VOLUME 4: INTEGRATED PEST MANAGEMENT PLAN

RANI JAMARA KULARIAY IRRIGATION PROJECT
DECEMBER 27, 2016

PREFACE

This document is the forth of eight volumes, which describes the Biodiversity Impact Assessment (BIA) conducted in relation to the Modernization Rani Jamara Kulariya Irrigation Scheme (MoRJKIS) in Tikapur Kailali Districts, Far West in the Province Seven of Nepal. This study was conducted by project proponent (Department of Irrigation, Rani Jamara Kulariya Irrigation Project) between April to November 2017 and finalized on December 26, 2017. The Report has been prepared in compliance with the GoN Law and World Bank Safeguard Policies.

The report of these studies comprises eight volumes, which are arranged as follows:

Volume 1: Executive Summary (combining the finds of EA, BIA, IPM, SA, VCDP & RPF)
Volume 2: Environment Assessment (EA);
Volume 3: Biodiversity Impact Assessment (BIA);
Volume 4: Integrated Pest Management Plan (IPM)-**this document;**
Volume 5: Social Impact Assessment (SIA);
Volume 6: Vulnerable Community Development Plan (VCDP);
Volume 7: Resettlement Planning Framework (RPF);
Volume 8: Stakeholder Consultation Proceeding conducted at Tikapur on December 14, 2017.

The relevant inputs received from the stakeholders during consultation has already been incorporated in respective reports. It is enclosed for reference only.

Abbreviations

ACIU	Agriculture Component Implementation Unit
DADO	District Agriculture Development Office
DFTQC	Department of Food Technology and Quality Control
DOA	Department of Agriculture
DOE	Department of Environment
DOH	Department of Health
EA	Environment Assessment
EIA	Environment Impact Assessment
EPA	Environment Protection Act
ESMP	Environmental and Social Management Plan
FAO	Food an Agriculture
FFS	Farmer Field School
FYM	Farm Yard Manure
IPM	Integrated Pest Management
IPNMS	Plant Nutrient Management System
MOAD	Ministry of Agricultural Development
NARC	Nepal Agriculture Research Council
NCS	National Council for Standards
NPPO	National Plant Protection Organization
PMP	Pest Management Plan
PPD	Plant Protection Directorate
PRMD	Registration and Management Division
RJKIS	Rani Jamara Kulariya Irrigation System
WHO	World Health Organization
WUA	Waster User's Association

TABLE OF CONTENTS

List of Tables

List of Figures

Executive Summary

Integrated Pest Management (IPM) is a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks in order to minimize haphazard use of pesticides and to conserve environment, project prioritize the IPM-FFS programs.

As part of safeguards requirement for the implementation of the Rani Jamara Kulariya Irrigation Scheme (RJK) an assessment was carried out in the project command area with the purpose of (i) assessing the environmental issues and problems related to use of agro-chemicals, (ii) understanding the status of current use of agro-chemicals, (iii) assessing the level of awareness of farmers in handling and management of pesticides and the types of pesticides used, and (v) provide recommendations.

The assessment process involved literature review, field observation, consultation with WB and RJK project staff, meeting with farmers, members of water user groups, agro-vets and the staff members from the project offices at Tikapur.

The findings suggest that there are incidences of pest problems in the project command area. This is because agricultural practices in the project command area is still cereal based and the crops cultivated are rice, wheat, maize, legumes, and mustard (for oil). However, some incidence of diseases were reported on select crops. They included the late blight on potato (due mainly to the use of disease infested planting materials), yellow mosaic virus on cucurbits, fruit flies, stemborer on rice and maize, powdery mildew, leaf spot on vegetables, leaf beetle on banana to name a few but they do not appear on regular basis (only endemic). However, with the completion of the modernization and rehabilitation of irrigation schemes farming systems will become intensive with significant increase in vegetable farming which will change the pest dynamics and complex. While the project promoted farmer field schools (FFS) have played a key role in disseminating the advantages and disadvantages of the use of pesticides through integrated pest management practices the farmers are yet to put full use of the knowledge they have gained. There are six agrovet dealers who are providing agrochemicals and inputs in the project command area. However, assessment revealed that only 2 out of 6 agro-vets are trained in pesticides and agro-chemicals. The need to follow safe standards to stock the harmful chemicals was noted at all the agrovet dealers visited. Since most farmers tend to visit the agro-vet services they play a key role in agriculture value chain. The assessment team did not find the use of chemicals that are banned by the WHO and/or the Government of Nepal, however, farmers are not adopting precaution while spraying the pesticides in the field. The team also noted that farmers have yet to adopt the practice of using fertilizers based on soil test results to avoid over or under application.

Based on the findings above, the report recommends the following in order to mitigate and address the problems associated with the use of pesticides and agro-chemicals. They include: (i) promotion of integrated pest management through FFS and demonstrations; (ii) improve FFS curriculum to include anticipated pest problems following the change in cropping pattern, (iii) promote awareness on the use of pesticides i.e. toxicity labels, safe and correct use and time of application of pesticides, (iv) train and engage agro-vet dealers, extension agents and leader farmers to extend messages on safe use of pesticides and agro-chemicials, (v) promote the use of disease/insect tolerant varieties when available, (vi) use of bio-pesticides, (vii) use of natural pests or beneficial insects, (viii) maintaining good soil health through use of

well decomposed farm yard manure, (ix) practice crop rotation, (x) companion planting, (xi) adjusting the planting time, and (xii) follow soil test results to apply correct use of fertilizers.

CHAPTER I: INTRODUCTION

1.1. BACKGROUND

The Rani Jamara Kulariya Irrigation System (RJK) is located in Kailali District, Far Western Development Region of Nepal where water from the Karnali River has been diverted to irrigate a command area of 14,300 hectares in a traditional way.

RJK irrigation schemes is perhaps the oldest farmer managed irrigation system in Nepal, constructed mainly by the indigenous community referred to as *Tharus*, nearly a century ago. Today, it cultivates a net area of 11,900 ha. The scheme is reported to have been developed between 1896 (Rani System) and 1915 (Kulariya System). The Jamara System was developed from 1903 onwards. The scheme encompasses eight village development committees. The systems, being old, are in dire need of rehabilitation and modernization in order to regulate water flow, ensure equitable and efficient distribution of water. In order to rehabilitate and modernize the Rani Jamara Kulariya irrigation systems; the Government of Nepal, with financial support from the World Bank, is modernizing and rehabilitating the the Rani Jamara Kulariya Irrigation schemes since October, 2011 with the objective of "*improving irrigation water delivery to, and management in, the command area*" benefitting nearly 25,000 households comprising 157,000 people from eight village development committees.

The first phase was to modernize the higher order canals and the second phase would work on the tertiary canals taking the water to the field and intensifying agriculture to increase production and productivity through best use of irrigation water together with effective extension and outreach services. The first phase ended in September 2017 and preparation for the second phase is in progress.

With the completion of the system and availability of water all year round, cropping pattern is expected to change significantly. With good connectivity and road access the farmers are likely to diversify cropping pattern to include high value cash crops such as potato, tomato, cucurbits, cole crops, legumes and oil seeds besides staples such as rice, wheat and maize which have year round market. With the change in cropping pattern the dependency on the use of pesticides and agro-chemicals is likely to increase.

1.2. RJK PHASE II

The main objective of the second phase of RJK is to improve irrigation and agriculture services for farmers in the irrigated area of the Rani Jamara Kulariya irrigation schenmes. The project will have three components: (a) scheme modernization (b) agricultural production support and strengthening of wate users assocations/groups, and (c) project management. The second phase is expected to start from the first quarter of 2018 with a duration of 5 years, closing in June 2023.

1.3. OBJECTIVE OF THE ASSIGNMENT

The Phase 2 focusing on increasing and sustaining agricultural production by carrying out a series of agriculture-based activities that is likely to introduce pesticides or increased use of pesticides (though project will not finance purchase of pesticide) and expected to have impacts on human and other living beings of project area and triggers OP/BP 4.09 Pest Management. Hence, to ensure Bank financed projects are safe both to human beings and the surroundings environment, the RJKIP has carried out a study on IPM for the judicious use of pesticides in order to minimize the impacts of pesticides.

1.4. SCOPE OF THE STUDY

The scope of the study is as outlined below:

a) Assessing the environmental issues and problems in relation to the use of agro-chemicals.
b) Status of current use of agro-chemicals, pesticides in particular and trend in pesticides used
c) Assess the level of awareness of farmers and others in handling and management of pesticides
d) Assess the types of pesticides used (banned Vs recommended) and possible adverse impacts on human health and the local environment
e) Suggest mitigation measures for minimizing the adverse impacts
f) Draw lessons from the first phase and identify best practices for scaling up
g) Develop detailed plan of action for IPM/ITPNS-FFS and suggest alternative options, if any, to implement good pest management practices, and
h) Develop indicators to monitor the progress.

1.5. METHODOLOGY

The assessment involved review of literature to consultation with key stakeholders and field visits. Stakeholders consulted included local farmers, agrovet dealers, agriculture components staffs, water user's associations and other partners involved in agriculture development in the RJK command area. Observations were presented to the stakeholders at the validation workshop in Tikapur on September 9 and 10, 2017 and in Kathmandu on 3 November, 2017. Feedback received have been incorporated into the report. The list of people consultated and their feedback is included in annex 2 of this report.

1.6. LIMITATION OF THE ASSESSMENT

Lack of secondary data on pest and pesticide use, inadequate data available were some of the key constraints faced during the assessment.

CHAPTER II: GENERAL FEATURES OF THE STUDY AREA

2.1. INTRODUCTION

The command area of RJK is inhabited largely by three ethnic groups. The *Tharu*s are the largest ethnic group with 48% composition ; followed by *Cheetri* 17%, *Dalit* 15%, *Brahmin* 10%, and the rest are 10% While the Tharus are native to the regionthe *Brahmins* and *Chhetris* migrated from the nearby hill and mountain districts. There are an estimated 26,601 households with a population of 135,062 people. Of this, 48.7% are female. For most households agriculture is the main occupation followed by foreign employment (remittance), service, and daily wages.

The project is bounded by the Karnali River on the east, Patharaiya River on the west and Mohana River on the south with tropical forest in the northern part. The secondary canals Rani, Jamara, Kulariya not only function as irrigation canals but also convey water (into from some part of the command area. Surface run off from northern forest area flow through the local drainage system to the south. These drains, in the form of rivulet, carry base flow as well as flash flood down to the Pathariya, Mohana and Karnali River. The tail end part of majority of canals including the branch canals, function as drainage canals. Dhobeni and Dhoduwa drains are inlet in the Kulariya branch and their discharge is passed through this branch to the Pathariya River. The details of command area is shown in Figure 1.

The project in the first phase has completed gravelling 117 km of road and constructed/improved 11 bridges and 15 cultverts. This has allowed farmers to transport their produce to the markets. In the second phase the project plans to gravel 97 km of farm roads. The total length of farm or service road proposed for gravelling in this study is 97.5km. The detail achievements in phase I under the agriculture component of the project is included in annex III of this report.

Total agricultural land in project locations is 14,300 ha of which Tikapur municipality alone covers 34.11%, followed by Munuwa 13.41% and Pratappur VDC 1.19%. Average landholding is reported as 0.42 ha per HH compared to the national average of 0.67 ha.

The common land tenancy systems in the project area are: *Battaya, Thekka, and Bandhaki*. In the Battaya system, the land owner and tenants have 50-50 share in the inputs costs and agricultural products. The labour cost is fully borne by the tenants only. In the Thekka (contract) system, the landowner gives the land on lease to the tenant on predetermined amount of cash or quantity in kind. The tenant has a freedom in choosing the crop type and cropping pattern and has the tendency to produce as much as possible. In the *Bandhaki* system, the tenants lend an agreed amount of money to the land owner against taking the land on lease for a defined period of time. In the project area, the large parcels of land belonging to school, and guthi are contracted out in a yearly rental basis to the famers/farmers group in a yearly rental basis (the rent is NRs 35000-55000/bigha year). These large plots are used for commercial farming like banana. The small parcel of land is normally offered to the tenants in a "*Battaya*" basis (normally for 2-3 years) , in this system the output is shared between tenant and tenement.

The project area is in plain Terai bounded by the Karnali River in the East, Pathariya River in the West and Mohana River in the South. Elevation of command area varies between 100 m and 200m with an average falling gradient of 1 in 700 towards south.

The project area receives an average annual rainfall of 1693 mm with a peak in receiving approximately 675 mm of rainfall from June to September. Rainfall is usually one month late as compared to the eastern region. Enclosed between the rivers and forest, the project area has good ground water potential with water table variation between 3 to 5 m.

2.2. SOIL CHARACTERISTICS

Soil structure in project area is granular made up of small crumbs of soil which allows water to easily drain down these small structures. Therefore, the soil in project area is a good medium for drainage and aeration.

The fine, smooth and coarse textured soils were commonly observed in the study area. Fine and smooth textured soils have less chances to reduce the decomposition of organic matter content in the soils and, hence, soil sustainability is maintained in such soil for the long term. In coarse textured soils, due to high aeration, rapid decomposition of the organic matter is possible

Soil pH range is 5.5- 8.5 (overall), dominating by medicum soil with soil organic matter (2.5-5%). Nitrogen ≥ 0.1%, Dominting low P_2O_5 ≤ 3 0 kg/ha, potassium as K_2O (dominating: medium 110-280kg/ha) Boron: dominating very low i.e less than 2 ppm (critical limit), Zinc dominating medium ≥1.25 ppm (critical limit), (NARC 2006).

While most of the command area protection works have been implemented in phase I of the .project there are some vulnerable areas that needs to be protected along the left banks of *Pathariya* and *Mohana* River and along some local drains. The location of vulnerable sites were determined in consultation with the concerned WUAs and the project. For command area protection, construction of embankment, revetment and spurs are proposed at different locations. The total length of command area protection works has been estimated to be 12.6 KM.

The Agricultural Component Implementation Unit (ACIU) at Tikapur will play a central role in implementing agricultural activities. Networks of farm roads metal with gravel top will facilitate the transportation of agricultural goods and services. To optimize productivity, other essential aspects embodied in the program include (i) Farmers' Field School (FFS) to provide trainings and impart skills to the farmers on agricultural technology covering cultivation methods, selection of crops and timings, production and use of high quality seeds, timing of irrigation and duration, use of manure and pesticides, harvesting and collection etc. (ii) production demonstrations for cereal, vegetable, oilseeds, sugarcane, pulses crops and their seeds, (iii) provision of agricultural machines on subsidized rate for ploughing, sowing and harvesting and (iv) organizing farmer-to-farmer interaction events within the project and in other agricultural development projects in the region. Even though productivity of crops is increased, total production will not be substantially increased unless cropping intensity is increased. Therefore, the proposed cropping pattern envisages increased cropping areas for paddy, maize, vegetables, oilseeds, pulses and sugarcane to achieve 226 % cropping intensity. The project area also has good potential for fruit production particularly for banana, pomegranate and lemon.

.

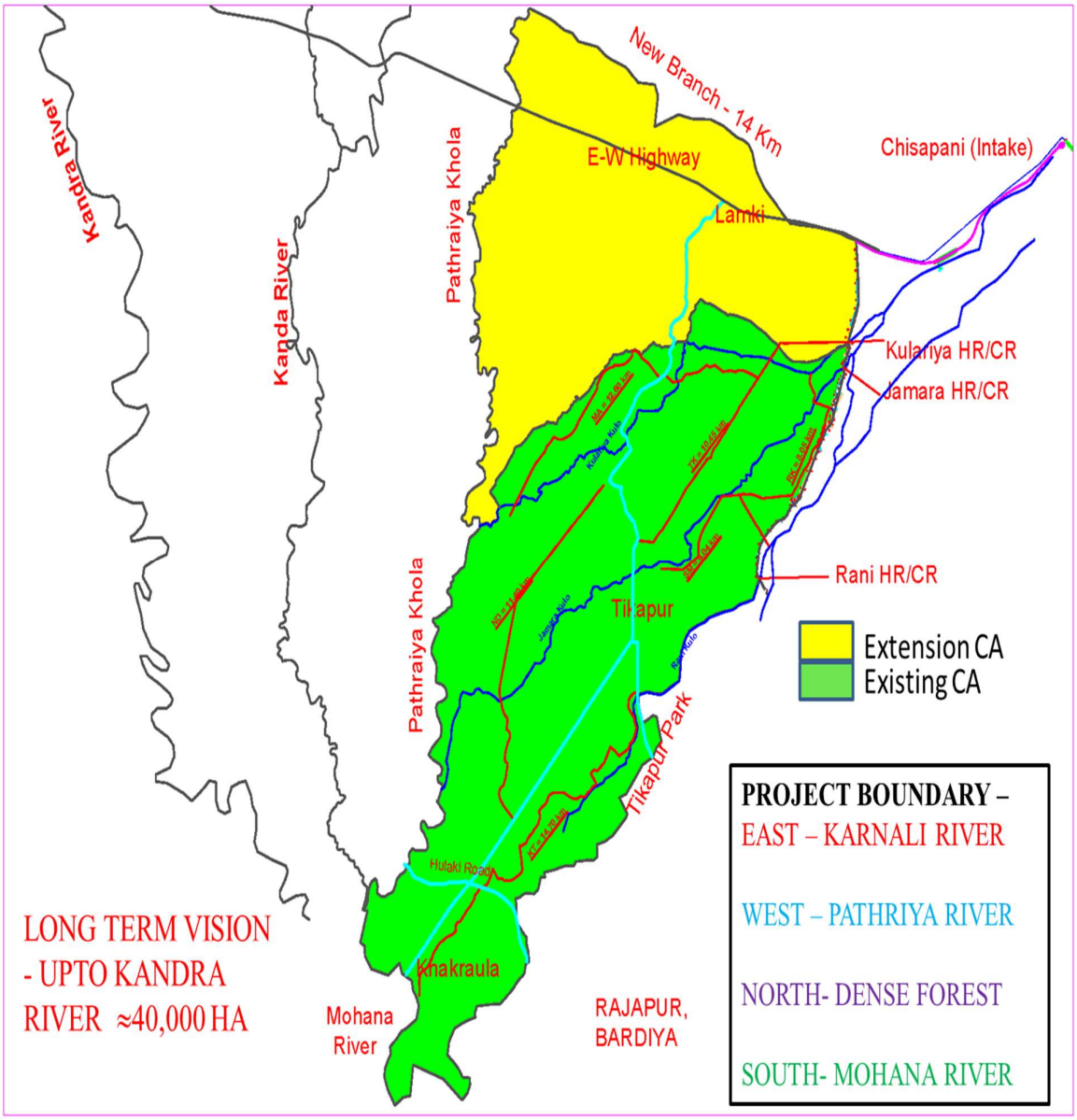

Figure 1 : Details of Command Areas

CHAPTER III: LEGAL AND INSTITUTIONAL FRAMEWORK

3.1. INTRODUCTION

The Environmental Impact Assessment Guideline of 1993, the Environment Protection Act (EPA) of 1997 and the Environment Protection Rules (EPR) of 1997 are key policy guidelines to the environmental assessment system in Nepal. The EIA process in development proposals and enactment is legally binding to the prescribed projects that integrate IEE and EIA. The projects, requiring EIA or IEE, are included in Schedules 1 and 2 of the EPR, 1997.

In the case of the present study rehabilitation and modernization of existing irrigation systems, the EPA and EPR of the Government of Nepal do not have a threshold for IEE or EIA for rehabilitation schemes. IEE has to be done only if the alignment of main canal is changed. However, the present study is guided by the ToR for environmental assessment. A checklist was prepared to identify and examine the likely impact, risk and screening after scheduled field study[1]. The issues identified during screening process will be included in the Environmental and Social Management Plan (ESMP).

The World Bank requires environmental assessment (EA) of projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable. Since the World Bank Sageguard Policy for Pest Maanagement OP4.09 is trigerred for this project Pest Management Policy is prepared for this project.

3.2. ACTS AND REGULATIONS RELATED TO PESTICIDES IN NEPAL

The Pesticide Act, 1991 and the Pesticide Rule, 1994 cover measures to regulate import, manufacture, sale, storage, transport, distribution and use of pesticides. It is mandatory that any pesticide before formulation, importation and distribution should be first registered in accordance with the registration procedure adopted by the Pesticide Board.

Besides, the pesticide act and regulation following are the related acts and regulations related to the integrated pest management and food safety in Nepal.Food Act 1966, Food Regulation 1967, Animal Health and Livestock Services Act 1999 and Regulation 2000, Aquatic Life Protection Act 1961, Seed Act 2045 and Rules 2054, Consumer Protection Act and Rules, Soil and Water Conservation Act 1982, Customs Act 1962 and Rules 1962, Solid Waste Management Act 2011, Water Resource Act 1992,

Department of Food Technology and Quality Control (DFTQC) is the apex organization responsible for the enforcement of Food Act and Regulations. It has been working for the implementation of Feed Act and Regulations as well. The main aim is to ensure and enhance the quality and safety of food and feed products in the country. DFTQC, as has been entrusted as CODEX Contact point for Nepal for more than three decades, has also been given the role of National SPS Enquiry Point in 2004.

Number of Nepalese Standards related with food: National Council for Standards (NCS) is the government body responsible to approve and endorse Nepalese standard. There are more than 100 Nepal standards in food sector related with food, food processing, transport and storage.

3.3. INSTITUTIONAL INFRASTRUCTURE TO REGULATE FOOD SAFETY

Plant Protection Directorate (PPD) under Ministry of Agricultural Development (MoAD), Department of Agriculture (DoA) is responsible for overall plant protection functions in the nation and also designated as the National Plant Protection Organization (NPPO) of Nepal (PPD, 2016). PPD is responsible for all

[1] The first field study is scheduled for July 26-27 and second one for August 10-15 of 2017.

activities on plant protection in the country and is official contact point for national and international plant protection related organizations. The NPPO has statutory responsibility for preventing the introduction, transmission, and spread of pests in the Nepal.

Government agencies responsible for the following:

a) **Registration of pesticides:** Pesticide Registration and Management Division (PRMD)
b) **Enforcement of regulations:** PRMD and Pesticide Inspectors in respective districts
c) **Extension:** Department of Agriculture and District Agriculture Development Office
d) **Farmer training:** Gos (PPD, RPPL, NARC, DADO), I/NGOs
e) **Pest and pesticide research:** Nepal Agriculture Research Council (NARC)
f) **National Plant Protection Organisation:** Plant Protection Directorate (PPD)
g) **Food safety:** Department of Food Technology and Quality Control (DFTQC)
h) Public health: Department of Health
i) Environment: Department of Environment

3.4. INTERNATIONAL CONVENTIONS RELATED TO PESTICIDE

Nepal is a member/signatory country of following relevant international conventions/protocols and organizations:

a) Stockholm Convention: [**Yes**]
b) Rotterdam Convention: [**Yes**]
c) Montreal Protocol: [**Yes**]
d) Basel Convention: [**Yes**]
e) Codex Alimentarius Commission: [**Yes**]
f) International Plant Protection Convention: [**Yes**]
g) APPPC in 1965 [**Yes**]
h) World Trade Organisation: [**Yes** in 2004]
i) Convention on Biodiversity: **[Yes**]

- **Key regulations related to pest and pesticide management in Nepal:**

a) The Pesticides Act, 1991, Amendment on 2008
b) The Pesticide Regulation, 1993
c) Plant Protection Act, (1972), 2007
d) Plant Protection Regulation, (1974), 2010
e) Is the legislation up-to-date? Yes
f) Is a functioning pesticide registration scheme in place? Yes
g) National Agriculture Policy – 2004 as an umbrella (National IPM Program, Promotion of Bio-pesticides, Plant Clinics, Promotion of Organic Agriculture)

a) The Stockholm Convention, 2001: It deals with the phasing out of the production and use as well as the waste management of POPs.
b) Rotterdam Convention on PIC, 1998 : It promotes shared responsibilities in relation to the imort of hazardous chemicals and an open exchange information. It calls on the exporters of hazardous chemicals to make use of proper labeling include directions on safe handling, and inform purchasers of any known restrictions or bans
c) FAO Code of Conduct on Distribution and Use of Pesticides, 1985. This is code of conduct on Pesticide management in the framework on pesticide management for allpublic; land private entities engaged in or associated with production, regulation, and management of pesticides.
d) London Guidelines for the Exchange of Information on Chemicals in International Trade, 1987: The London Guidelines were adopted through UNEP Governing council decision. Since they are primarily addressed tothe governments with a view to increasing chemical safety and information exchanges.

The annexes contain various forms including PIC decision guidance document, and introduction to the guidelines. These guidelines provide a mechanism for importing countries to responsibilities of importing and exporting countries and exporting industries in ensuring that these decisions are heeded.

Government of Nepal (GoN) is the signatory of Stockholm Convention, Basel Convention and Rotterdam Convention to minimize environmental pollution and to manage agrochemicals, including pesticides. The Joint Secretary responsible for environment division at the MoAD has been assigned as the Designated National Authority (DNA) of Rotterdam Convention to look after agrochemicals, pesticides and pesticide waste management in the country. GoN has accorded high priority to integrated pest management (IPM) to minimize pesticide risk.

3.5. The WHO RECOMMENDED CLASSIFICATION OF PESTICIDES BY HAZARD AND GUIDELINES TO CLASSFICIATION 2009

This document sets out a classification system to distinguish between the more and the less hazardous forms of selected pesticides based on acute risk to human health (that is the risk of single or multiple exposures over a relatively short period of time). It takes into consideration the toxicity of the technical active substance and also describes methods for the classification of formulations.

The document lists common technical grade pesticides and recommended classifications together with a listing of active ingredients believed to be obsolete or discontinued for use as pesticides, pesticides subject to the prior informed consent procedure (Rotterdam Convention), limitations to trade because of the Stockholm convention (POPs), and gaseous or volatile fumigants not classified under these recommendations. As per WB safeguard policy refers these WHO standards. Accordingly, all the pesticides listed under Ia and Ib of this guidelines are restricted for use in RJKP.

CHAPTER IV: EXISTING AGRICULTURAL SITUATION AND PRACTICES

4.1. KEY CROPS, CROPPING PATTERN AND PRODUCTIVITY

Cropping pattern is pre-dominantly rice based. Depending on the availability of water, rice is followed by potato or wheat or vegetables in the winter and maize, vegetables, or legumes in the spring.

Monsoon (J**une – October/November)**	Winter **November – February**	Spring February - June
Rice	*Wheat/potato/lentil/mustard*	*Maize/vegetables*
Rice	*Wheat/potato/lentil/mustard*	*Vegetables/maize*

In terms of land use, rice occupies the largest share occupying 11,252 ha followed by wheat (5448 ha) and maize (1058 ha). According to the project base line survey (2013) average yields of rice, wheat and maize is 3.72, 2.38 and 2.46 metric tons per ha compared to the national average of 3.2; 2.3 and 2.8 tons respectively (Table no. 4.1). Of late there has been an increase in the cultivation of cash crops like vegetables (tomato, cucumber, bitter gourd, bottle gourd, eggplant and banana). With the availability of perennial water and improved road networks the cultivation of high value crops are likely to increase substantially brining about changes in pest dynamics. FYM and inorganic fertilizers are used for maintaining/improving soil fertility. However, the amount used is either insufficient and/or uneven. Most plant nutrients are available at soil, pH level 6.5-7.5 (neutal to slightly acidic). Besides, this pH range is favorable for microbial activities that contribute to the availability of nitrogen, sulfur, and phosphorous in soils.

Table 4. 1: Productivity of key crops in the project area and their comparison to the District, National (in tons per ha)

Crop	Project area	District	National	South Asia Average
Rice	3.72	3.27	3.15	4.2
Wheat	2.38	2.31	2.32	3.075
Maize	2.46	2.31	2.32	2.5

Source: ACIU, 2017 and review of South Asian Counties report

It is apparent from Table 4.1 above that the yields of major crops are low compared to the neighboring countries average. Key constraints to increasing agricultural productivity include: (a) use of low quality seeds, (b) insufficient irrigation water, (c) lack of technology know-how on improved farming practices, (d) loss to pest and diseases, and (e) weak post-harvest support including marketing.

4.2. TYPES OF PEST PREVALENT IN THE PROJECT AREA AND THEIR CONTROL

It is estimated that average crop loss due to pest damages in Nepal range from 25 to 35 percent (PPD, 2012). While the pest problems in the RJK is reportedly not severe the discussion with farmers and extension agents revealed that the intensity and occurrence of pest is on the increasing trend with the intensification and diversification of farming systems. This is particularly true for vegetables and fruit farming which are highly vulnerable to all kinds of pests and diseases. This observation conforms to the

assessment of the study team as, with the availability of water, cropping pattern is likely to change substantially.

Major pests problems reported in the RJK command area include: (a) late blight of potato which incurred a loss of up to 50% in 2015; (b) yellow mosaic virus in cucurbits, (c) fruit flies and (d) bugs. In addition to this, there were also reports of crop losses due to weevil and improper storage.

4.2.1. Problems of insects and diseases in cereal crops: While disease and insects in the crops like paddy, wheat, maize, mustard and lentil are yet to pose a serious problem there are reported cases of damages on paddy from stem borers (especially when there is shortage of water) and bugs in spring paddy. But these problems have been within the economic threshold level. In crops like mustard, maize and lentil, the attack of diseases and insects there have been no reported losses.

4.2.2. Problems of insects and diseases in vegetables: Based on field obseravations and interviews with farmers and agriculture technicians, it is learned that commercial vegetable cultivation has been gaining momentum in the project command area. Nearly 400 hectares of land have been brought under commecial vegetable farming. As stated earlier, the problems of insects and diseases are seen more on vegetables than cereals with varying level of incidences on different types of vegetables

Some of the key pests and their extent of damage on various crops as reported by the farmers are briefly summarized in Table 4.2 below.

Table 4. 2: Key pests and their extimated damage

Pest	Crop	Estimated damage	Remarks	Remedies
Late blight (Phytophthora infestance)	Potato, Tomato	50% in 2015	Due to the use of low quality seeds from India obtained through informal channel.	The use of resistant clones along with judicial use of fungicides can control the late blight diseases in Nepal.
Yellow mosaic virus	• Cucurbits • Tomatoes • Cucumbers • Squash/ Zucchini	20% in 2016	Endemic. Due mainly to use of the same crop on the same land.	Plant resistant plants, Mosaic viruses are mostly spread by insects (insects should be prevented by suitable cover), Weeds control is required as some types may serve as hosts for the disease. Soil treatment is also one of the option that minimize the attack and loss.
Fruit flies	Cucurbits	20-25%	Fruit Flies are found flying around fruits and vegetables, both fresh and rotten. They can also be found around any moist organic matter and garbage.	Maintaining sanitation, using traps, using fruit fly control insecticide and aerosols

Bugs	Okra, beans and other vegetables	30%		
Stem Borer	Fruits and crops	15-20%	Bore the stem of fruits by larva Release of saw dust where it has affected	Borer infested plants should be traced, removed and destroyed during March and September, i.e. before the beetles emerge Use of 1/ 2 drops of the kerosene oil in each hole Plugging the hole Cutting the affected branches and pasting with Bordeaux mixture.
Maize borer, *Chilo partellus*	Maize	N/A	Foliage damage, stem tunneling, dead-heart, stem breakage, plant lodging, ear damage, and tassel damage are the various damages caused by this pest.	Use of maize borer tolerant cultivars is the best approach in controlling this pest which is eco-friendly and sustainable approach in maize protection. Other control approaches are biological, cultural and judicious use of chemicals are equally important against this pest.
Powdery Mildew (a fungus) *Sphaerotheca fuliginea*	Vegetables and pulses	20%	Powdery mildew appears in epidemic form when the plants are in the pod stage towards the end of January and in February. The disease is characterized by the formation of white, floury patchesinitially on the leaf progressing towards tendrils, pods and stems covering most of the aerial part at advancement of the disease.	Several chemical fungicides and bio-control agents are used to control the disease.
Leaf beetle *Nodostoma subcostatum*	Banana	8-10% Banana production	They chew the fruit and the leaves seriously from August to September	It can be controlled by clean cultivation and spraying of BHC @ 0.1%

Leaf spot	Vegetables, fruits, and crops		Disease affecting the foliage The majority of leaf spots are caused by fungi, but some are caused by bacteria. The spots will vary in size and color depending on the plant affected, the specific organism involved, and the stage of development	Remove infected leaves and dead twigs, Keep foliage dry, keep plants healthy, use fungicides (if needed), replace the plant

Source: AICU, 2017, Interaction with IPM experts in Nepal

Farmers generally obtain information on plant protection from the Agriculture Service Center at Tikapur and Agriculture Contact Points at Chuwa and Munuwa. In addition to these centers, farmers also obtain advises from the agro-vet dealers. There are eight agro-vet dealers operating in the RJK area. Discussion with the Agro-vet dealers revealed that out of the eight agrovets only two had basic knowledge on pesticides. Visit to agrovet dealers further revealed that stocking of pesticides are not done properly and farmers are not provided with information on safety measure, timing, quantity and types of pesticides to be used for different types of pest and diseases etc. Since the agro-vet dealers are already operational on the ground they could be brought into agriculture value chain be training and developing them to become technically qualified service providers. Common pesticides used in the RJK area are presented in the Table 4.3 below.

Table 4. 3: Types of pesticides used in RJK command area and their sources.

Types of pesticides	Name of the pesticide	Target crops	Classificaiton of Pesticide by Hazard (as per WHO)	GoN Banned Category
Macozeb group (Systemic and contact pesticide)	Dalfin G-sunamy Kitop Roger	Cereals and vegetables	Moderately hazardous	No
Seed Treatment	Bavistin Hinoan	Rice, wheat, maize, potato, vegetables	Moderately hazardous	No
Fungicide	Diathe M-45 Diathen Z -78 Krinoxil Gold	Vegetables, rice, maize, wheat etc	Moderately hazardous	No
Virus	Vircon Super	Vegetables	Slightly hazardous	No

The pesticide registration and management unit under the Department of Agriculture is responsible for pesticide registration, issuing of persmission for export, and production and management of pesticides in Nepal. The division is also involved in regular monitoring of pesticide use in Nepal. Accoriding to the

division, the type of pesticides used in project falls under the WHO Category II type including endosulfan, carbofuran category which are moderately hazardous, and carbaryl malathion (slightly hazardous).

4.3. TRANSPORTATION, STORAGE, SUPPLIERS AND APPLICATION OF PESTICIDES

Chemicals are harmful. They pose serious health hazard to both users and consumers. Therefore, they need to be handled properly. During the field visit, the study team visited several agro-vets centres and had conversation with traders, technicians and farmers regarding the transportation, storage and applications of pesticides. Some of observations are stated below:

4.3.1. **Transportation**[2]

Pesticides are not transported in the enclosed means of transportation. Producers and traders transport the pesticides in trucks, mini-trucks, vans and in some cases on the roofs of buses. Generally, the signs of danger are not displayed in the means of transportation. In case of local transportation Auto rikhsa, Rikhsa, Motor bike, cycles, Jeeps are used. So, pesticides are transported openly as other goods. Specialized means of transport are not used. Transporters, traders, loaders and onloaders are exposed openly with pesticides while transporting pose a serious threat to public health and environment.

4.3.2. **Storage**[3]

Most of the Agro-vets do not have separate storage houses for the pesticides. They store whatever spaces are available in their shops. So, they are not stored correctly as recommended. Therefore, there is a need to train the agro-vets in handling of pesticides. Traders are heavily exposed with harmful pesticides several hours in a day.

4.3.3. **Applications/Use of pesticides**[4,5]

Most of the farmers do not seem to visit agriculture offices for advice and prescription regarding the use of pesticides. They tend to receive advise from the agrovets, who, as stated earlier, are not sufficiently trained to make recommendations. Further pesticides are used without using safety gears like aprons, globes, and mask directly posing health hazard to those applying the pesticides.

4.4. LEVEL OF AWARENESS OF FARMERS AND OTHERS IN HANDLING AND MANAGEMENT OF PESTICIDES:

FFS activities in first phase of program and through other awareness raising aciviteis majority of the farmers in the command area seems to have some idea of the harmful affects of the use of pesticides on both crops and human health. The assessment noted that the use of synthetic pesticides is on the increasing trend and observed that many farmers are not aware of the correct dosage, type and time of application of pesticides. This has resulted in some cases the overuse of chemicals especially on vegetables making them unsafe for consumption. While the review of FFS curriculum showed that key topics such as the selection of chemicals, quantity and quality of pesticides, use of bio-pesticides and safety measures to be adopted are well covered there is still need to translate these learnings into action. In the first phase a total of 86 FFS were established and trained 2236 members on cropping pattern, use of bio pesticides, safety measures, type of pesticides to be used and the waiting period to be adopted for various crops.

[2] https://pesticidestewardship.org/homeowner/transporting-pesticides/
[3] https://www.epa.gov/pesticide-worker-safety/requirements-pesticide-storage
[4] www.epa.sa.gov.au/files/477372_guide_pesticides.pdf
[5] http://npic.orst.edu/health/safeuse.html

4.5. HARMFUL EFFECTS OF PESTICIDES IN RJK AREA

While no systematic study has been carried on the impact of the use of pesticides on the human health and the local environment in the RJK area, the following impacts, based on the experience from [6]other locations can be applied in the case of RJK as well. They include:

- Water contamination
- Soil contamination and degradation of soil fertility
- Destruction of beneficial insects and natural enemies.
- Impact of pollination – due to destruction of pollinating agents such as bees, bumble bees
- Deterioration of the quality of food/fruits/vegetable and honey due to chemical loading.
- Chances of building immunity of the pest due to continued use of chemicals.
- Health hazards such as cancer, nervous system disorder, reproductive problems, birth defects and neurological diseases
- Increased risk of attention deficit hyperactivity disorder due to consumption of chemical laden fruits and vegetables.

4.6. LESSONS AND BEST PRACTICES FROM THE FIRST PHASE

A. FFS as learning entity: Agricultural component in its first engaged FFS as a platform for learning and testing new ideas. Each FFS on an average would have about 25 farmer members comprised of both male and female, who would come to the FFS plot to learn and test new innovations. These FFS have been found to be very effective in reaching the farmers at the grassroots level. Therefore, it is recommended that in the second phase of RJK the agriculture component should continue to work through the FFS. However, there is a need to target key crops in addition to establishing the schools in the strategic locations.

B. Demonstrations: Most of the farmers in the RJK area are oral. Their ability to read and write is limited. Therefore, the project is recommended to promote new technologies and innovations through demonstrations where farmers would have the first hand opportunity to practically learn and share. Field days should be continued promote farmer-farmer learning and sharing opportunities.

C. Cross learning and visit: One of the activities has worked very well in the RJK is the learning and sharing visits. Farmers are selected by the WUAs who are taken to various sites to observe best practices and learn and share from other farmers outside of their locations.

D. Use of agrovet dealers: There are eight agrovet dealers in the RJK area. These agrovets have a very important role to play in the agriculture value chain. They can be provided with training in new skills and technologies related not only to pest control but in agronomic practices and engage them to provide quality services to farmers. The project should carry out a needs assessment of the agrovets, provide them with training in required skills and engage them.

E. Enhancing the competitiveness/quality control. One of the major problems faced by the farmers in RJK command area is the cheap and low quality agricultural produces coming from across the border. One way of dealing with this issue is to inform the market of the quality of produce from RJK area (which have far less pesticides loading) and to establish a pesticide residue laboratory along the two or three critical entry points where agricultural produce coming into the country would be subject to toxicity test.

[6] Use of pesticide in commercial vegetable cultivation, Tandi Chitwan, 2001
Pesticide Pollution in Nepal by Kanti Shrestha, NAST 2014
An Overview of Agrochemicals and Their Effects on Environment in Rupandehi district, Nepal, Govinda Bhandari, 2014

4.7. Alternative approaches of pesticides and its use

With the provision of year round irrigation, extension services, improved technology and cultivars in the second phase of the RJK, the cropping intensity in the RJK command area is expected to change considerably through crop diversification and intensification. With the proposed construction of cold storage facilities, good connectivity to market and vibrant extension and outreach services the farmers are likely to go for cultivation of high value cash crops such as tomato, okra, cucumber, bitter groud, bottle gourd, cauliflower and cabbage which have year round market. While the improvement in farming systems will provide farmers with additional cash income the change also warrants the change in pest dynamics. New pest and diseases such as late blight, mossaic virus as evidenced in the other intensive farming systems, are likely to emerge for which the extension agents as well as farmers will have to be prepared. Thus, in order to help the farmers the following mitigative actions are recommended.

Introduction of disease and insect tolerant varieties: Introduction and promotion of disease and insect tolerant varieties, where available, is one of the alternative approaches for preventing disease and insect damages. There are some potato varieties such as Khumal White -1; Janakdeve, Khumal Rd-2, Kufribatshaha and NPI-106 that have the capacity to tolerate late blight of potato. The use of these varieties could offer potato farmers to save their crops from the blight. Along with the provision of the tolerant varieties farmers needs to be provided with husbandry practices associated with the new crops.

It is advisable to control the pest at every stage of its life-cycle: i.e. eggs, larval/nymphal, pupal, and adult and at every stage of the crop.

Use of bio-pesticides: Use of bio-pesticides is another alternative approach for controlling several pests and insects. Farmer can use locally available plant materials to prepare bio-pesticides. For example, *Titepati, Asuro*, *Neem* leaves, garlic and chilly have natural insecticidal property. The decoction of these mixtures could take of insects such as aphid and bugs. Similarly, livestock urine, kerosene, and soap solution have also been found to control some of the vegetable pest. Bio-pesticides are safe as they do not contain harmful chemicals and are far cheaper than their counterparts.

A. Use of natural pests or beneficial insects: Use of natural pests is one of the best alternatives for controlling diseases and insect pests on crops. For example, BT virus, ladybird beetle, dragonfly, damselfly, spider etc have been found to be effective in controlling some of the insect pest. The application of all these techniques would need to be accompanied with practical training and demonstrations.

B. Maintaining good soil health: A healthy soil is a pre-condition for health growth. When soil have sufficient organic matter and the required nutrients they tend to produce healthy plants which have better ability to fight the pest and diseases. Therefore, it is recommended that farming practices in the RJF command area should also focus on soil and soil fertility management. Timely irrigation is another important factor that contributes to health crop with better ability to withstand disease and insect damages.

C. Crop rotation: Crop rotations are generally recommended to break up the pest and disease cycle by destroying the habitat. It is recommended that the crops of same family such as tomato, potato, chilly should not be planted in sequence on the same land. They should be rotated with the crops from difference families. For this, the project is advised to adopt crop planning practices based on farmer preference, market demand and pest complex in the area. Growing of garlic and onion for a season have been reported to clean up the soil.

D. Companion planting: Companion planting is another strategy to address pest problems. Some of the plants such as garlic, marigold have insecticidal property. They emit odor and smell that deters pest such as nematodes. Similarly, legumes such as peas and beans help to provide extra nitrogen to other

plants. Mixing these plants in with non-leguminous crops, vegetables, fruits can contribute to producing healthy plants through the provision of nitrogen, one of the major plant nutrients.

E. Practice good cleaning of equipment and field between seasons

Diseases can spread between fields or between seasons if farmers do not take proper precautions. After harvest, farmers must ensure to clean the harvesting equipment to prevent the spread of infected plants.

Some diseases can live on the stubble between seasons and infect a healthy planted crop. In general, plowing after harvest removes stubble that serves as remaining food and shelter for pests, especially insects. In cases where your field was infested, you should remove all stubble from the previous season.It is always advisable to clean the bunds and patch all rat holes on bunds and around your field. In fallow fields or forested areas of project, the farmers may want to have a community rat control effort or put up trap barriers to keep rats from damaging crop for which project can provide support. Other good practices that are recommended includes:

A. Ratooning (allowing the crop to sprout and continue growing after harvest) is not recommended because diseases and insect hosts can be sustained from season to season. It is best to clean the field of any crop and leave it fallow for a few weeks to a few months before planting again.

B. Use clean seeds and resistant varieties: Certified seed is recommended but if farmers can't get certified seed, use clean seed that does not have any discolored seeds, weed seeds or other rice varieties mixed inCertified seed is recommended but if farmers can't get certified seed, use clean seed that does not have any discolored seeds, weed seeds or other rice varieties mixed in.

Many varieties have been developed with resistance to different diseases. It is recommended that the farmers should check with agriculture section of municipalities and rural municipaltiies, project agriculture expert to find out which resistant varieties they carry.

Also it is advisable to use short-duration and resistant cultivars to decrease insect pest populations. In short-duration cultivars, insects cannot compete as many generations, so populations may not reach damaging levels. Resistant varieties experience less feeding damage on their leaves and stems, which means less entry points for bacterial and fungal diseases.

C. Planting Time: Advisable to plant at the same time as your neighbors: Planting at the same time (or within a 2 week window) as the neighboring fields can help to minimize insect, disease, bird, and rat pressure on individual fields. Planting at the same time (or within a 2 week window) as the neighboring fields can help to minimize insect, disease, bird, and rat pressure on individual fields.

D. Selection of appropriate pesticides and their handling and use as per the label are the most important steps for safe use of chemical pesticides. In this regard, the Government of Nepal needs to develop mechanism for enforcing the regulations for the overall management and use of pesticides adoping international guidelines with adequate educational and training interventions.

E. Over dose, over apply of fertilizers in field is not recommended: High nitrogen can increase susceptibility to certain pests and diseases that is why specific fertilizer recommendations are very important.

F. Advisable to follow natural pest enemies: Overuse of pesticide is common among farmers and can actually lead to pest outbreaks. Natural insect enemies of the rice pests are also killed when pesticides are applied and this can lead to an outbreak of other rice insect pests. Other ways to encourage natural pest enemies are to allow plants on the bunds and between fields to flower (yellow and white flowers attract natural enemies).

G. Not recommended to apply pesticide within 40 days of planting: Generally, a rice crop can recover from early damage without affecting yield. The diseases section shows the information on specific diseases that require early management.

H. Proper storage of grain is essential: The storage of grain at moisture content below 13-14%, preferably in an airtight container is recommended. It is advisable to clean the grain before storing so it is free of dust, chaff, and excessive broken grains. The storage area should be clean and have a damp proof floor and waterproof walls and roofs. Ideally, the storage area should be sealed to keep out rats and birds and to allow for fumigation if necessary. Stack bags on a pallett with at least 50cm of space on every side of the stack. It is not recommended to store grain for more than 6 months. Also, it is not advisable to store new grain next to old grain that is infested with insects. It is advisable to cultivate plant species that are drought tolerant to reduce the amount of irrigation required and potential runoff. Use organic materials and mulch to control irrigation runoff and reduce the need for chemical controls.

I. Accord highest priority to biological control and other eco-friendly methods and use chemicals only as a last resort.

J. Regular monitoring of pesticide residues in food, water and environment in project areas and vicinity.

K. 4.8. Situation Analysis of Pest and Pest Managemet Approaches and Lesson leanrnt from project Command Area.

- In the first phase of the project, ACIU conducted 16 week long 86 Farmer Field Schools (FFS). It covered crop management in the field, preparation and use of organic pesticides, safe use of chemical pesticides, detrimental effects of pesticides on human health, environment and the beneficial insects.
- During the field visit it was observed that some farmers were spraying the pesticides without using PPE, and they were found to be using high doses of often strong pesticides. Since IPM requires interdisciplinary approach and understanding, it is important that curriculum for FFS facilitators are multidisciplinary. Trainings regarding the testing and certification of pesticides/chemical residue in the products would be beneficial. Although testing of pesticides residue is not necessarily within the mandate or capacity of the ACIU it is advised that the extension agents be provided with some basic training in how to detect pesticide residue or provide them with information on where the residues can be tested should there be a need.
- Farmers prefer practical training over classroom trainings. Training courses should be planned in such a way that it covers the entire cropping season and that there is sufficient interaction between farmers and extension workers during the learning period.
- It is not a common practice for farmers to read instructions on the labels. Hence, chances of over or misuse of chemical. And, pesticides are commonly store in places within the reach of children putting them in danger of accidental poisoning from pesticide.
- There is no proper system to dispose the waste such as empty/used pesticides containers as observed during the field visit and interview with farmers.

Farmer Field Schools have been conducted to impart knowledge and skills to the farmers on crop management from seeding to harvesting. The farmers are trained in cultivation of different types of crops including proper use of fertilizer, pesticides and irrigation to increase production. In a Farmers Field School about 25 to 30 farmers participate on a 16-week long training on cultivation of different types of crops. So far, the project has conducted 86 Farmer Field Schools and trained more than 2236 farmers includnging

women. In summary, the outcome of FFS in first phase includes: farmers were trained on cropping pattern, preparing biological pesticides, using chemical pesticide safety, identifying harmful and beneficial insects.

4.9 SYSTEM AND PRACTICE OF PESTICIDE TESTING, CERTIFICATION

There is no existing system and practices of testing pesticides residue in the agriculture products and also there is no certification system. There is no institutions/laboratory for testing of pesticides in the project area. The agriculturist, agovet are not trained in pesticide testing and related areas. Project staff, local quarantine office at border, agriculture section of municipalities and rural municipalities should be strengthened in this regard. There is a need to establish the Rapid Bioassay of Pesticide Residue (RBPR) testing laboratory nearby project command area somewhere in Tikapur or Lamki.

4.10. Banned Pesticides in Nepal and its situation in project area

Nepal has banned all the POP and other notorious pesticides in 2001 for the first time and continued with their impacts were accessed. All together Nepal has banned 16 pesticides which are listed in Table 4.4.

Table 4. 4: Banned Pesticides of Nepal (Source: Krishi Diary 2017/18)

S. N	Name of Pesticide	Banned Year
1.	Chlordane	2001
2.	DDT	2001
3.	Dieldrin	2001
4.	Aldrin	2001
5.	Endrin	2001
6.	Heptachlor	2001
7.	Mirex	2001
8.	Toxaphene	2001
9.	BHC	2001
10.	Lindane	2001
11.	Phosphamidon	2001
12.	Organo-mercury compound	2001
13.	Methyl Parathion	2007
14.	Monocrotophos	2007
15.	Endosulphan	2014
16.	Phorate	2015

Eight agrovets working in the project command area, are aware of banned pesticides and these pesticides are not in their selling lists. The assessment team did not find any banned pesticidesin their stock. FFS trained farmers are also informed about the banned pesticides and their detrimental effects on human health. But the farmers who are not trained on the pesticides risk the exposure to harmful affecs of pesticides. The project could train and engage the agro-vets who have far greater access to and influence on farmers for safe and correct use of pesticides.

Potential adverse impacts of Pesticides in the project influence area

Pesticide overuse can cause pollution of soil, water, and air making unstable ecosystem, pest build of resistance to pesticides, all of which result in unsustainable agriculture. They do play an immunosuppressive role for aquatic fishes and amphibians causing decline of species and number in total. They also cause death of wildlife and bees disturbing the ecosystem chain. Organic farming and following practice of IPM, which ensure the sustainability in agriculture with judicious use of all pest management

options, will be better alternatives. IPM generally refers to the pest management system that utilizes all suitable technique and methods as compatible as possible keeping the pest below economic injury level.

The use of chemical pesticide has many harmful effects. The pesticides serious concerns about health risks arising from the exposure of farmers when mixing and applying pesticides or working in the fields and from residues on food and in drinking water for the general population have been raised. These activities have caused a number of accidental poisonings, and even the routine use of pesticides can pose major health risks to farmers both in the short and the long run and can degrade the environment.

Most of pesticides show a high degree of toxicity because they are designed to kill certain organisms and thus create some risk of harm. Within this context, pesticide use has raised serious concerns not only of potential effects on human health, but also about impacts on wildlife and sensitive ecosystems. Chronic head and stomach aches, loss of vision, birth defects, damage to the central nervous system, immune system deficiencies, pulmonary diseases, respiratory difficulties, deformities, DNA damage, disruption of the hormonal system, and death are all possible outcomes of pesticide exposure. Exposure to pesticides has also been proven to be an important risk factor in the development of cancer. The use of insecticides has been associated with cancers of the prostate, pancreas, liver, and other organs. More recently, studies of contact with organophosphates have shown that exposure to the residues of these compounds on fruits and vegetables may double a child's risk of attention deficit hyperactivity disorder.

CHAPTER V: Pest Management Plan (PMP)

Pest Management Plan

Major vegetable crops and the pest/disease attacking them with their current management options are shown in Table 5.1.

Table 5. 1: Pest Management option for Major vegetable crops

S. N	Crops	Insect Pests/ Diseases	Pest Management option
1.	Rice	Brown plant hopper	Integrated Pest Management solutions such as insect traps and bio-pesticides
		Stem borer	Integrated Pest Management solutions such as insect traps and bio-pesticides
		Rice hispa	Integrated Pest Management solutions such as insect traps and bio-pesticides
		Gandhi bug	Most effective control through IPM approaches
2.	Maize	Maize stem borer	Use of predators, cropping strategies changed for e.g. growing maize within an area at a same time
		Cob weber	Use IPM practices
3.	Tomato	Tomato fruit borer	IPM strategies, Use pheromone lures (Heli-lures for monitoring and mass trapping)
		Tuta absoluta	IPM strategies, Use Tomato Leaf Minor lures for monitoring and mass trapping, can also use bio-insecticides and botanicals such as Neem pesticides)
		Tobacco caterpillar	IPM strategies, Use pheromone lures (Spodo-lures for monitoring and mass trapping)
		Tomato pinworm	IPM strategies, Use pheromone lures
4.	Potato	Potato tuber moth	Use pheromone lures and other iPM strategies
		Cut worm of Potato	Flooding, and other IPM practices
5.	Cucumber	Melon fruit fly	Use pheromone baits, cue-lures
		Red pumpkin beetle	Use ashes, neem pesticides and other IPM practices
6.	Cole crops	Cabbage butterfly	Follow IPM strategies and use botanicals e.g Neem pesticides
		Diamond back moth	Use pheromone lures for monitoring and mass trapping

The PMP Activities and budget are detailed out in subsequent write ups.

1. Collaboration and coordination with agriculture sections of municipalities and rural municipalities. Department of Agriculture/PPD, NARC and other INGOs working in IPM sector. Also for scaling up IPM technology in RJKP.

2. Training to farmers on Integrated Plant Nutrient Management System (IPNMS) for a balanced use of both chemical fertilizers and organic manures. The agriculture section of municipalities and rural municipalities, TAL have the capacity, tools and guidelines for such trainings. They have been conducting such trainings on the past. RJKP should coordinate and collaborate with those agencies in conducing IPNMS trainings.

3. Capacity building of RJKP in agriculture component (manpower, facilities, staff trainings, demonstration kits, laboratories etc). The regular involvement of technical staff in each and every activities of the program along with the farming group is necessary for the effectiveness of the project. For this, permanent deployment for the project period of a technical staff and his/her empowerment is must. Therefore, allocate full time field staff for remaining period in all the project sites.

4. Awareness raising program for IPM through street drama, newspaper, brochure, pamphlets, FM/local television (both print and electronic version). Special awareness package on Pesticide, Health and Safety aspects in using pesticides, development of tool kit regarding IPM and wider distribution in project area communities.

1. Trainings including exposure visit of project area farmers to areas with effective IPM tools and techniques. Training to the farmers has to be continued so that they will upgrade their knowledge on non-chemical agriculture to reduce project dependency. The training to agrovetsare insufficient, so it is recommended to train/facilitate local private entrepreneurs/Agro-vets for the availability of bio-products, rational use and recommendation of safe pesticide.

2. Continuation of Farmers Field School in second phase of Agriculture component of RJKP: The field school has helped hundreds of farmers in project areas in phase 1 to learn agro-ecological concepts, apply IPM practices, reduce the use of pesticides and improve crop yields. The FFS should be continued by addressing the shortcomings of phase 1, strengthening and replicating FFS in other project areas in a sustainable manner . The facilitators of FFS in first phase of the project could be used as a resource person in the second phase of agriculture component of RJKP. The project through agriculture component should make available the easy to understand reading materials to the farmers. All the materials (leaflet, brochure) etc should be illustrated through pictures and translated in local language 'Tharu" which is common in area and useful to the farmers.

3. Pest Identification: It is advisable to know the pests or disease on plants before planning for treatment. The specimen could be sent to the expert when farmers are unable to identify it. Such mechanisms could be supported by the project to the farmers and continuation of this practice.

4. Maintaining Quality seed, quality soil: For prevention of over use of fertilizer, pest, maintaining the quality of soil and seed, the techniques mentioned in annex IV of this report shall be followed.

5. Establishment of good and continued supply chain through agriculture component of RJKP: A more efficient development of supply chain system of the bio-products to the field level is necessary. As the products are expensive the scaling up programs should be tied up with the subsidy mechanisms for smallholder farmers.

6. Research and Development: the experts engaged through ACIU should also collaborate with others in developing innovative chemistry and other control agents to manage insects, weeds and diseases. The RJKS should seriously work in improving crop varieties with pest and disease resistant traits. The in-depth survey related to pesticide use in project areas, its impact should be done to find out the actual "on the ground"situation of pesticide use and its impact.

7. Strengthening of quarantine at Nepal India Border in Kailali, establishment of pesticide testing laboratory (along with manpower and training) other support to agriculture programs of concerned organizations. There is an urgent need to develop the proper mechanism to monitor the pesticide level in vegetables to reduce the health impact of pesticide among farmers and consumers.

8. Initiation of forming a regulatory body, **regular surveillance on pesticide use in RJKP areas to control Pest related issues:** Implementation of CAD activities emphasizes on increasing production and productivity of various crops. To address these issues, the project should initiate to constitute a regulating body in the use of fertilizer and pesticides in the project area. The regulating body shall be represented by the farmers' groups, agricultural service providers, WUAs, local government bodies, agricultural cooperatives and civil societies. In addition, RJKP shall have to conduct awareness program on the proper

use and associated risks of such fertilizers and pesticides to the sellers, buyers and users. The RJKP will collaborate and support in a joint mechanism to monitoring of sales and use of banned (by GoN from 2063/ 7/ 13) 13 types of insecticides/ pesticides by the agriculture section of municipalities and rural municipalities, ACIU, WUA, quarantine offices, custom offices and the police.

The use of chemical pesticides because of intensive farming has reduced people's welfare by increasing the incidence of acute health symptoms; and also resulted in increased health and environmental costs. This could be minimized in Nepal by the (i) implementation and xpansion of IPM,(ii) by introducing better and safer protective measures , (iii) by improving heeducation and awareness of the users , and (iv)by the careful nforcement of governmental rules and regulations . This could be improved by community based IPM, and education and training to farmers.

Proposed Budget for IPM-FFS for phase 2

The proposed budget for IPM-FFS for MoRJKIS Phase 2 is shown in Table 5.2.

Table 5. 2: Proposed Budget for IPM-FFS for Phase 2

S.N	Activities	Number /Unit (US$)	Unit Cost	Total (US$)	Remarks
1	IPM-FFS Trainings to the farmers	100	1,000.00	100,000.00	
2	Establishment of plant protection labs and equipments	1	76,000.00	76,000.00	
3	Integrated Pest Management Program				
	IPM related Publications	10	1,000.00	10,000.00	
	IPM awarness programs	10	1,000.00	10,000.00	
	IPM-FFS facilitator trainings	5	5,000.00	25,000.00	
			70,000.00		
4	Impact study of IPM-FFS	2	10,000.00	20,000.00	
	IPM related interaction programs	5	1,000.00	5,000.00	
	IPM plant clinics	20	2,000.00	40,000.00	
	Trainings to IPM-FFS staff trainings	5	2,000.00	10,000.00	
	Trainings and orietation to Agro-vets	6	2,000.00	12,000.00	
	Total		**30,800,000.00**	**308,000.00**	

CHAPTER VI: INSTITUTIONAL ARRANGEMENTS

Roles and responsibilities in control the sales and use of banned chemicals:

The agriculture section of municipalities and rural municipalities, regional plant protection office of Plant Protection Directorate of GoN has the main responsibilities to control the sales and use of banned pesticides. The policies at the district level have a role to play in helping the agriculture section of municipalities and rural municipalities for the control of the said chemicals. The quarantine check posts at the border and the customs office also have to be active in controlling the import of such banned chemicals. The WUA and the Farmers groups also have to be active in controlling the banned pesticides. They can conduct awareness programs and trainings to meet the objectives. Table 6.1 shows the list of Project IPM Team.

Table 6. 1: Project IPM Team

S.N	Name of the person /organization	Roles and Responsibilities
1	Local Environment Monitoring Committee	Overall monitoring of IPM activities
2	Local Government	Coordination, Monitoring and compliance on pesticide transporation, storage, distributions
3	ACIU	Implementation of PMP
4	Regional PPO, PPD , NARC, facilitation by ACIU	Training materials, trainers, survey, IPM scaling up,
5	Local clubs, NGOs, medias, WUA, farmers group	Work in collaboration with ACIU for awareness raising and other activities
6	RJKÍP	Budgeting, ,coordination, reports, meeting with stakeholders, facilitation at municipal and rural municipality level to control the sale and use of banned chemicals, survey to project areas after IPM implantation to monitor the progress (Key Performance Indicators shall be developed) to assess to monitor the progress
7	GoN, WB	Regular monitoring and feedback

Bibliography

1. Plant Protection Directorate, Hariharbhawan, Lalitpur, Tel: 5535844
   email: ppd@ppdnepal.gov.np
2. IPM IL Project, Bakhumdole, Lalitpur, Tel: 5520943
   www.idenapal.org
3. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification, 2009
4. IPM Innovation Lab Project of USAID, https://www.usaid.gov/nepal/fact-sheets/integrated-pest-management-innovation-lab-project
5. Farmers Field School To Promote IPM in Asia, FAO experience By:Andrew Barlette
6. Entomology Division, Nepal Agriculture Research Council, Khumaltar, Lalitpur, 523041
7. National Plant Quarantine Programme, Hariharbhawan, Lalitpur Nepal
   Ph./Fax No. ++977-1-5553798
8. How to practice IPM, FAO, http://www.fao.org/agriculture/crops
9. International Code of Conduct on the Distribution and Use of Pesticide, Guidance on Pest and Pesticide Management Policy Development, FAO, June 2010.