chemical pest management practices should be implemented. While considering the strengthening of pesticide legislation and regulation, some existing pesticide act and regulations should be amended as per the need and context of present agriculture scenario. PPD/PRMD under Department of Agriculture (DoA) should include and implement Good Agricultural Practices (GAP) for each registered pesticides as a part of registration process. The control mechanisms should be implemented in the porous border to strengthen import control of hazardous agrochemicals. Prioritizing bio-control demonstration and mass awareness, eliminating the most hazardous pesticides, encouraging alternatives to chemical pesticides (like intensive IPM program, use of bio-control agents, botanical pesticides, trap cropping, green manuring practices.etc), intensive advocacy, coordination and monitoring activities and so on need to be in practice.

References

Aatreya, K., Sitaula, B., Johnsen, F., & Bajhracharya, R. 2011. Continuing Issues In the Limitations of Pesticide Use In Developing Countries. Journal of Agricultre Environment Ethics, 49-62.

Adhikari. 2018. An overview of pesticide manaement in Nepal. Journal of Agriculture and Environment, 18, 95-105.

Agronews. 2009. Global agrochemicals market (2009-2014). Retrieved from http//news.agropages.com/Report/53 html

Agrow. 2007. AGROW's top 20: 2007 Edition. Retrieved from http://www.agrow.com/reports/agrow_top20_2007_chapter1.shtml

Anderson, H., Tago, D., & Treich, N. 2014. Pesticides and Health: A Review of evidence on health effects, valuation of risks, and benefit-cost analysis. Advances in Health Economics and Health Services Research, 1-61.

Anonymous. 1998. Annual Technical Report 1997/98. Khumaltar, Lalitpur, Nepal: Entomology Divison, Nepal Agricultural Research Council.

Anonymous. 2005. Annual Technical Report 2004/05. Khumaltar, Lalitpur, Nepal: Entomology Division, Nepal Agricultural Research Council.

Anonymous. 2006. Pesticide residue work on some vegetables. Entomology Division. Khumaltar, Lalitpur, Nepal: Nepal AgriculturAL Research Council.

Aryal, K., Neupane, S., Lohani, G., Jors, E., Neupane, D., & Khanal, P. 2014. Health Effects of Pesticides Among Vegetable Farmers and the

Adaptation Level of Integrated Pest Management in Nepal. Kathmandu: Nepal Health Research Council.

Atreya, K. 2008. Proabilistic assessment of acute health symptoms related to pesticide use under intensified Nepalese Agriculture. International Journal of Environment Health Reserch, 18(3), 187-208.

Atreya, K. J. 2011. Health and environmental costs of pesticide use in vegetable farming in nepal. Environ. Dev. Sustain. 14, 477-493.

Atreya, K. J. 2012. Health and Environment costs of pesticide use in vegetable farming in Nepal. Environment Development and Sustainability.

Atreya, K., & Sitaula, B. 2010. Mancozeb: Growing Risk for agriculture commodities, 6(8).

Bhandari, G. 2014. An Overview of Agrochemicals and their effects on Environment in Nepal. Applied Ecology and Environmental Sciences, 66-73.

Canada. 2002. A History of Crop Protection and Pest Control in our Society. Crop Life.

Dahal. 1995. A study on pesticide pollution in Nepal. Kathmandu, Nepal: National Planning Comission, Government of Nepal, in collaboration with International Union for Conservation of Nature (IUCN).

Dhital, S., Rupakheti, D., Tripathee, L., & Sigdel, S. 2015. A review on Status of Pesticides Use in Nepal. Research Journal of Agriculture and Forestry Sciences, 26-29.

Diary, K. 2019. Banned Pesticides in Nepal. Agriculture Information Training Centre.

Eldridge, B. 2008. Pesticide application and safety training for applicators of public health pesticides. In Vector-Borne Disease Section (p. 1616). Capital Avenue, MS7307, P.O.Box 997377: Sacramento, C.A.

EPA. 1999. Recognition and management of pesticide poisoning. In Office of Pesticide Programs. Washington DC, USA: United States Environmental Protection Agency.

Fantke, P. W. 2013. Dynamics of pesticide uptake into plants from system functioning to parsimonious modeling. Environ.Model.Softw. 40, 316-324.

FAO. 2017. Pesticide residues in food. Rome: Food And Agriculture Organizations of the United Nations.

Fernandez-Alba, A., & Garca-Reyes, J. 2008. Large scale multi residue methods for pesticides and their degradation products in food by advanced LC-MS.Trac-Trend. Analytical Chemistry, 973-990.

G.C. 2012. Status of Pesticide Use in Nepal and Future Strategy for their safe and alternative use.

GC, Y. 2018. Status of Plant Protection Activities in Nepal. Retrieved from IPPC: https://www.ippc.int/static/media/files/publications/1310180880_21b _Nepal2.pdf

Gupta, P. 2004. Pesticide exposure- Indian scene. Toxicology, 83-90.

Harrison, S. 1990. The fate of pesticides in the environment. Penn, USA: Agrochemical Fact Sheet.

Hussain, S., Siddique, T., Saleem, M., Arshad, M., & Khalid, A. 2009. Impact of pesticides on soil microbial diversity, enzymes and biochemical reactions. Adances in Agronomy, 159-200.

Ibitayo, O. 2006. Egyptian farmers' attitide and behaviour regarding agricultural pesticides: implications for pest risk communication. Risk Anal 26, 989-995.

IFOAM. 2008. Criticisms and frequent misconceptions about organic agriculture: the counter-arguments. Retrieved from www.ifoam.org

International, W. 2014. Knowledge -based integrated sustainable agriculture and nutrition (KISAN) project pesticides evaluation report and safer use action plan (PERSUAP). Washington DC: USAID.

International, W. 2014. Knowledge Based Interated Sustainable Agriculture And Nutrition (KISAN) project pesticides evaluation report and safer use action plan (PERSUAP). Washington DC: USAID.

Joshi, K., Conroy, C., & Witcombe, J. 2012. Agriculture, seed and innovation in Nepal: Industry and policy issues for the future. 2033 k Street, NW|Washington DC: International Food Policy Research Institute.

Joshi, U. 1988. Monitoring of DDT residues in food articles of Nepal. Proceedings of First National Conference on Science and Technology, April 24-29. Kathmandu, Nepal: Royal Academy of Science and Technology.

K.S. 2000. Pesticide Usage in the United States: History, Benefits, Risk and Trends. The University of Georgia College of Agricultural and Environmental Sciences.

Kafle, B., Pokhrel, B., Shrestha, S., Raut, R., & Dahal, B. 2015. Determination of Pesticide Residue in Water and Soil Samples from Ansikhola Watershed, Kavre, Nepal. International Journal of Geology, Earth And Environmental Sciences, 119-127.

Kafle, L., G.C, Y., Yang, J., Bhattarai, S., Tiwari, S., & Katuwal, M. 2014. Integrated Pest Management in Nepal.

Kanshakar, V., khanal, N., & Ghimire, M. 2002. Use of Insecticides in Nepal. Kathmandu: Proc. in developing Countries.

Khanal, G. S. 2016. Patterns of pesticide use and associated factors among the commercial farmers of chitwan, Nepal. Ennviro. Health Insights 10, 1-7.

Khanal, G., & Singh, A. 2016. Patterns of Pesticide Use and Associated Factors Among the Commercial Farmers of Chitwan, Nepal. Environmental Health Insights, 1-7.

Koirala, P. K. 2007. Pesticide residues as environmental contaminants in foods in Nepal. J.Agric. Environ.8, 311-318.

Koirala, P., & Tamrakar, A. 2008. Analytical capability on pesticide analysis in food in Nepal(abstract). Proceedings of 5th National Seminar (pp. 10-12). Kathmandu, Nepal: Nepal Academy of Science and Technology.

Koirala, P.,Dhakal.S and Tamrakar,A.S. 2009. Pesticide Application And Food Saety Issue In Nepal. The Journal of Agriculture And Environment, 111-114.

Kunstadter, P. 2007. Pesticides in Southeast Asia: environmental, biomedical and economic uses and effects. Silkworm Books, Ms Trasvin.

Mathur, S. 2010. Future of Indian pesticides Industry in next millenium. Pesticide Information, 9-23.

MoAD. 2014. Kathmandu.

MoF. 2019. Economic survey. Kathmndu, Nepal. Retrieved May 2019

Mostafalou, S., & Abdollahi, M. 2012. Concerns of environmental persistence of pesticides and human chronic diseases. Clinical and Experimental Pharmacology S5: e002.

NPC. 2004. Enhancing the Competitive Strength of the Nepalese Agricultural Produces. Singhadurbar Kathmandu: National Planning Comission Secretariat, Central Monitoring and Evaluation Division, Government of Nepal.

PAN. 2012. Pesticides and health hazards, Facts and Figures. Germany, GLS Gemeinschafsbank: Pesticide Action Network.

Parajul, S., & Paudel, S. 2019. Eco-Friendly Management of Diamondback Moth Plutella xylostella L.) of Cabbage (Brassica oleracea var. Capitata) in Nepal. International Journal of Applied Sciences and Biotechology (IJASBT), 7(3), 304-308.

Pesticide Management and Registration Division. 2018. List of Registered Pesticides in Nepal. Harihar bhawan, Lalitpur: Department of Agriculture.

Pimental, D. 2005. Environmental and economic costs of the application of pesticides primarily in the United States. Environment, Development And Sustainability, 229-252.

Pimental, D. 2005. Environmental and economic costs of the application of pesticides primarily in the United States. Environ.Dev.Sustainability.7, 229-252.

PPD. 2008. Annual Progress Report. Hariharbhawan: Plant Protection Directorate.

PPD. 2014. Survey on National Pesticide Consumption Statistics in Nepal. Harihar bhawan, Lalitpur: Plant Protection Directorate.

PPD. 2015. Annual Progress Report. Hariharbhawan: Plant Protection Directorate.

PQPMC. 2019. List of registered pesticides and pesticide consumption statistics. Plant Quarantine and Pesticide Management Centre. Retrieved August 29, 2019

Pretty, J. B. 2015. Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects 6, 152-182.

PRMD, 2018. List of Registered Pesticides in Nepal. Department of Agriculture. Hariarbhawan, Lalitpur: Pesticide Registration and Management Division, Plant Protection Directorate (PPD).

PRMS. 2012. Pesticide Statistical Booklet. Ministry of Agriculture Development.

PRMS. 2012. Pesticide Statistics Booklet (in Nepali Pesticide Registration and Management Section). kathmandu: Ministry of Agriculture Development.

Randall C, e. a. 2014. Pest Management. Washington: National Pesticide Applicator Certification Core Manual.

Raven, P., Berg, L., & Hassenzahl, D. 2008. Environment. John Wiley and Sons Inc.

RI. 2011. The farming system trials celebrating 30 years. USA: Rodale Institute.

Schreinemachers, P., & Tipraqsa, P. 2012. Agricultural pesticides and land use intensification in high, middle and low income countries. Food Policy, 37(6), 616-626.

Scialababa, N.-H., & Hattam, C. 2002. Organic agriculture, environment and food security. Rome: Food and Agriculture Organization (FAO). Retrieved from http://www.fao.org/docrep/005/y4137e/y4137e00.HTM on August 8, 2013

Stanhill, G. 1990. The comparative productivity of organic agriculture. 30(1-2), 1-26. Retrieved july 30, 2011, from http://www.sciencedirect.com/science/article/pii/016788099090179H

Stephan, J., Kelvin, L., & Detlef, B. 2016. Human Elimination of Organochlorine Pesticides: Blood, Urine and Sweat Study. Biomed Research International, 1-10.

WHO. 2006. Preventing disease through healthy environments: Towards an estimate of the environmental burden of disease. Paris, France: World Health Organisation of the United Nations.

WHO. 2009. In The WHO recommended classification of pesticides by hazard and guidelines to classification. 20 Avenue Appia, 1211 Geneva 27, Switzerland: World Health Organisation.

Yadav, I., Syed, J., Cheng, Z., Zhang, G., & Jones, K. 2015. Current status of persistent organic pesticides residues in air, water, and soil and their possible effects on neighboring countries. A comparative review of India, Science of Total Environment, 511, 123-137.

Yang, Y. 2007. Retrieved from Pesticides and Environmental Health Trends in China. A China environment health project factsheet. Washington, DC, USA: Woodrow-Wilson International Centre for Scholars. Retrieved from Retrieved from Pesticides and environmental health trends in China.

Yassin, M. S. 2002. Knowledge, attitude, practice, and toxicity symptoms associated with pesticide use among farm workers in the Gaza Strip. Occup. Environ. Med., 387-394.