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Review Article

Perception on biological pesticide by various levels of stakeholders in Nepal

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ABSTRACT: Government of Nepal (GoN) has been prioritizing Integrated Pest Management (IPM) strategy as the most important strategy after a sudden outbreak of Brown Plant Hopper (BPH) and heavy loss in rice production. GoN has been continuing IPM programs with the successful completion of different phases like technical cooperation, marketing and institutionalization. Awareness creation among multi-sectoral stakeholders is the most and major outcome through IPM program in Nepal. Plantwise, a global program led by CABI, has been working with GoN since 2013, for the improvement of plant health system. This program has also a good impact in the promotion of non-chemical strategies of pest management. Despite of having many national programs, efforts of GoN as well as different non-governmental and community based organizations; a significant progress has not been seen in the use of biological pesticides. This paper has tried to analyze the role of different stakeholders in the promotion of bio-pesticides along with other non-chemical management strategies viz. the trend of recommendations by plant doctors with the information retrieved from Plantwise Online Management System (POMS), perception of farmers as well as agro-input suppliers to the bio-pesticides, plant clinic interventions for bio-pesticides promotion, and policy review for finding reasons for less use of bio-pesticides in the field. Around 200 farmers who visited plant clinics and 50 agro-inputs suppliers from different regions were randomly selected for the survey with the developed questionaire. This paper is a preliminary review of secondary information on relevant policies, acts, regulations, etc. Major problem has been observed in agro-input suppliers among the whole cycle of biopesticide use.

KEY WORDS: IPM, plant clinics, plant health system, plant doctors, policy, stakeholders

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INTRODUCTION

Crop losses due to pests and diseases is a major threat to the income of rural farmers. It also threatens food security worldwide. In Nepal the pre-harvest and post-harvest average annual loss due to pests and diseases has been estimated to be around 35% (Palikhe, 2002). There are different stakeholders involved in minimizing this loss. Efforts from these stakeholders are based on their level of responsibility. Pesticide act and regulation, orders, directives are all formulated for the systematic management of chemical pesticides like import, export, formulation, manufacture, trade, use functions. National Agriculture Policy 2004, Agri Business Promotion Policy 2006 and Agriculture Development Strategy 2014 are the major guiding documents for agriculture development which are also trying to address organic agriculture though to a lesser extent. Similarly, the state has enacted National Standards of Organic Agriculture Production and Processing 2007. All of these enacted documents focus on the minimization of chemical pesticides.

Government of Nepal (GoN) has been prioritizing Integrated Pest Management (IPM) as the major strategy for the pest management in its policy. Several government agencies, allied institutions as well as Non-Governmental Organizations (NGOs) in Nepal started adopting IPM since 1998 after the outbreak of Brown Plant Hopper (*Nilaparvata lugens* Stål*)* in 1997 at Chitwan district (Yubak Dhoj, 2012; Kafle *et al*., 2014; Plant Protection Directorate [PPD], 2008; PPD, 2009). Since then many efforts have been made to minimize the use of chemical pesticides. GoN launched three phases of IPM programs namely Community IPM program (CIPM), National IPM Program Phase I and Phase II with the financial support from government of Norway and technical support from FAO. The major thrust of IPM program was is awareness creation among the farmers as well as the consumers. Establishment of seven Community IPM Resource Centers (CIPMRCs) in different parts of the country, formation and operation of national, regional and district level IPM coordination committee namely NCC,

RCC and DCC respectively are the major outputs of this program. These institutions including IPM Farmers Group in different parts of the country are playing significant roles for the non-chemical pest management practices. Plant Protection Directorate under the Ministry of Agriculture and Livestock Development (MoALD) has been supporting these CIPMRC as well as other institutions from the establishment to its operation. The concepts behind these resource centers are strengthening them up to the production and marketing of different types of bio-pesticides and developing them into centers for learning and extension. Rapid Bioassay of Pesticide Residue (RBPR) unit established in almost all of its provinces is another endeavor for the monitoring of pesticides and with the ultimate objective to minimize chemical pesticides thus for the promotion of IPM.

Pesticide Registration and Management Division (PRMD) has been established for the regulation and management of pesticide. Similarly, agriculture extension officers including plant protection officers (PPOs), junior level agriculture technicians (JTs and JTAs) are the front-line plant health advisory service providers to the farmers.

Besides these efforts of GoN, an innovative concept called plant clinic was introduced in Nepal in 2008. A plant health clinic is a community-based advisory service run by extension workers and based at public places, such as farmer cooperatives, local markets or bus stations with simple facilities such as tables, chairs, shade, photos, reference books and tools (knives, scissors, and hand lenses) to examine the sick plants (Bently *et al*., 2007). Farmers get specialist's recommendation for the control measures of the biotic or abiotic problems. Thus, the unnecessary and unwanted use of pesticide will be reduced to a great extent (Yubak Dhoj, 2012). Plant clinics after its introduction in the country gained popularity among different stakeholders of plant health system. Now with the support from CABI led plantwise program, regular plant clinics have been in operation in forty districts. This program has been trying to address the whole plant health system like data generation from plant clinics, their management and use through Plantwise Online Management System (POMS), monitoring system, empowering and encouraging non-governmental sectors, strengthening the diagnostic capacity of plant doctors involving in diagnostic services through plant clinics etc.

In spite of having all of these efforts, use of bio-pesticides in the farmers' field is not in the satisfactory level. So, this paper tries to identify the gaps among the government policies, structural arrangements and farmers' awareness in promoting and using biopesticides.

This paper is a preliminary review of secondary information on relevant policies, acts, regulations, etc. Primary information was obtained from POMS to observe the trend of biological recommendation from plant doctors. For this purpose validated data of plant clinics were obtained from POMS. There were 1197 queries from 158 different clinic sessions. Similarly, status of bio-pesticides registration was obtained and reviewed from the annual publication of 2017 from Pesticide Registration and Management Division (PRMD). Knowledge on pest management options as well as bio-pesticides by Junior Technicians (JTs) and Junior Technicians Assistants (JTAs) was assessed by voting behavior method. For this, Seventy eight JTs and JTAs, who were the participants of plant clinic trainings organized by regional plant protection laboratories on different dates, were requested to write down any two pest management options in two different cards within two minutes. Similar procedure was carried out with the same respondents to assess the knowledge on bio-pesticides. Two hundred farmers who attended plant clinics at different dates were randomly selected and assessed their knowledge about bio-pesticides. Open ended questions were asked with the farmers for this purpose. Similarly, fifty agro-input suppliers were randomly selected from different locations of the country and assessed the difficulties on bio-pesticides trade and supply by interview method. More over direct observation and experience of author were also used. The data thus obtained were analyzed with a simple MS Excel work and percentage calculation was done.

Trend of recommendation by plant doctors

Top ten crops of these sessions were tomato, paddy, cucumber, cauliflower, faba bean, chilly, bitter gourd, potato, broad leaf mustard and brinjal respectively. Interestingly nine of these ten crops are vegetable crops. Vegetable crops are considered as high value crops as they provide almost 5 to 10 times higher economic value (Pun and Karmacharya, 1998) and majority of farmers in Nepal have small holdings and have to specialize in production with high return from a small area (Gurung *et al*., 2016). There are many ecological, economical and practical reasons because of which vegetable crops are more prone to diseases and insect pests. More than 85% of the total amount of chemical pesticides is being used in vegetable crops in Nepal (PPD, 2017). If we observe the plant doctors' recommendation 333 out of total 1197 are based on biological control. So, 27.81% of the total recommendations are the recommendations which focused on biological control.

Plant doctors often provide mixed recommendations. They usually include cultural and monitoring practices and use of either chemicals or biological. As different types of recommendations are mutually inclusive that is cultural,

monitoring, resistant varieties and use of biological, chemical insecticide or fungicides, the total percentage exceeds 100%. However in most of the cases either biological or chemical recommendation has been done in isolation. So the perception on bio-pesticide by plant doctors has been observed fairly well.

Availability of bio-pesticide according to the registration status

According to pesticide registration and management unit 2017, there are only 11 types of registered biological pesticides with 78 different trade names. These pesticides are *Azadirachtin, Bacillus subtillis* 2% AS*, B. thuringiensis, Beauveria bassiana, Metarhizium anisopliae,* Nuclear Polyhedrosis Virus of *Helicoverpa armigera* 0.43% AS, Nuclear Polyhedrosis Virus of *Spodoptera litura, Paecilomyces lilacinus* 2*10^9/g SP*, Pseudomonas fluorescens, Trichoderma harzianum, T. viride* and *Verticillium lecanii*. Table 2 shows total import of Biological pesticide in Nepal is only 0.013%.

Thus, the supply of bio-pesticides in market is very less in quantity as well as the diversity of products. The use of bio-pesticides has remained very low particularly due to the following reasons; non-availability in sufficient quantity in local market, exorbitant cost, and usually farmers seek for knock down effect that a chemical pesticide will provide when compared to a biopesticide, also lack of standardized method of extraction and use and lack of industries involved in production and marketing (Ansari *et al*., 2013).

Table 1. Number of different mixed recommendations recommended by plant doctors

Recommendation type	Number	% age of recommendation on different options
Cultural	692	57.81
Biological	333	27.82
Monitoring the field	608	50.79
Resistant Varieties	59	4.93
Insecticide	463	38.68
Fungicide	333	27.82

Source: POMS, 2018

Memory of technicians on the different pest management options

Among 78 Junior Technicians (JTs) and Junior Technical Assistance (JTAs) almost 31% (n=24) proposed cultural method as the first recommendation and similar reaction was observed for the chemical too. Only 15% (n=12) of the participants perceived biological method of pest management as the first rank.

Farmers' perception on biopesticides

There were 23.5% (n=47) farmers out of 200 who participated in IPM-FFS. Among these IPM farmers 97.87% (n=46) knew about use of biopesticides however only 15.21% (n=7) could tell the name of at least 2 biopesticides available in the market. Only 7.5% (n=15) farmers procured and used biopesticides. Rest of the farmers only put the biopesticide as the first priority which did not necessarily mean that they would use biopesticides always. The mostly used biopesticides are *Azadirachtin* and *Trichoderma*. All these farmers were familiar with the preparation and use of home made biopesticides prepared from different botanicals and accepted that these home made formulations worked very well if it was correctly prepared. However only 19.56% (n=9) of IPM farmers practiced preparation of home made biopesticides using different botanicals.

There were 153 farmers out of 200 who never participated in IPM-FFS. Among these non-IPM farmers 13.72% (n=21) knew about biopesticides.

There were 41.83% (n= 64) clinic farmers who knew about the use of biopesticides. Out of them 26.56% (17) adopted use of different biopesticides after getting the prescription from the plant doctor. All of these 17 farmers correctly told the name of at least two biopesticides *Trichoderma*a and Neem. Thus, plant clinics could provide adequate information about biopesticides and their use and was more effective than extension methods.

Reasons for less availability of biopesticides - perception of agro-input suppliers

There were 50 agro-input suppliers from different parts

Table 2. Trend of chemical and biological pesticide import in Nepal

Types of Pesticide	Imported a.i. (kg) on 2012/13	Imported a.i. (kg) on 2013/14	Imported a.i. (kg) on 2014/15	Imported a.i. (kg) on 2015/16
Chemical	360336	380562	471324	501170
Biological	147w	72	52	63
Total	360483	380634	471375	501233

Source: PRMD, 2017

Table 3. Memory by Technicians (JTs/JTAs) on the different pest management options

Options for pest control	Number	%age for the different options
Cultural	24	30.76923
Physical/ mechanical	18	23.07692
Biological	12	15.38462
Chemical	24	30.76923

of the country who took part in this survey. All of them were more or less familiar with bio-pesticides and their advantages over chemical pesticides. 100% (n=50) of the respondents are agreed that bio-pesticides are safe for human as well as environment health. Only 12% (n=6) were found to be familiar with the other advantages of bio-pesticides viz. less or no effect for non-targets, lesser chance of secondary pest outbreak. *Trichoderma, Azardirachtin, Pseudomonas* and *Metarhizium* were available in only 34% (n=17) of the agro-outlets. However, rest of them, 66% (n=33), were even ready to shift the trade of chemical pesticides with biopesticides, but lack of specific facilities for the storage, less demand by farmers, less availability etc. are the issues which discouraged them. 74% (n=34) responded that the issues of less availability of biopesticides, shorter shelf life and need for specific storage facility were important and ranked first. Similarly, all of them told that the demand for biopesticides is very low and this issue was ranked second or third but 22% (n=11) of them put this issue as first priority. Another cause for the less availability of biopesticides were attributed to high cost and there were fewer profit margins for the agro-vets. 54% (n=27) of agro-vets did not want to talk on this issue whereas 46% (n=23) agreed and put it on second rank for the less availability of biopesticides. 76% (n=38) agro-vets perceived that biopesticides are less effective than chemicals and ranked this issue on third position where 24% (n=12) ranked this on fourth position. Thus, it has been observed that there are a lot of bottlenecks on the supply side which should be addressed from the policy level to managerial level. The existing acts and regulations should be amended so that it can encourage the registration of the biopesticides (Ansari *et al.,* 2013). The front-line agriculture technicians as well as agro-dealers should be trained and regularly updated with the recent status of biopesticides available in the international markets. Extension of farmers field schools based on IPM approach should be done. More numbers of extension materials about biopesticides should be produced in local language.

The perception about benefits of biopesticides on human and environmental health from all relevant stakeholders was very positive. However, there are many important stakeholders who needs to be trained and familiarized with all available biopesticides. For this, trained plant doctors and IPM farmers' facilitators can be mobilized. This positive perception of stakeholders can be taken as the encouraging environment for the promotion of biopesticides use. Major reasons for nominal use of biopesticides in the field are the combination of farmers' awareness in the use of bio-pesticides, less interest and confidence of technicians for recommending bio-pesticides and less supply in the market.

In the advisory system and supply chain there is a very important role player in between. This is agro-input supplier who acts as an interface between the supply and use. This interface is facing various difficulties. Lack of storage facilities, less demand, no discrimination between chemical and biopesticides are the major reasons due to which agro-input suppliers tend to have less interest to supply biopesticides. So, as a first step of intervention, the government must encourage farmers to use biopesticides. Plant clinics can be best options for making farmers familiar with use of biopesticides. Providing duty free system for biopesticides would encourage its trade from agro-vets consequently more supply to the farmers and more use in the field. Promoting research to increase the shelf life of biopesticides and mass production of already proven strains of different biopesticides are other important interventions that needs to be carried out. Policies should be formulated as well as implemented for price discrimination among the biologically derived and chemically derived products with a strong monitoring and certification system.

REFERENCES

Ansari AR, Aryal S, Dangi N. 2013. Extent and potential use of bio-pesticides for crop protection in Nepal. Retrieved from: https://www.researchgate.net/publication/271510970 Extent_and_potential_use_of_biopesticides_for_crop_protection_in_Nepal

Bentley JW, Boa E, Danielsen S, Zakaria AKM. 2007. Plant clinics for healthy crops. *Leisa India*. **23**: 16-17.

Danielsen S, Kelly P. 2010. A novel approach to quality assessment of plant health clinics. *Int J Agric Sustain.* **8**: 257-269. https://doi.org/10.3763/ijas.2010.0494

Gurung B, Thapa RB, Gautam DM, Karki KB, Regmi PP. 2016. Commercial vegetable farming: an approach for poverty reduction in Nepal. *Agron J Nepal* **4**: 92-106. https://doi.org/10.3126/ajn.v4i0.15518

Kafle LN, Yubak Dhoj GC., Yang JT, Bhattarai S, Tiwari S, Katuwal M. 2014. Integrated pest management in

Nepal. The 5th International Conference on Clinical Plant Science.

Palikhe BR. 2002. Challenges and options of pesticide use. In: The Context of Nepal. *Landschaftsökologie und Umweltforschung* **38**: 130-141.

PPD, Nepal. 2017. Press release on the occasion of 'No Pesticide Use Week, 2017'.

PPD, Nepal. 2010. Annual report 2065/66. Plant Protection Directorate, Hariharbhavan Lalitpur, Nepal.

PPD, Nepal. 2008. National IPM Programme in Nepal: Ministry of Agriculture development 2008.

PRMD. 2017. Updated list of registered pesticide in Nepal. Pesticide Registration and Management Division,Hariharbhavan, Lalitpur, Nepal, 6-84.

Pun L, Karmacharya BB. 1998. Vegetable training manual. Department of Agriculture, Hariharbhavan, Lalitpur, Nepal, p. 325.

Yubak Dhoj GC. 2012. Status of pesticide use in Nepal and future strategy for their safe and alternative uses. Retrieved from: https://www.scribd.com/document/264196800/Status-of-Pestiside-Nepal

Yubak Dhoj GC. 2014. Biopesticide-effective alternative to organic Nepal. *J Agric Environ*. **16**: 95-106.