

Scenario of Plant Protection Services in Nepal

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1 Introduction

Nepal is an agrarian country. Agriculture is the backbone of Nepalese economy where 66 % people have been depending on agriculture for their livelihoods. Most of the farmers are subsistence, although commercialization has been also initiated in some parts of country.

Plant protection is an important discipline in the agriculture science as it is related to the concept and approaches of pest management. Since 2014 B.S, establishment of Department of Agriculture in Nepal (DoA), DoA has been providing extension and advisory services to the farmers in the field of plant protection.

Previously, plant protection was more concerned with the application of Chemical pesticides. With the development of ecological agriculture, there has been a paradigm shift in the tactics of pest management.

Various organizations under the Department of Agriculture, from central level to local level, have been providing services of plant protection. To assess the gap and provide recommendation about a way forward of the plant protection services, it is necessary to review the works of institutions that are involved in the plant protection. The aim of this article is to study about present scenario and review of plant protection services. The study is based the literature review and secondary data are which going to be explored from published sources and websites. The findings will assess the impacts of the services and help to rethink and re-design the of plant protection programmes in future to promote sustainable agriculture in Nepal.

2 Plant Protection Services in Nepal

In the process of growing and after harvesting of crops, plant protection is the key activities that need to be considered to protect the crops from the attack of insect pest and diseases. In addition to growing of crops to derive the livelihoods, Nepalese farmers have been adopting

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other agricultural occupation such as sericulture, apiculture, and mushroom farming. Plant Protection is that discipline which has been helping to perform these activities.

To support the various activities of agricultural development including plant protection services, Government of Nepal (GoN) has established Department of Agriculture (DoA), Nepal Agriculture Research Council and academic institutions – AFU, T.U, HICAST and CTEVT. Extension and advisory services and research works have been being delivered by these organizations.

To provide plant protection services, there are some organizations under the DoA have been working in central, regional and district level. Centrally working organizations are Plant Protection Directorate, Postharvest Management Directorate, Directorate of Industrial Entomology, National Plant Quarantine Programme and Pesticide Management and Registration Division. Five Regional Plant Protection Laboratories and Regional Plant Quarantine Offices have been working in each development regions and District Agriculture Development Offices (DADOs) in 75 districts.

2.1 Plant Protection Directorate

Plant Protection Directorate has been functioning in the central level under the DoA which is an umbrella organization to perform the plant protection activities throughout the country. In Nepal, 30-35% of crop production has been damaged by insect pest, diseases and weeds (PPD, 2012). To reduce the crop yield from such infestation and promote sustainable agriculture, following are the main objectives of Plant Protection Directorate (PPD, 2014a).

- Ecofriendly management of crop pest through implementation of Integrated Pest Management (IPM) programme that helps to achieve the national objectives of agriculture intensification and diversification.
- Safe use and management of pesticides through effective enforcement of Pesticide Act 2048 and Regulation 2050.
- Promotion of agricultural trades by strengthening external and internal quarantine to prevent the introduction of pest as provisioned in Plant Protection Act, 2064.
- Prepare pest map in district, regional and central level through survey and surveillance.
- Provide assistance and counseling to the GoN for formulation of policies of plant protection.

2.1.2 Policies

- Give top most priority to the concept of IPM for ecological pest management and implementation of IPM-FFS;

- Regulate the export and import of agricultural commodities by imposing Plant Protection Act, 2064 and Regulation, 2066 to prevent introduction of quarantine pest.
- Appropriate management of pesticides as provisioned in the Pesticide Act, 2048 and 2050.
- Delegation of responsibility to Regional Plant Protection Laboratories (RPPL) for monitoring and backstopping of district programmes.

2.1.2 IPM Programme in Nepal

The Integrated Pest Management (IPM) approach in Nepal was initiated in Nepal since 1997 under the Community IPM support Program (FAO). The program was financially supported through FAO and was also operated in support of FAO and Plant Protection Division. Over the time, this program has been run by PPD and been executed by the Ministry of Agriculture and Co-operatives, Nepal. After termination of Community IPM, there were two phases in the programme. The financial support for first phase (2003-2007) and for second phase (2008-2013) was received through Norwegian Government. Government of Norway provided a grant of US\$ 1,284, 444 for the first phase and US \$ 5,000,000 for the second phase.

PPD has been the coordinating for its operation, where FAO-Nepal has been remaining in the backstopping part in some of the selected intensive IPM Districts.

The National Integrated Pest Management Program in Nepal has been designed to support reduction of poverty, ensure food security and environment protection in a sustainable way. The specific objectives were:

- To contribute to institutionalize a sustainable national IPM program in Nepal by strengthening the capacity of the PPD, and strengthening the capacity of National, Regional and District level training and extension institutions;
- to empower farmers to increase production and productivity efficiently, while protecting the environment.

Its strategy is to implement and gradually up-scale participatory IPM using the Farmers Field School approach as a national program and covering seventy five districts of Nepal in integrated agricultural development with primary focus on rural poor where IPM will increase economic benefits, farmer empowerment and better marketing of safer commodities leading to a transparent mode of agricultural transactions that safeguard human health and environment in response to governments national commitments to global biodiversity and environment protection and WTO related issues.

2.1.3 Impacts of IPM Programme in Nepal

IPM is one of the important activities of PPD. Since 1997, PPD has been implementing the IPM-FFS with the assistance of various donors. Initially, it was started to manage the infestation of Brown Plant Hopper in the rice field of Chitwan district. So far, more than 10000 IPM-FFS have been conducted in the rice and vegetable crops. The IPM-FFS have many good many impacts in the agriculture, economic and social system of Nepal. Studies had been carried to assess the impacts of IPM. Following are some key achievements after the implementation of first phase of IPM programme during 2003-2007 in Nepal (PPD, 2014b).

Fig.1 Increased in number of Farmer Facilitators

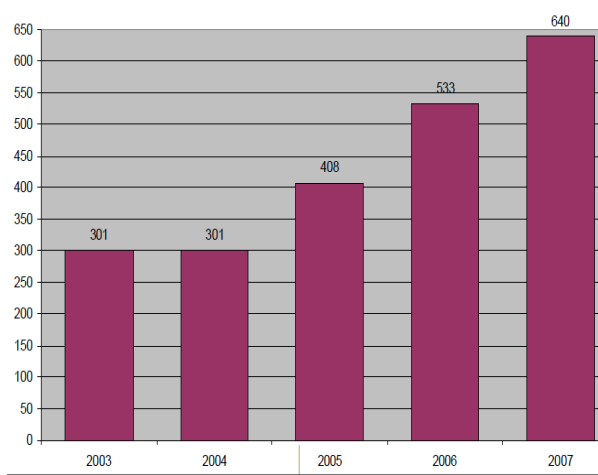


Fig. 2 Annual number of Total FFS

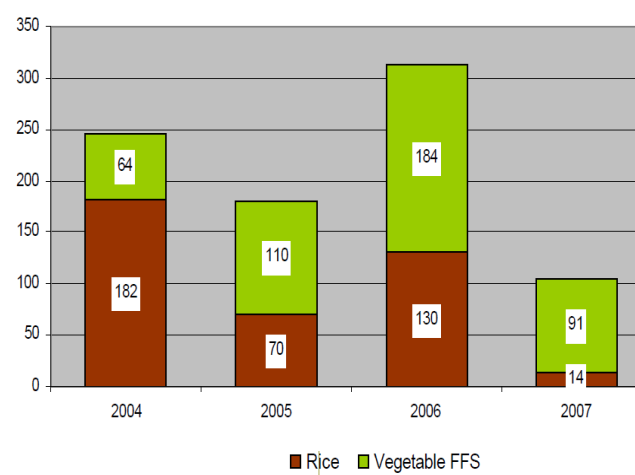


Fig. 3 Gender Mainstreaming

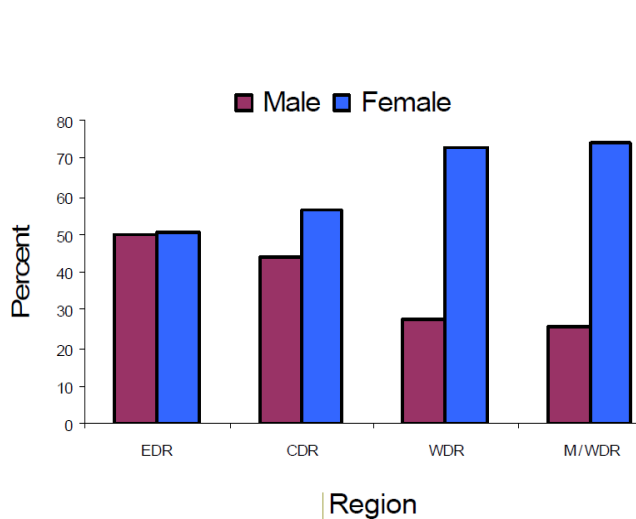


Fig. 4 Gender Participation in Vegetable FFS

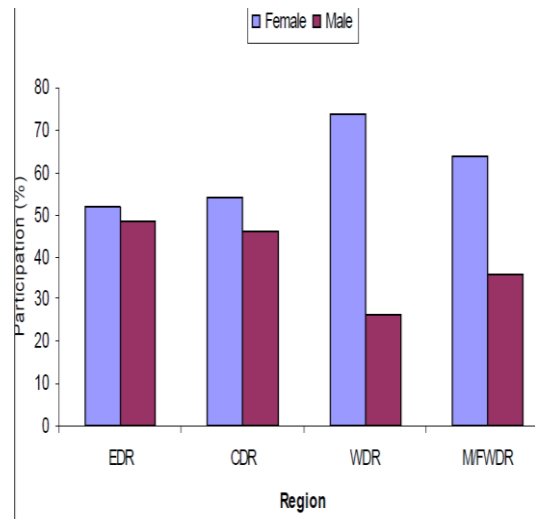


Fig. 5 Social inclusion

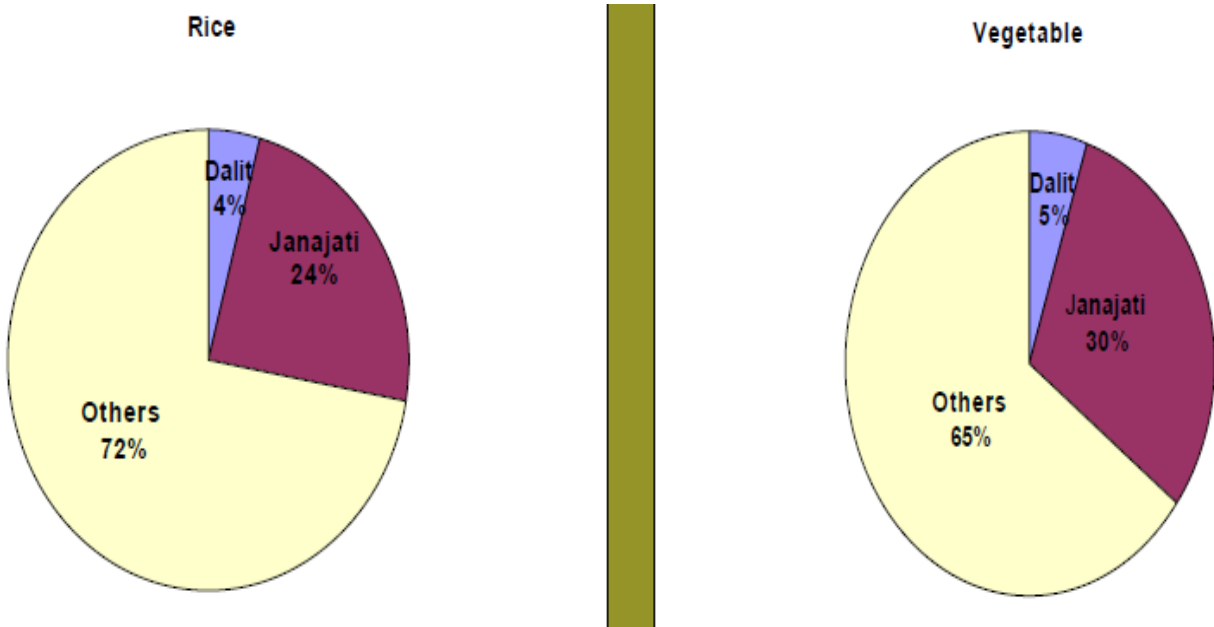


Fig. 7 Insecticide Use Pattern in Farmer Practice in Rice

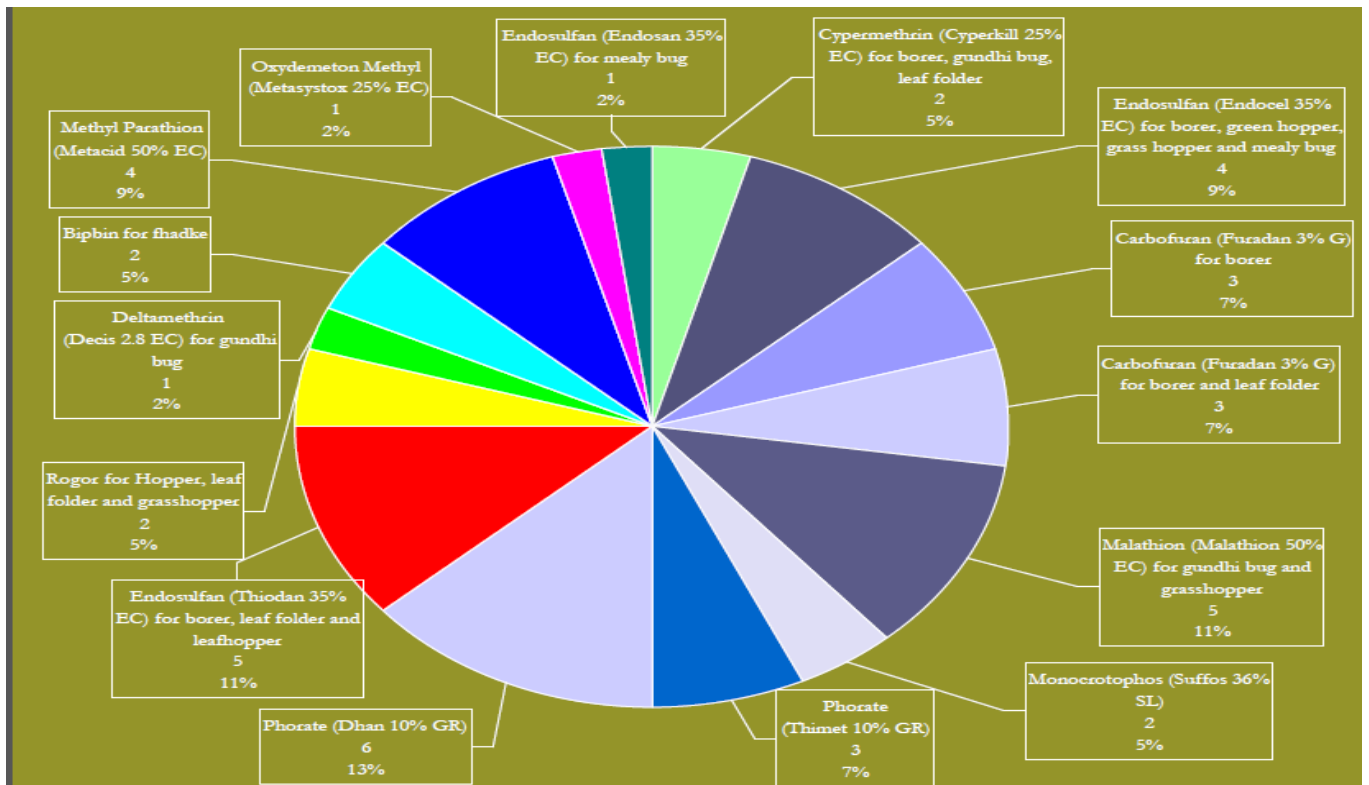
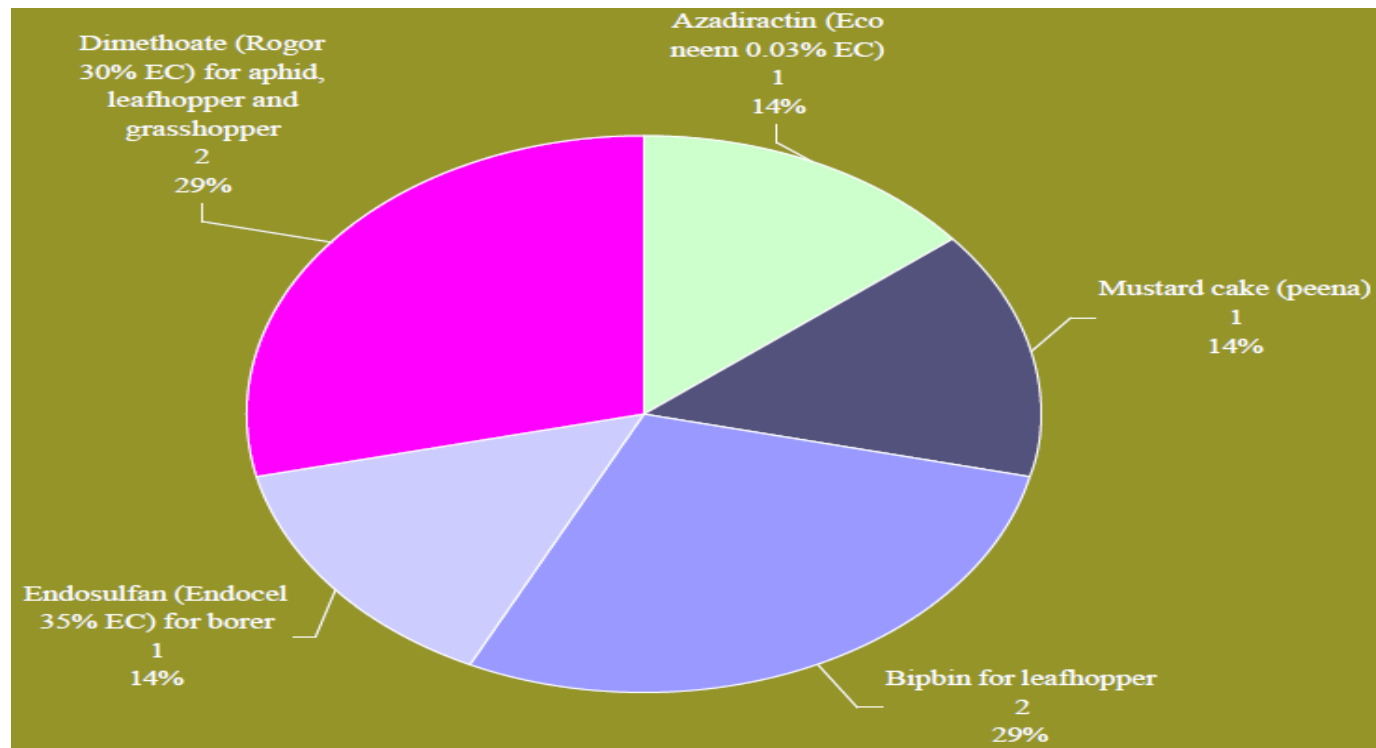


Fig. 8 Insecticide Use Pattern in IPM Practice in Rice



National Integrated Pest Management Phase-II in Nepal was a continuation of the earlier first phase. The second phase had imparted positive impacts in the agriculture system of Nepalese farmers that include reduction of pesticide application and fertilizer management. The main achievements were as follows:

- There was no use of class Ia pesticides at all;
- No application of banned pesticides;
- FFS farmers were reducing the area under class Ib pesticides considerably;
- Area under pesticide application was reduced by 78.76%;
- Cost of pesticide was reduced by 96.60%;
- A notable increase in in-country migration and decrease in seasonal migration to India of FFS category had been noticeably found.
- In terms of fertilizers use, decrease in nitrogen application and increase in use of FYM in rice, vegetables and cole crop in FFS households.
- Use of improved rice seeds found increased mainly in the FFS type of households in Surkhet Sarlahi and Bara districts.
- Similar finding was seen in case of use of improved seeds in tomato and potato.

3 Pesticide Registration and management Division

PMRD was established in 2051 B.S to regulate the import, export, formulation, distribution and professional application of pesticides through Pesticide Act, 2048 and Regulation, 2050. It has been functioning under the Plant Protection Directorate.

3.1 Mission of PMRD

- To carry out the activities related to the import, export, formulation, distribution and professional application of pesticides;
- To formulate national policy on pesticide, regulate the quality of pesticides and coordinate between the public and private sector.

3.1.2 Pesticides Imported and Formulated in 2012/13

Nepal has been imported the pesticides mainly from India. There has been an established formulation plant. In the fiscal year of 2012/13, the total amount of money expended to 1636413.756 kg of pesticides was Rs of 569950139.00 (Table 1)

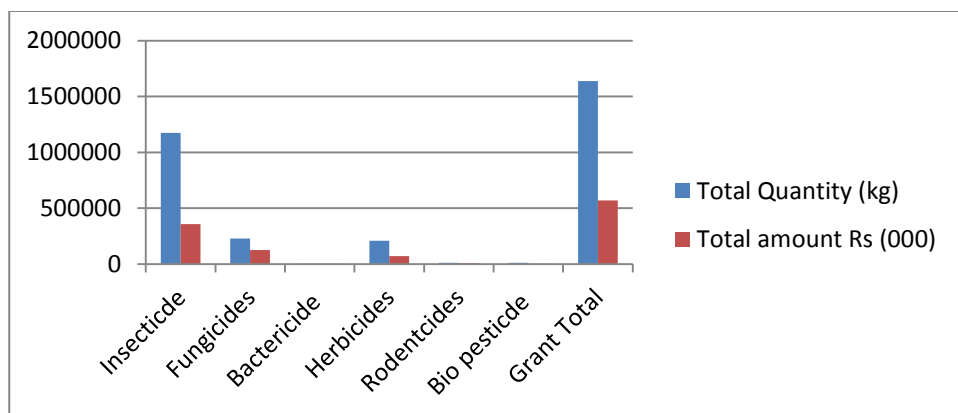
Table 1 Pesticides Imported and Formulated in 2012/13

	Pesticides	Total quantity (kg)	Total Amount (Rs 000)
1	Insecticide	1175033.756	359000.942
2	Fungicides	229517	127070.253
3	Bactericide	58	181
4	Herbicides	209028	72330.477
5	Rodenticides	12402	7325.767
6	Bio pesticide	10375	4041.7
7	Grant Total	1636413.756	569950.139

(Source: PMRD, 2014)

Insecticide was the main pesticides that has been imported and used in the agriculture sector then followed by fungicides and herbicides (Graph 1). Biopesticides has been regarded as the safer to manage the pests although its import in Nepal was only limited to the 10375 kg with the worth 4041700.

Graph 1: Pesticides Imported and Formulated in 2012/13



The PMRD has banned 14 pesticides including POPs and extremely hazardous pesticides (IA) – Chlorodane, Lindane, Dieldrin, Endrin, Aldrin, Heptachlor, Mirex, Endosulphan, Toxafen, B.H.C, Lindane, Phosphamindin, Methyal Parathion, Organomercury Chloride and Monochorotofus. There are total 1561 pesticides have been registered among IA is no at all (Table 2). Among the registered pesticides, insecticides are the highest in number- 889 (Table, 3).

Table: 2 Summary of Registered Pesticides 2070/71

Hazard Level	WHO Class	Common name
Extremely Hazardous	IA	0
Highly Hazardous	IB	62
Moderately Hazardous	II	793
Slightly Hazardous	III	282
Unlikely to present acute hazard in normal use	NH	394
Hazard level not calculated	NH	30
Total		1561

Source : PMRD, 2014

Table: 3 Summary of Registered Pesticides 2070/71

Types of Pesticides	Number	Remarks
Insecticides	889	
Acaricide	19	
Fungicide	408	
Bactericide	11	
Herbicide	168	
Rodenticide	23	
Molluscide	1	
Bio-pesticides	42	
Total	1561	

Source : PMRD, 2014

3.1.3 Postharvest Management Directorate

Rural Save Grain Project was started in Nepal in the year 2036. Its main objective was to reduce the loss of cereal grains by rodents, birds and other store grain pests. The project was implemented for more than a decade. Later on Postharvest Loss Reduction Section was established under the Plant Protection Directorate in the year 2049, which was upgraded as Post Harvest Management Directorate in the year 2061.

The Directorate started to work not only on cereal grains but also for postharvest loss reduction in fruit and vegetables. In coordination with NARC, DFTQC and other organizations, Postharvest Management Directorate has carried out some study for postharvest loss reduction in fruits and vegetable crops.

In the past different works was done like design of different storage structures to reduce loss in storage, promoting fumigants and other local herbs for controlling stored grain pests, improvement in local storage structures, rodent control campaign etc. Recently the Directorate has focused in perishable crops like fruits and vegetables. The main outcome to remember are the testing of solar drier for drying different commodity, zero energy cold storage (mini) for household level, cellar store for citrus and apple, modelling for grading machine and hand held sizer for citrus fruits, harvesting tools for papaya, study of different packaging material for safe handling of perishables, vase life study and recommendation for different flowers etc.

Table 4: Postharvest Loss of Different Cereal Grains (%) in Nepal

Crop	Harvesting	Transportation	Threshing	Drying	Storing	Processing	Total
Paddy	1.63	0.52	2.19	1.57	6.31	4.40	16.62
Wheat	2.21	1.22	3.07	2.07	7.76	2.00	18.33
Maize	3.33	1.04	2.85	2.50	7.44	2.30	19.46

Table 5. Transportation Loss of Fruits and Vegetables in Nepal

Crop	Percentage of Loss
Tomato	23-35
Apple	26-35
Cabbage	6-19
Cauliflower	4.48-18.75
Mangoes	36.36
Radish	3.48
Oranges	2.02-8.2 50

Table 6. Storage Loss of Fruits and Vegetables in Nepal

Crop	Loss %	Type
Tomato	14-25	Zero Energy
Apple	10	Cold store
Apple	15-30	Underground pit
Carrot	6-14	Zero Energy
Oranges	22-23	Cellar Store

4 National Plant Quarantine Programme

NPQP is responsible for trade facilitation through phyto-sanitary risk management in the trans-border trade of agro-forest products and other related commodities. After getting membership of the APPPC in 1965, Nepal has promulgated plant protection act and regulation and the Initially, Plant Quarantine Unit was established under the Plant Pathology Division of Nepal Agriculture Research Council which can be considered as the milestone of the history of plant quarantine in Nepal. Since then, many institutional arrangements have occurred in this organization and finally established as National Plant Quarantine Program in 2003.

NPQP is an authorized government institution for regulating plant quarantine related activities. It has been functioning under the Department of Agriculture and Plant Protection Directorate under the Ministry of Agricultural Development. Now, there are 5 regional plant quarantine offices in each development region, 8 check posts and 2 sub-check posts in different customs points. Out of them, three check posts are in Nepal-China border; one check post is at Tribhuvan International Airport, Kathmandu; and all other are along the Indo-Nepal border.

This institution has to regulate the activities on plant health dynamics to reduce the risk of entry, establishment and spread of notorious plant pests within the national territory in pursuant to Plant Protection Act 2007 and Plant Protection Regulation 2010.

4.1 Surveillance of regulated pests:

Surveillance is one of key activities of plant quarantine. For the purpose of surveillance, following activities have been done.

- Nepal has developed National Sanitary and Phytosanitary Measures (NSPM)uses it to identify the regulated pests;
- 500 pests of 19 commodities are declared as QPs, and regulated with pursuant to Plant Protection Act of Nepal;
- PRA for other commodities are going on.
- Pest Identification Manuals of the quarantine pests of Apple, Banana, Citrus, Coffee, Zinger, Tea, Large Cardamom, and Garlic prepared and published.

4.1.2 Transaction in the quarantine Check Post

- Birgunj is the main border checkpoint for trade in goods subject to SPS measures.
- In 2013, Nepal had recorded exports and imports subject to SPS measures of about US\$ 250 million and US\$ 1.16 billion, respectively.
- One-quarter of these exports and more than half of these imports were cleared at Birgunj.

4.1.3 Lacking in the Quarantine Check Post

In spite of high importance to maintain measures to ensure that food is safe for consumers, and prevent the spread of pests or diseases among animals and plants; following things have in lacking the quarantine check post in Nepal.

- Competent laboratories and expert diagnosticians in the customs points;
- Post entry quarantine facilities;
- Holding yards for the consignments;
- Automated fumigation chambers;
- Quarantine pest reference library.

5 Directorate of Industrial Entomology

Directorate of Industrial Entomology (DOIED) was established in 2052 B.S to promote and develop of industrial importance commodities of sericulture, bee keeping and mushroom farming.

Under DOIED, Sericulture development programme have being performed at nine centers and bee keeping development programmes at two centers. There has not been a separate center for mushroom, so DOIED has been running directly to this programme.

5.1 Bee Keeping in Nepal

There are two beekeeping centers in Nepal which are located in Godawari and Bhandara. These sections were established with the view of improvement of livelihoods of poor people of Nepal whereas beekeeping has been a primitive business in Nepalase culture. Because of availability of bee pasture and suitable climate, there is a huge potentiality of beekeeping in Nepal.

5.1.2 Beekeeping Today

Commercial beekeeping started in Nepal since 1990s with the introduction of the exotic honeybee *Apis mellifera* from India. There is an approximate of 120000 bee colonies in Nepal. An official data of honey production is 1600 mt annually (DOIED, 2104).

The honey production in Nepal is estimated to be 25 - 30 kg per hive per year from commercial *Apis mellifera* (European honeybee) beekeeping whereas the production of *Apis cerana* (Asian hive bee) colony is about 5-8 kg. Compared to Nepal's neighbours, this is a relatively low production rate. There are several reasons that contribute to this, as given below:

- Poor management of hives
- Greater focus on division of colonies and selling of bee boxes

- Lack of sound knowledge of queen breeding techniques and more dependency on swarms or naturally built queen cells
- Repetitive use of old combs
- Lack of reliable market and lack of sound marketing
- Due to all these, the economy is too small for beekeepers who also have other
- economic activities to rely upon.

5.1.3 Bee Species in Nepal

Five honeybee species are found in Nepal of which are (*Apis florea*, *Apis dorsata*, *Apis laboriosa*, and *Apis cerana* and *Apis mellifera*).

5.1.4 Major Challenges in Beekeeping

Many factors have been creating a big challenge to beekeepers and hinder the promotion of beekeeping in Nepal. They can be broadly grouped under threats to bee survival, barriers to honey trade, lack of knowledge, and non-conducive policies. The main factors are summarized below.

5.1.5 Threats to survival

- Reduction in bee foraging areas as a result of deforestation and forest fires
- Poor accessibility to forage areas (forestland farming) as a result of the limited road network
- Use of poisonous pesticides
- Limited use of biological measures for protection of crops against pests and diseases

5.1.6 Barriers to honey trade

- Lack of a pesticide residue monitoring programme; lack of accredited laboratories and equipment; lack of a certification system in the Hindu Kush Himalayan countries, except in China and India
- Poor quality honey due to lack of processing and packaging services at different levels

5.1.7 Lack of knowledge, skills, and awareness

- Lack of awareness at the farmer's level about the role of honeybees in pollination and biodiversity conservation
- Lack of knowledge sharing among key stakeholders both within countries and especially at the regional level
- Lack of skilled labour and effective mobilization of existing labour

- Lack of technology development and research on beekeeping

5.1.8 Non-conducive policy environment

- Inadequate policies on beekeeping

5.1.9 Conservation of Honeybees

Bees are under threat the world over. Loss of bee forage areas, loss of floral diversity, loss of natural forests, the move to monoculture cropping, the wide use of pesticides, and more recently the transfer of pests and diseases are all contributing to a marked reduction in bee numbers.

Some of the actions needed are listed in the following.

- Expansion of bee forage areas
- Plantation of bee flora in forests and on degraded waste lands
- Reduction of deforestation, control of forest fires
- Adoption of organic farming or integrated pest management systems for crop protection
- Ensure traditional honey hunting practices are kept at a low and sustainable level to prevent brood destruction
- Enforce policies for the promotion and conservation of honeybees
- Raise awareness about the role of beekeeping in conserving the environment and biodiversity

10 Conclusion

IPM programme was initiated in Nepal since 1997 with the assistance of FAO. After implementing IPM, one of the important impacts is reduction in pesticide application so area under pesticide is reduced by 79%. National IPM programme helped to support the capacity building of PPD and other national, regional and district level extension institutions. Other important reflections in the agriculture system are gender mainstreaming; increased social inclusion, reduction to the cost of pesticide by 96.60%; decrease in seasonal migration to India of FFS category had been noticeably found; decrease in nitrogen application and increase in use of FYM in rice and vegetables; use of improved in rice; and use of improved seeds in tomato and potato. Pesticide Management and Registration Division has banned 14 pesticides including POPs and IA. So far, 1561 pesticides have been registered by PMRD. Postharvest management Directorate has been working to reduce the loss of agricultural commodities. National Plant Quarantine Programme has been regulating the activities to reduce the risk of entry, establishment and spread of plant diseases. So far, 500 pests of 19 commodities are declared as

QPs, and regulated with pursuant to Plant Protection Act still it has competent laboratories and diagnosticians in the custom points.

Commercial beekeeping started in Nepal since 1990s with the introduction of the exotic honeybee *Apis mellifera* from India. There is an approximate of 120000 bee colonies in Nepal. An official data of honey production is 1600 mt annually. Several reasons that has contributed to the low production of honey are reduction in bee foraging, poor accessibility to forage areas, use of poisonous pesticides, limited use of biological measures f protection of crops against pests and diseases, lack of a pesticide residue monitoring programme, lack of accredited laboratories and equipment, lack of a certification system and poor quality honey due to lack of processing and packaging services.

The service suffers from weak linkages with national agricultural research systems. The research and extension system is also poorly linked with the agricultural university system. The three organizations – NARC for research, DOA for extension, and IAAS for university do not seem to have benefited from cross-fertilization of the agricultural knowledge triangle.

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