Government of the People's Republic of Bangladesh
Ministry of Fisheries and Livestock
Department of Livestock Services (DLS)

Final Report

Pest Management Plan (PMP)

for

Livestock Development-based Dairy Revolution and Meat Productions (DRMP) Project

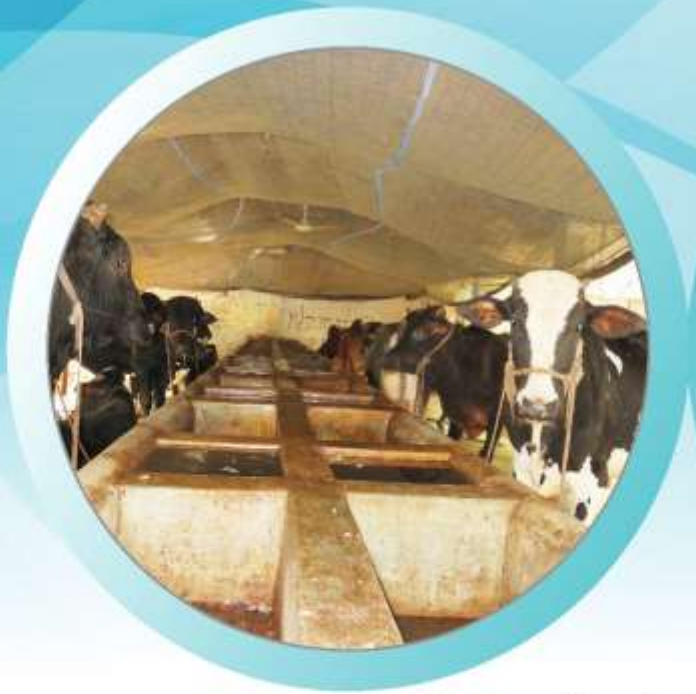

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Table of Content

List of Tables

Abbreviations and Acronyms

AGP	Antibiotic Growth Promoter
BLRI	Bangladesh Livestock Research institute
CIG	Common Interest Group
CEAL	Community Extension Agent for Livestock
DOF	Department of Fisheries
DAE	Department of Agriculture Extension
DLS	Department of Livestock Services
EMP	Environmental Management Plan
EMF	Environmental Management Framework
EIL	Economic Injury Level
FAO	Food and Agriculture Organization
FMD	Foot and Mouth Disease
IPM	Integrated Pest Management
GOB	Government of Bangladesh
MDG	Millennium Development Goal
MOA	Ministry of Agriculture
MOFL	Ministry of Fisheries and Livestock
NAP	National Agriculture Policy
NATP	National Agriculture Technology Project
NEAP	National Agriculture Extension Policy
NGO	Non-Government Organization
NLDP	National Livestock Development Policy
NIPMP	National Integrated Pest Management Policy
PMP	Pest Management Policy
SOWT	Strength, Opportunity, Weakness and Threat
TOT	Training of Trainers
UAO	Upazila Agriculture Office
WHO	World Health Organization

Executive Summary

Pests are more than a nuisance to livestock, which can drag down the profits by different impacts like direct loss of nutrient, pest irritation, lead to stress, creation and transmission of diseases, environmental pollution, etc. As a consequence, pests affect animal production, reproduction, weight gain and overall stock health. It is problematic for both livestock in the pasture and in confined housing. In order to combating the threat posed by the animal pests and to suppress pest populations below the economic injury level (EIL) without impairment of human and environmental health, a comprehensive pest management plan (PMP) as well as a clear commitment and combined effort from agriculture, livestock and fisheries department, different industries, and the community is required. The Pest Management Plan (PMP) was worked out identification of problems and assessment of present status through field visit, face to face interview with farmers, expertise, holding workshops, review of different documents and literatures.

The strategy has been developed based on several relevant policies, rules, regulations such as (i) National Livestock Development Policy (NLDP), 2007, (ii) National Poultry Development Policy,2008, (iii) National Livestock Extension Policy(draft),2013 (iv) Animal Disease Acts, 2005, (v) Animal Disease rule, 2008 (vi) Animal slaughter Act-2011 (vii) Bangladesh Animal and Animal Products Quarantine Act,2005 (viii) Fish Feed and Animal Feed Act, 2010 (ix) WHO Classification of Pesticide by Hazards and the Guidelines to Classification, 2009; (x) FAO Definition of Pesticide; (xi) World Bank's Pest Management Safeguard Policy (OP 4.09); and related projects- Small scale dairy and poultry farmers support services in selected 22 districts, National Agriculture Technology Project (NATP) DLS component, Livestock disease prevention and control project, Quality control of livestock vaccine, medicine and feeds.

The present status of Animal Pests was reviewed and the harmful effect was analyzed in the Livestock sector by both scientific and traditional method. The use of drugs, pesticides, insecticides, chemicals, etc. were identified which have harmful effect on livestock, human and environment. The pests are causing harms in the form of direct loss of nutrient, disease production, disease transmission, production loss, etc. also been discussed. Four consultation workshops organized at different livestock potential areas of the country. The concerned stakeholders were Dairy farmers, Poultry farmers, Feed seller / manufacturers, Sweetmeat makers / sellers, Meat (beef & mutton) sellers, Poultry sellers / processors, Livestock officials and Scientists who has expressed their perceptions and prudent opinions to prepare the plan. The Team also visited several stockholder's establishment such as poultry farm, dairy farm, live birds market, slaughter house, etc. to collect information on the relevant subjects.

Strategies of pesticide management Plan (PMP) would be implemented through skill and awareness development training of farmers, pesticides dealers, livestock extension personnel, animal health personnel and pharmacist. Quality pesticide /insecticide / drug should be made available. In addition, good farm management modalities should be developed and implemented. The plan would be reviewed, assessed, and monitored regularly during implementation.

1. Introduction

1.1 Background

Livestock is an important component of agricultural economy of Bangladesh performing multifarious roles. It supports the landless people and livelihood to the rural poor families particularly women. It is potentially important for poverty reduction; income generation, contribution to food and nutrition security, and employment generation. It also helps land cultivation and post-harvest threshing, supports as draft power for transportation, provide fuel for cooking and manure for crop and vegetables, enhance export earning, address cultural and religious uses, etc.

Pest's infestation and outbreak of infectious diseases are the most significant constraint to livestock and Poultry development in Bangladesh. The impacts of diseases and pests are multifaceted: like; loss to the farmers due to mortality and morbidity, loss of productivity, cost for disease management including treatment and sanitation, low quality of livestock products, reduced production and public health hazard, affecting livelihood of the livestock farmers, etc.

Climatic condition of Bangladesh is highly conducive to animal pests and diseases. Debris around the sheds and density of animals of different species in a single shed is a common phenomenon in rural small holders' houses in Bangladesh that encourages easy and rapid transmission of pests and diseases. Commercial intensive farming practices of livestock also possess higher risk of pest and disease. Indiscriminate pests control procedure using drugs and chemicals in livestock and poultry enterprises is also related with the ecosystem and food safety issues.

Therefore, it is utmost necessary to identify and control the pests using environmentally acceptable methods through awareness building of the farmers about economic loss as well as public health hazard from the pests.

Livestock Pests (Parasites) includes arthropods, helminthes and protozoan, which lives on the animals for their nutrition and multiplication. The tropical climate of Bangladesh and poor husbandry methods provide suitable ecological conditions for rapid multiplication and dissemination of a wide variety of pests and parasites. Presence of more than 100 pests and parasites in the country has been reported by the Extension and Research personnel and other investigators. Agricultural pests are causing huge damage and economic loss in the country, especially in the crop sector. Management measures also have direct impact on livestock sector through contamination of feeds staffs and pollution of environment, so proper pest control measures is essential. For these reasons, pest management in livestock and crop production system is equally important.

1.2 Justification

Livestock and poultry sector is taking an increasingly important role in many ways like; accounting for 14.31% in the agricultural GDP and emerging as a major driver in the last two decades showing an incremental GDP growth rate as compared to the fisheries or crops sectors. The livestock and poultry sector also plays a vital role in the food supply, food security and livelihood security of the country's millions of smallholders livestock farmers and other stakeholders. Milk, meat and eggs provide about half of animal sourced protein consumed in Bangladesh. It also acts as a major driver in employment, about 50% indirectly and 20% directly of total population is associated with the livestock sector. Milk, meat and egg-based solutions is popular to address malnutrition and hidden hunger in the country,

particularly among poor women and children in rural areas. Considering these facts, Bangladesh Government has recognized that the expansion of dairy and meat production, processing, value addition, marketing and consumption can offer an important pathway to sustainable economic development and future poverty reduction opportunities for Bangladesh. A number of challenges are being faced to reach the goal in livestock production like other agricultural sub-sectors. Among the challenges livestock pest and its management is an important issue to increase milk and meat production. Livestock pests have potential negative influence on production, quality, livestock and environmental health. There is no approved protocol for pest management in livestock sector at present, though various methods are being practiced for pest management in Bangladesh which are creating predicament to some extent to livestock, fisheries, human and environment. Considering these facts, it is indispensable to think of preparing a plan for pest management before commencing the development of a program on dairy revolution and meat production.

1.3 Prologue

The Government of Bangladesh recognizes the need to increase the value of its dairy and meat productions and processing through more sustainable management and in doing so, improve the lives of poor and providing subsidy to farmers. Several key sector wise challenges necessitate government interventions and investments to enable responsible private sector-driven growth. These include: (1) The absence of effective regulatory Framework for post-harvest dairy and meat sector; (2) Limitation in the basic public infrastructure necessary to enable private sector investment; and (3) limitation in both public and private sector capacity for improved livestock management and optimal productivity.

To overcome these challenges, and enable and encourage private sector investment in post-harvest dairy and meat, the global experience highlights the need to establish a core public sector governance framework including an agreed sector vision, coherent policy and enabling legal framework to enable the design, piloting, and implementation of post-harvest dairy and meat related activities supported by adequate institutional capacity building. The first and foremost necessity to strengthen Department of Livestock Services (DLS) capacity to implement an effective management system to address the de facto uncontrolled, open access system for private sector entrepreneurs.

In this reality, the project conceives the following overall objective:

a) The General objective of the Pest Management Plan is:

- To promote an environment friendly practice of pest control of livestock and Poultry through biological, cultural, physical, sanitation and hygienic practices, natural control mechanism and by appropriate use of drugs and chemicals in pest control.
- To make aware of the drug/chemical/pesticide use and disease issues amongst small holders, farmers and entrepreneurs.
- To implement PM action plans during serious pest infestation or outbreak of diseases and to introduce the technologies for a significant decrease in the application of pesticides.
- To assess the capacity of the country's regulatory framework and institutions to promote and support safe, effective, socially and environmentally sound pest and disease

management and to provide for appropriate institutional capacity support recommendations.

- To ensure the provision of continuous surveillance on pest infestation in addition to epidemiological study with research on economic and zoonotic important pests.

b) The specific objectives are:

- To identify the major pests and diseases of livestock and poultry birds in Bangladesh.
- To outline the procedural measure to prevent and control the major pests and diseases of livestock and poultry birds in Bangladesh.
- To control pests and diseases of livestock and poultry birds following the PMP and also IPM initiatives.
- Promoting the use of a range of preventative and non-chemical approaches to control pest populations and stave-off infestation. If an infestation with adverse impacts occur, thereby warranting additional treatment. The targeted application of a toxic pesticide is to be used only after all other reasonable non-toxic options are exhausted.
- To formulate cost effective and safer pest management measures.
- To ensure compliance with national standards, laws and regulations;
- To ensure compliance with the World Bank safeguard policy OP 4.09.

2. Review and Evaluation of Pest Problems

2.1 Present Status and Need for the PMP

Pest management plan for the Bangladesh Agriculture and Livestock is of paramount importance to pest control issue in rearing of animals. Due to poor livestock management system, indiscriminate use of all types of chemicals is contaminating the biophysical environment. These chemicals in the agricultural sector are killing beneficial insects. In Bangladesh, pest likes endo and ecto-parasite, insect, arthropods are causing loss in animal production in greater scale. Direct loss is caused by sucking blood and nutrient from animals and birds and hence reduce the production and quality. Some insects and arthropods acts as vector of many fatal diseases, results a huge loss in livestock sector by loss of production and lives.

The aim of PMP is to suppress pest populations below the economic injury level (EIL). All pest control techniques should be carefully evaluated to formulate appropriate measures that reduce the development of pest populations and keep pesticides and other interventions to such levels that are economically feasible and reduce or minimize risks to human health and the environment. However, some of the chemicals presently used in pest control program can be harmful to animals as well as to environment. Besides, due to inadequate knowledge, farmers are using chemicals in inappropriate dose, resulting harmful effect on animals as well as on environment. As a consequence, pest has become resistant to chemicals and drugs. Therefore, PMP is of dire need to the farmers and nation as well.

2.2 Goal of Preparing the PMP

The goals of the PMP program are -

a) To protect human health and the surrounding environment by employing a range of preventative strategies and using least toxic products for pest control and eradication.
b) PMP is to promote the use of Integrated Pest Management (IPM) measures which is expected to reduce reliance on chemical pesticides.

The strategies of inspection and monitoring of pest populations and locations to enhance control are.

a) To minimize the quantity and toxicity of chemicals used for pest management.
b) To minimize environmental impacts by using species specific pesticides and targeting application areas carefully.
c) To establish clear criteria for acceptable circumstances in which using a pesticide other than a least toxic pesticide is necessary, toxic pesticides shall only be used when there is a threat to public health and safety or to prevent economic or environmental damage by the pests and only after other alternatives have been implemented and are found to be ineffective.

Capacity building to prepare and operate PMP-

a) Improvement of DLS capacity to identify and diagnose livestock pests and their economic impacts.
b) Generate manpower along with skill development through training.
c) Expansion of laboratory facility at upazila level with full competence.

2.3 The Aim and the Nature of the PMP

PMP is prepared with the aim of standardizing a comprehensive plan for controlling pests through managemental practices. In case of pesticide use, necessary measures should be taken to reduce any harmful effect to the existing environmental conditions. Special efforts need to be made to improve the current pest management practices to decrease harmful effects of chemicals causing negative impacts on agriculture, livestock and environment. Integrated Pest Management (IPM) system is encouraged to decrease economic loss and to ensure environmental and health safety. The farmers will be taught that pesticide application should be employed as a last sort following the four 'R's, e.g. (a) right pesticide, (b) right dose, (c) right time, and (d) right method of application when managemental improvement have been less or ineffective.

2.4 Promotion of Safer Pesticides Management

For promoting safer pesticide management, it is proposed to:

i. Create awareness among the farmers about the dangers related to pesticides and the necessity to learn about their potential harm.

ii. Impart training on appropriate methods of storage, proper doses, handling and application procedures to distributers, prescribers, and farmers

iii. Teach preventive measures as well as actions that might be necessary in case of accident

iv. Provide easy-to-follow handbooks, leaflets, proper instructions according to rules and regulations.

2.5 Methodology Followed in Preparing the PMP

There are some distinct steps followed in preparing the PMP including-

a) Review of pervious strategies, literatures, relevant rules, regulations, policies, etc.

b) Problem identification from pest and its existing control measures in livestock, agriculture and fisheries sectors as because in many cases the control measures are similar to these sectors.

c) Different stakeholders experiences and opinions bears important values to prepare PMP, on account of that issues four consultation workshops were organized with relevant stakeholders at different districts, interviews with poultry farmers, dairy farmers, live bird market poultry sellers, slaughter house workers, feeds sellers, etc.

d) Settings of baseline situation through identifying pests causing and transmitting diseases, and harmful economic impacts. Find out existing pest control measures and their environmental impact in livestock and poultry sector.

e) Collect and process data from stakeholders, livestock professionals, districts and national level livestock offices, organizations, institutes.

f) Develop strategies, considering strength, weakness, opportunity and threat regarding pest, diseases, and their controlling measures including IPM.

g) Prepare Pest Management Plan, considering the status of pest and their impact on livestock, human and environment.

3. Regulatory Framework for Pest Management

3.1 National Policies, Laws and Regulations

Laws/ Regulations relevant to environmental issues with respect to Pesticide Management in Bangladesh include-

- National Agriculture Extension Policy (NAEP) 1996, 2006 and 2012
- National Agriculture Policy, 1999
- National Integrated Pest Management Policy, 2002

All these documents contain recommendations for using safer methods for utilizing pesticides, including use of IPM methods in one way or the other. The components of the IPM policy include:

i. Maintenance of ecological balance,

ii. Executing appropriate actions on pests,

iii. Operating an effective system for implementing IPM program.

iv. Developing human resources as the core of IPM

v. Conducting research on IPM

The National Agricultural Policy (NAP), 1999 stipulated that IPM will be the main policy for controlling pest and diseases. The NAP has given importance to the following activities for the pest control.

a) Farmers will be motivated to use more pest resistant varieties of crop.

b) Modern cultivation practices will be followed to reduce incidence of pest infestation

c) Use of mechanical control measures such as light trap, hand net etc will be increased and popularized. Biological control measures will be used to destroy harmful insects and preserve the useful ones.

d) Regular training and discussion programs on IPM will be conducted among the farmers under the supervision of Union Agricultural Development Committee for successful introduction and popularization of the method at the farmers' level.

e) Pest surveillance and monitoring system will be strengthened.

The Integrated Pest Management Policy advocated among others are -

a) Growing a healthy crop through proper management of soil, water, fertilizers, pests, etc.

b) Conservation of biological control agents by avoiding or reducing the use of toxic pesticides.

c) Augmentation of biological control agents.

d) Use of pest tolerant crop verities.

e) Use of cultivation practices that can minimize pest populations.

f) Mechanical control of pests.

g) Monitoring of field by the farmer on a regular basis.

h) Build up farmers as experts in their own fields in taking Pest Management decisions.

i) Income generation activities such as growing of 'ail' (border) crops, fish culture in the rice field, etc.

Use of pesticides that are not harmful to the environment as a last resort The National Integrated Pest Management Policy (NIPMP) includes the following number of specific actions regarding the use of pesticides in addition to some others

a) New proposal for registration of any pesticide will be declined if it falls under WHO class 1A and 1B pesticide compounds.

b) Experimental toxicity data on beneficially insects, fish and other aquatic animals in Bangladesh must be taken into consideration before registering any pesticide.

c) GOB will provide support and incentives to the private sectors for producing bio-control agents (parasitoids, predators and insect pathogens such as fungi, bacteria and viruses) and botanical pesticides locally.

d) GOB will monitor any misleading advertisement toward using pesticides and will initiate appropriate legal actions against such malpractices.

There is no specific rule or regulation on pest management in the livestock sector in Bangladesh, but different livestock policies/rules/Acts are relevant to pests, drugs, food safety of animal origin foods do exist. Relevant policies/rules/Acts are follows:

a) National Livestock Development Policy(NADP),2007

b) National Poultry Development Policy,2008

c) National Livestock Extension Policy(draft),2013

d) Animal Disease Act, 2005 and Animal Disease Rules,2008

e) Animal Feed Act,2010

f) Animal Slaughter and Quality Control of Meat Act,2011

a) National Livestock Development Policy, 2007

The current Livestock Development Policy has come into force in 2007. The First National Livestock Policy was formulated in 1992. The main issues focused in the latest policy were: (1) Dairy Development and Beef Fattening (2) Poultry Development (3) Breeds and Breeding (4) Feeds and Animal Management (5) Veterinary Services (6) Institutional Analysis of DLS and BLRI (7) Marketing of animal products (8) International trade.

b) National Poultry Development Policy, 2008

This Policy with a vision to accelerate production, employment generation and entrepreneurship development, promoting extension and research, quality control, feed production and importation, etc.

c) National Livestock Extension Policy(draft), 2013

National Livestock Extension Policy 2013 (draft: submitted for Govt. approval) reflected the increasing trend of livestock production related service demands; increasing trend of investment; veterinary

public health, food security and food safety issues; effective extension service; supply chain development; dissemination of models and technologies; strong linkage among research, extension, education and farmers; impediments of farmers access to services; increasing demand of organic products; family level small scale farming; and also other driving factors.

d) Animal Disease act, 2005 and Animal Disease Rules, 2008

The Govt. of Bangladesh has promulgated this act in order to control the transmission of animal diseases. The country is under threat of getting outbreak of different emerging and re-emerging diseases including trans-boundary transmissible diseases, controlling these diseases is prerequisite for livestock and poultry development in the country.

The Acts have been promulgated to ensure healthy veterinary services in the country. A list of bacterial, viral, protozoan and parasitic diseases of large and small ruminants and poultry birds have been included in the Act.

The Act has the provision of imposing ban on sale, slaughter or marketing and also on animal movements during outbreak.

e) Fish Feed and Animal Feed Act, 2010 and Animal Feed Rules 2013

This Act has been promulgated to ensure quality of feed using in fisheries and livestock sub-sectors and came into effect in 2010. Also incorporated ban of adding antibiotic, growth hormone, steroid and insecticides in the feeds to highlight the food safety issues.

f) Animal Slaughter and Quality Control of Meat Act, 2011

This Act has been promulgated to ensure quality meat production through anti and postmortem examination by veterinarian, transportation, processing, preservation, testing, sales. Act also addresses drug/ antibiotic/ chemical's residues which are harmful to human health. Slaughter house management including use of safe water, proper waste management, prevention of contaminants is the important issues in the Act. Act has remarked on personal health of meat processor, handler, and seller also.

There have a lot of Laws, Regulations, Acts, Rules, and Policies under Bangladesh Regulatory Framework on Livestock and Fisheries. Above mentioned regulations are specific in individual arena of livestock development, environmental safety and wellbeing of country and nation but have not addressed in specifically on Livestock Pest Management or Pest Control Measures.

3.2 WHO Classification of Pesticide by Hazard and the Guidelines to Classification, 2009

The WHO Recommended Classification of Pesticides by Hazard was approved by the 28th World Health Assembly in 1975 and has since gained wide acceptance. When it was published in the WHO Chronicle, 29, 397-401 (1975), an annex, which was not part of the Classification, illustrated its use by listing examples of classification of some pesticides active ingredients and their formulations. Later suggestions were made by Member States and pesticide registration authorities that further guidance should be given on the classification of individual pesticides. Guidelines were first issued in 1978, and have since been revised and reissued every few years.

Revised criteria for classification (introduced for 2009 update): The table showing the Recommended Criteria for Classification. WHO now uses the Acute Toxicity Hazard Categories from the GHS[1] as the starting point for classification. This change is consistent with the 1975 World Health Assembly Resolution which envisaged that the WHO Classification would be further developed with time in consultation with countries, international agencies and regional bodies. The GHS meets this requirement as a classification system with global acceptance following extensive international consultation.

Table 3.1: GHS Classification

WHO Class		LD50 for the rat (mg/kg body weight)	
		Oral	Dermal
Ia	Extremely hazardous	<5	<50
Ib	Highly hazardous	5-50	50-200
II	Moderately hazardous	50–2000	200–2000
III	Slightly hazardous	Over 2000	Over 2000
U	Unlikely to present acute hazard	5000 or higher	

3.3 FAO Definition of Pesticide

The Food and Agriculture Organization (FAO) has defined pesticide as:

Any substance or mixture of substances intended for preventing, destroying, or controlling any pest, including vectors of human or animal disease, unwanted species of plants or animals, causing harm during or otherwise interfering with the production, processing, storage, transport, or marketing of food, agricultural commodities, wood and wood products or animal feedstuffs, or substances that may be administered to animals for the control of insects, arachnids, or other pests in or on their bodies. The term includes substances intended for use as a plant growth regulator, defoliant, desiccant, or agent for thinning fruit or preventing the premature fall of fruit. Also used as substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transport.

3.4 World Bank's Pest Management Safeguard Policy (OP 4.09)

The purposes of OP 4.09 are:

a) To ensure good practices that are applied in World Bank financed projects,

b) To avoid excessive use of pesticides, and

c) To promote environmentally sound and sustainable pest management.

Its objectives relevant to the DRMP Project include:

i. To minimize the environmental and health hazards related to pesticide usage, and

[1] http://www.unece.org/trans/danger/publi/ghs/ghs_rev03/03files_e.html

ii. To ensure that pest management activities follow an Integrated Pest Management (IPM) approach.

The overall pest management approach is based on the capacity of the country's regulatory framework and institutions to promote and support safe, effective and environmentally sound pest management. OP 4.09 is triggered in the DRMP Project as:

a) the project is expected to introduce new pest management practices or expand or alter existing pest management practices, and/or

b) the project may lead to substantially increased pesticide use and subsequent environmental and health risks because of the introduction of productive varieties. In addition, use of pesticides and other agro-chemicals may increase as a result of the enhanced livestock extension services activities by the DLS including supply of inputs.

3.5 OIE- World Animal Health Organization

OIE World Animal Health Organization is an equivalent of WHO in the human field which sets international standards for animal health and welfare, monitor animal diseases, notification and strengthens veterinary services. In international trade OIE also monitor residues including antibiotics and pesticides.

When it comes to Standard setting, the OIE Specialist, Commissions and Regional Representatives regularly commit time to and participate in sessions to raise Delegate's (OIE delegates are in most country directors of veterinary services who are veterinarians) awareness of when and how to participate effectively in the standard setting process. They also encourage dialogue between delegates and promote closer regional collaboration among them by sharing their individual national positions on standards being developed or reviewed.

In terms of Animal Disease Notification, the OIE has made extensive improvements to the World Animal Health Information System (WAHIS). It also continues to assist member in meeting their obligation to notify animal disease occurrences. OIE staffs conduct regular training sessions, at regional level for designated national focal points for disease information. This has certainly significantly improved the quality of and responsiveness to notifications of disease outbreaks.

An effective and credible Veterinary Service is one of the most critical elements for fair and safe international trades in animals and animal products. Without a strong Veterinary Service and a robust international certification program, member states will continue to experience trade restrictions. The OIE therefore places great emphasis on building the capacity and quality of Veterinary Services.

4. Major Insects Pests & Diseases of Livestock and Poultry Birds and Their Control Measures

4.1 Pest Problems in the Past and Present

Agricultural and Livestock Pests and Diseases have threatened farmers since onset of farming. The damage they cause can be nutritional, developmental, social, environmental and overall economical. The presence of a pest or disease in a farm poses threat to adjacent farms and sometimes even to distant localities. As such, pests and diseases imply negative impacts on third parties and call for an additional response, either from affected parties or from public agency.

Pests can have adverse and damaging impacts on greater agricultural production and market access, the natural environment, and our lifestyle. Pest may cause problems by damaging crops and food production, parasitizing livestock, or being a nuisance and health hazard to humans.

In recent years the spread of emergent diseases and invasive species has increased dramatically. Indiscriminate application of different methods of pest control in both the sectors, has made many of the pests resistant to drugs and pesticides.

At the same time, numerous developments - such as the rapidly increasing transboundary movements of goods and people, trade liberalization, increasing concerns about food safety and the environment - have heightened the need for international cooperation in controlling and managing transboundary pests and diseases.

Agricultural sector

Plant pests affect food crops, causing significant losses to farmers and threatening food security.

Pest problem is a crucial ancient issue in crop production in Bangladesh. It causes loss of production, increase production cost, hamper in food security and safety, etc.

So, Pest management plan for the Bangladesh agriculture is of paramount importance because annual yield loss due to insect pests alone is 16 percent for rice, 11 percent for wheat, 20 percent for sugarcane, 25 percent for vegetables, 15 percent for jute and 25 percent for pulse crops

The spread of transboundary plant pests and diseases has increased dramatically in recent years. Globalization, trade and climate change, as well as reduced resilience in production systems due to decades of agricultural intensification, have all played a part.

Transboundary plant pests and diseases can easily spread to several countries and reach epidemic proportions. Outbreaks and upsurges can cause huge losses to crop and pastures, threatening the livelihoods of vulnerable farmers and the food and nutrition security of millions at a time.

In addition to local plant pest the locusts, armyworm, fruit flies, banana diseases, cassava diseases and wheat rusts are among the most destructive transboundary plant pests and diseases. Plant pests and diseases spread in three principal ways:

a. trade or other human-migrated movement

b. environmental forces – weather and windborne

c. insect or other vector-borne – pathogens

In agriculture, pests are kept at bay by cultural, chemical and biological means. Ploughing and cultivation of the soil before sowing reduces the pest burden. Besides, there is a modern trend to limit the use of pesticides as far as possible to reduce the pest impact. This can be achieved by monitoring the crop, only applying insecticides when necessary, and by growing varieties and crops which are resistant to pests. Moreover, biological means are used, in terms of encouraging the natural enemies of the pests and introducing suitable predators or parasites, where possible. At present, the use of chemicals as pesticides are reducing due to its harmful residual effect on animals and human beings. The Government has banned use of several pesticides in agricultural sectors.

In homes and urban environments, the pests are the rodents, birds, insects and other organisms that share the habitat with humans and that feed on and spoil possessions. Control of these pests is attempted through exclusion, repulsion, physical removal or chemical means. Alternatively, various methods of biological control can be used including sterilization program.

Livestock sector

In livestock sector, both ecto and endo parasites are prevailing with great threat in production and development. There are no specific integrated pest management (IPM) program in Bangladesh except the use of anthalmintic in animals and birds against endo- parasites and some chemicals for ecto-parasites & to maintain hygienic environment or bio-security.

Besides these, farmers are using chemicals indiscriminately without knowing the proper dose, method, precaution to personal health during controlling pests in their farms. Improper disposal practices of used vaccines, empty vials, medicine packet, syringes and other appliances in the farms are creating environmental hazards as well as affecting food safety.

4.2 Insects Pests and Diseases

Common pest of Livestock: Insect or pest of livestock is one of the most important issues in animal health and production. Ecto-parasite control can be expensive and time-consuming issues of a livestock farmer. They are not only annoyance; they can also transmit diseases and have an impact on the bottom line. In fact, lack of awareness of farmers about the harmful effect of pests causes a huge loss. Managemental and preventive measures are not adopted properly. Diagnostic capability is also highly limited at all level to address the hazard.

Common insects/pests and its harms to the animals and poultry are presented in Table 4.1 and Table 4.2.

Table 4.1: Common Insect Pest of Animals and their Impacts

Name of pests	Animals attacked	Causing direct damage	Causing Indirect loss
Black Flies	Cattle, poultry, swine, horses, sheep, goats, dogs, deer	Cause bird and livestock death as well as cause a stamped, trampling of young, structure crashing and tumbling. Suffocation and deaths by blocking respiratory passages. Excess blood loss can be detrimental to the host's health. Most deaths are caused by toxemia and shock to the actual bites. Persistent attacks cause unruly host behavior, weight loss, reduced milk production, malnutrition of young animals, dermatitis and epidermal necrosis, impotence, delayed pregnancy and stress-related diseases.	Transmitters of pathogens (nematodes, protozoans and viruses) that can cause disease. Black flies are carriers of the protozoan *Trypanosoma.* Natural transmitters of vesicular stomatitis virus to livestock, cattle, horses, and pigs.
Blow Flay	All livestock	Cause myiasis (the infestation of a live mammal typically from an infected sore) are from the genera *Calliphora*, *Chrysomya*, *Cynomya*, *Eucalliphora*, *Lucilia*, *Paralucilia*, *Phormia* and *Protophormia*	Heavy larval infestations can lead to the death of the animal.
Bot Flies (*Hypoderma bovis, H. lineatum, Oestrus ovis,* and *Gasterophilus intestinalis*.)	Sheep nose bot, Common horse stomach bot flies,	Larvae generally cause injury to their hosts.	
Cattle Grub (Heel Fly):	Cattle	Reduced weight gains, lowered weaning weights, tissue/meat damage and carcass downgrading at slaughter and self-injury by panicked cattle running to escape females laying eggs. Fatal when the larvae are clustered near the esophagus or the spinal column	Significant loss to the cattle industry due to damaged hides

Name of pests	Animals attacked	Causing direct damage	Causing Indirect loss
Fleas	All animals are potential hosts	Causes of severe anemia have been associated with huge numbers of cat flea bites for all animals attacked. Dermatitis, allergies and anemia when fleas are present in large numbers. Severe infestation of fleas can cause the death of goats, lambs or calves due do anemia.	Fleas are immediate hosts for helminthes (tapeworms) that parasitize domestic animals
Horn Fly	Cattle, bison and water buffalo, horses and other large mammals	Excessive number of painful bites that occur on a daily basis, the lesions can lead to secondary infections and cosmetic defects in tanned or dyed leather.	Vector (carrier) for *Stephanofilaria stilesi*, a spirurid nematode that causes stephanofilariasis in cattle.
Horse Flies	Cattle, horses, donkeys, sheep, goats, and human	Heavy attacks can lead to reductions in weight gains of beef cattle, reduced milk yield, reduced fed utilization efficiencies and hide damage from the puncture wounds.	The adult flies serve as vectors for many disease agents (viruses, bacteria, protozoans and nematodes) of animals. **Disease Transmission:** Equine Infectious Anemia (EIA), swamp fever. Anaplasmosis, caused by Anaplasma marginale (a fatal disease-mortality 50%.

Table 4.2: Common Insect Pest of Poultry and their Impacts

Name of pests	Animals attracts	Causing direct damage	Causing Indirect loss
House Fly (*Musca domestica* L.)	Birds, domestic animals and humans	Known to carry bacteria and viruses that cause disease conditions such as diarrhea, cholera, food poisoning, dysentery, and eye infections.	
Little House Fly (*Fanniacanicularis)*	Pest of poultry particularly caged layer	The dispersal from developmental sites to residential homes has resulted in nuisance citations and lawsuits. Causing nuisance, transmission of exotic Newcastle disease (END) virus to poultry Cause of human myiasis,	
Northern Fowl Mite, (*Ornithonyssus sylviarum* [Canestrini and Fanzago])	Poultry (layer, breeders), turkey, over 70 species of birds.	Blood fed, Stress, Thickening of vent skin, reduce production, loss of blood vessel in the vent, reduce egg size, reduce FCR	Dirty vent feather, reduce immunity, Nuisance to worker
Mosquitoes *(Culicidae)* (over 3000 spp.)	All animals and birds	Mosquitoes are known to transmit a number of pathogens that cause serious human and animal diseases such as malaria, dengue, chikungunia, yellow fever, Rift Valley fever, heartworm and encephalitis. Blood of an animal host is required to develop eggs in most species. Although a single mosquito will only take a small amount (2 to 8 milligrams) of blood from their animal host, blood loss from the host can be quite significant when biting mosquitoes are numerous. Mortality of livestock and pets exposed to massive mosquito attacks.	Nuisance and disease to humans.
Chicken Mite or poultry red mite, (*Dermanyssus gallinae* [De Geer])	Poultry-all	Cause serious irritation and blood loss to birds. This leads to decreased feed consumption, weight gains, and egg production. When mite populations are very high. Birds can die because of blood loss due to blood feeding.	Birds will spend more time grooming, especially at night instead of sleeping. Implicated as vectors of poultry disease-causing agents, and may harbor pathogens between flocks. Infest other bird species (including domestic species) and can cause irritation and dermatitis in human.

Name of pests	Animals attracts	Causing direct damage	Causing Indirect loss
Chicken Lice: *Menacanthus stramineus*), shaft louse (*Menopon gallinae*), fluff louse (*Goniocodes gallinae*), wing louse (*Liperus caponis*), and chicken head louse (*Cuclotogaster heterographus*)	Chicken spp.	Feed on host tissue and blood by gnawing on skin or pinfeathers. Cause irritation, feather loss and decrease feather insulation, and at high infestations can reduce the egg production. These effects are pronounced in young birds. Lice are generally species specific, and will not readily move between animal species. When louse infestations are high on chickens,	Will occasionally crawl onto human handlers of infested birds, but the lice cannot feed and will not survive on people or in the environment off-host for long.
Bed Bug, (*Cimex lectularis* L.)		Known as human parasites, but also infest chickens. Bed bugs do not remain permanently on their host, but instead spend most of their time in cracks and crevices of nearby structures traveling to the host at night to fee Considerable distress and blood loss to birds, especially when bug populations reach high levels; adult females may feed every 3-4 days. Allergic reactions. Heavily infested houses may develop anemia leading to high morbidity and even mortality of young birds.	Acts as human parasites to suck blood develop allergic dermatitis.
Sticktight Flea, (*Echidnophaga gallinacea* [Westwood])	Chickens, turkeys, and other animals. most common in free-range and backyard poultry systems.	Adults can cause irritation to their host and blood loss, which can lead to anemia or even death.	Stick tight fleas are not known to be important vectors of disease.
Fowl Ticks Argas persicus	All fowls	The vector of *Borrelia anserina* (avian spirochetosis, and the rickettsia *Aegyptianella pullorum*, which causes fowl disease (aegyptianellosis. Produce anemia (most important), weight loss, depression, toxemia, and paralysis. Egg production decreases. Red spots can be seen on the skin where the ticks have fed. Because the ticks are nocturnal, the birds may show some uneasiness when roosting. Death is rare, but production may be severely depressed.	
Litter Beetle, (*Alphitobius diaperinus* [Panzer])	Poultry	Adult and immature beetles can be a direct threat to bird health in cage-free systems because they can carry several pathogens of poultry.	Immature beetles can cause significant structural damage to poultry housing. Cause damage to

Name of pests	Animals attracts	Causing direct damage	Causing Indirect loss
		Both adult beetles and larvae can harbor various poultry pathogens, including bacteria like *Salmonella* and *Escherichia coli*, as well as viruses including the causative agents of both Newcastle and Marek's disease. Beetles are also intermediate hosts for the chicken tapeworm (*Choanotaenia infundibulum*)	poultry house insulation as they chew through the insulation to create harborage sites within which they pupate.

Endoparasites in livestock

Despite of persisting common knowledge that endoparasites of livestock can cause production losses, it is often assumed that there would be no effect on production if no symptoms of parasite infestation are observed. Recent research has shown that low infestations of worms such as brown stomach worm caused suppression of appetite resulting in a 45-75% reduction in growth. Apart from the reduced feed intake the worms also cause a loss of protein by leakage through the damaged gut and diarrhea. Endoparasites are classified in three major groups:

Roundworms

Roundworms are considered as the most economically devastating internal parasites of livestock. Figure 1 shows the life cycle of the nematode. In the host animal, adult nematodes produce eggs. The egg is expelled from the host with the feces, contaminating the pasture. A first-stage larva hatches from the egg. The larva will molt two times before it becomes a third-stage larva. Once the larva is in its third stage, it is capable of migrating from dung pats and soil onto moist grass. Larvae can survive up to a year on pasture. Infection occurs when the third-stage larva is consumed with the grass. The larva completes its life cycle in the gastrointestinal tract of its host. Once the adult stage is reached, copulation occurs and the life cycle starts over. Unlike other nematodes, the medium stomach worm can spend part of its parasitic life cycle in hypobiosis, a condition similar to hibernation. Hypobiosis usually begins in the spring. The “hibernating” larvae do not emerge until summer. Grazing pastures is a major source of round worm infestation. The need to control most of the roundworm or internal parasites will exist as long as cattle are grazing pastures by pastures management also.

Tapeworms

Cestodes (tapeworms) require an intermediate host to complete their life cycle. Different tapeworms require different intermediate hosts. All of the important species affecting sheep, goats, and cattle require pasture mites. These mites ingest the eggs while feeding and the larval stages of the worm develop inside the mites. Besides Intermediate host, other problems are house hold pet animals such as dogs and cats which are very susceptible to tapeworm. Routine de-worming program is essential for tape worm control since; other animals may get infected from pet animals.

Flukes

The fluke’s life cycle requires two hosts – cattle and snails. The adult flukes are found in the bile ducts of cattle. The eggs are laid in the ducts and expelled with the feces. A larval stage hatches from the egg and infects the snail, where it reproduces asexually. Specific stages of the juvenile fluke leave the snail and encyst on aquatic vegetation. Cattle eat the vegetation and become infected. The fluke migrates to the liver, infects the bile duct and matures into an adult. Intermediate host control management also needed to control Flukes because animal cannot acquire disease without intermediate host.

Table 4.3: Endoparasites causing Diseases/Damages to the Animals

Group of parasites	Name of parasites	Causing diseases/damages	Susceptible animal
Round worms	Haemonchus spp. Ostertagia spp. Oesophagostomum spp. Parafilaria spp. Hyostrongylus spp. Nematodirus spp. Dictyocaulus spp. Chabertia spp. Oesophagostomum spp. Stephanurus dentatus spp. Ancylostoma spp. Uncinaria spp. Bunostomum spp. Metastrongylus spp. Filaroides spp. Aelurostrongylus spp. Strongyloides spp Ascaris spp. Strongyles spp. Toxocara spp. Parascaris spp. Oxyuris spp. Habronema spp. Thelazia spp. Dirofilaria immitis Acanthocheilonema reconditum spp Stephanofilaria stilesi spp Onchocerca cervicalis spp Trichuris spp. Dioctophyma renale, etc.	Anemia, decrease production, wt. loss, rough hair coat/feather, stunted growth, cachectic, constipation, diarrhea, emaciation, death.	All animals and birds
Tape worms	Moniezia spp. Taenia spp Dipylidium spp. Echinococcus granulosus & Echinococcus multiocularis Diphyllobothrium spp. Anoplocephala spp. Moniezia spp. Hymenolepis spp.	Anemia, decrease production, wt. loss, rough hair coat/feather, stunted growth, pot belly cachectic, diarrhea, emaciation, death.	All animals and birds

Group of parasites	Name of parasites	Causing diseases/damages	Susceptible animal
Flukes (liver fluke, Lung fluke, Schistosomia)	Calicophoron – formerly Paramphistomum spp. Fasciola spp.	Decrease production, wt. loss, rough hair coat, anemia, stunted growth, poor infertility, liver fibrosis, cachectic, bottle jaw, diarrhea, emaciation, death.	All animals, common in cattle, buffalo, sheep, goat.
	Visceral Schistosomiasis	Dirrhoea, wt. loss, anemia, hypoalbuminemia, hyperglobuminemia, retarted growth, hepatitis,fibrosis, granuloma, patechiation, hemorrhage, vascular lesions in lungs, pancreas, & bladder,death,	All ruminants (cattle, Buffalo, Sheep, Goat)
	Nasal Schistosomiasis	Cauliflower like growth in nasal mucosa, partioal obstruction of nasal cavity, nasal discharge, occlution of nasal passages,	
Protozoan	Balantidiosis	Diarrhea, Indigestion, Enteritis, Loss of Weight, etc.	All animals, common in ruminant.
	Coccidiosis	Dysentery, Diarrhea, emaciation, Anemia, death	All animals and birds.
	Theilerisis	Pyrexia, Anemia, Emaciation, Loss of Weight, Rough hair coat, Death is very common.	Common in Cross bred cattle.
	Anaplasmosis	Pyrexia, Anemia, Emaciation, Loss of Weight, Rough hair coat, Recumbence, Death is very common.	Common in Cross bred cattle.

4.3 Currently Available Pest Management Technologies

The Current Integrated Pest Management (IPM) technologies for controlling insects of rice, vegetables and fruits differ according to the commodities and the types of insects and diseases.

Current Available Pest Management Technologies in Livestock Sector also depends upon the type of pests like insect (ecto-parasites), endo-parasites.

4.3.1 Current General IPM Measures for Insect Control

In the livestock sector: The technologies are-

- Use of pesticides/insecticides –in the form of spray, dust, dipping and chemicals (ivermectin) injection/pours, negusunt/ neguvon (pulv/ointment), etc.
- Use of chemicals coil, mosquito mat to protect from mosquito's bites.
- Some chemicals such as camphor, naphthalene, phenyl, oil of turpentine and other traditional substances such as plant extract, tobacco dust, etc. for the treatment or control of adult and larval stage of flies.
- Use of mechanical devices such as mosquito net, net with chemicals, electric mosquito killer racket, etc.

- Environmental management such as bio-security, waste management, proper disposal of dung, litter, etc.

Agricultural sector

At present a lot of general IPM measures are being adopted in agricultural sector in the country which are mentioned below.

- Perching for attracting insect-eating birds.
- Use of sex Pheromone trap.
- Use of light traps.
- Use of tolerant/resistant varieties.
- Picking/catching by hand net or mosquito net and destruction of eggs, nymphs& adults.
- Burning or mixing the debris and left-over rice straw under soil.
- Delaying pesticide spray to help parasitic (friendly) insects in eating eggs of destructive insect pests.
- Removing water from the field and drying the soil temporarily.
- Increasing planting space of seedlings to allow increased light penetration through the canopy.
- Using balanced fertilizer.
- Pulling out of affected plants & burying under the soil.
- Collection and destruction of infested leaf (with egg mass and grub).
- Application of ash on the plants.
- Practicing clean cultivation.
- Using yellow sticky trap.
- Cultivating trap crops like okra or mustard between rows and around the field.
- Spraying bio-pesticides.
- Destruction of infested flower pods and fruits regularly.
- Treating seeds with insecticides before planting in seedbed.
- Covering seedbeds with fine nylon net.
- Irrigation of field during infestation with very low quantity of kerosene oil.
- Use of poison bait (broken rice husk +gur +Carbarin insecticide).
- Using approved insecticide as a last resort

4.3.2 Current General IPM Measures for Disease Control

Livestock sector

In the Current General IPM Measures for pest control or disease produced by it can be divided into different methods under the management aspect in Livestock sector-

a) Maintenance of proper hygiene in house- regular cleaning, bathing, etc
b) Environmental management- Neat & Clean environment, proper disposal of farm waste, etc.
c) Mechanical- Use of net, use of smoke, etc.
d) Physical- Physically removes of insect, arthropods, etc.
e) Traditional – Application of different plant extract, ash, etc.

f) Chemicals- Use of chemical in the form of powder, spray, anti-insect coil, insect repeler, pesticide, insecticide, etc.

g) Drug- There is different type of tablets, bolus, powder, liquid and chemicals (ivermectin) injection / pours for control of endo-parasites.

The common groups of anthelmintic are –

Benzimidazoles

a) Albendazole –effective against threadworms, roundworms, whipworms, tapeworms, hookworms

b) Mebendazole – effective against pinworms, roundworms and hookworms

c) Thiabendazole – effective against roundworms, hookworms

d) Fenbendazole – effective against gastrointestinal parasites

e) Triclabendazole – effective against liver flukes

f) Flubendazole – effective against most intestinal parasites

g) Abamectin – effective against most common intestinal worms, except tapeworms, for which praziquantel is commonly used in conjunction with abamectin

h) Diethylcarbamazine – effective against Wuchereria bancrofti, Brugia malayi, Brugia timori, tropical pulmonary eosinophilia, loiasis

i) Ivermectin – effective against most common internal parasites (except tapeworms)

j) Suramin – It is used for treatment of human sleeping sickness caused by trypanosomes

k) Pyrantel pamoate – effective against most nematode infections

l) Levamisole

Salicylanilides

a) Niclosamide – effective against tapeworms

b) Nitazoxanide – effective in vitro against a wide range of helminths with clinical efficacy against Ascaris lumbricoides, and Cyclospora cayetanensis

c) Oxyclozanide – effective against liver flukes

d) Praziquantel – effective against estodes (i.e., tapeworms), some trematodes

e) Octadepsipeptides (e.g.: Emodepside) – effective against a variety of gastrointestinal helminths

f) Aminoacetonitrile derivatives e.g., Monepantel : effective against a variety of gastrointestinal roundworms including those resistant to other anthelmintic classes

g) Spiroindoles (e.g., derquantel): effective against a range of gastrointestinal roundworms including those resistant to other anthelmintic classes

h) Pelletierine sulphate is effective against diverse tapeworms, ring worms and nematodes.[7]

i) Artemisinin shows anthelmintic activity.

Agricultural Sectors

A number of IPM measures are being used in the sector-

a) Using tolerant varieties
b) Using Light trap and hand net
c) Using balanced fertilizer, urea application in three installments
d) With-holding irrigation for 7-8 days & applying 5 kg potash fertilizer per bigha (0.33 areas) of land
e) Collecting floating debris along the field borders and burying under soil
f) Using crop rotation
g) Using seed collected from healthy plants
h) Using seed treatment measures
i) Using organic manure
j) Keeping standing water in the field(depending on the disease)
k) Keeping the land dry for some time in case of leaf scald attack
l) Burning out the affected straw
m) Keeping under control the grass-type weeds
n) Not to use same land for seedbed be continuously
o) Using purified seed by soaking in fungicide-mixed water
p) Using soft seed bed and keeping it moist all the time (depending on the disease)
q) Drying land immediately after disease appearance (depending on the disease)
r) Throwing disease affected seedlings
s) Burning out the disease affected plants
t) Growing different varieties of rice at interval
u) Using balanced fertilizer
v) Mixing rice bran with seed bed soil (depending on the disease)
w) Covering seedbed with polythene sheets during cold spells
x) Prompt destruction of infested plant material to reduce initial inoculums
y) Weed control (solanaceous weeds) such as nightshades
z) Removal and destruction of the affected plant parts
aa) Application of neem cake at 250kg/ha
bb) Using yellow sticky traps
cc) Field sanitation by burning of crop debris
dd) Avoiding crowded planting of seedlings
ee) Maintaining field sanitation
ff) Using virus tolerant varieties
gg) Using of disease free seeds
hh) Use of high land and well-drained soil (for vegetables& fruits)
ii) Use of fungicide as a last resort

4.4 Major Insect Pests and their Control Measures using IPM

Integrated Pest management (IPM) has been developed as a way to control pest without solely on pesticides. It is a systematic plan which brings together different pest control tactics in to one program. Integrated control of ecto-parasites of veterinary importance is being implemented on a limited basis at present. However, several forces are accelerating a global shift to integrated pest management (IPM) which include the following:

- Reduction in new chemical compounds registered for use on livestock and poultry
- Universal development of resistance to pesticides
- Heightened environmental sensitivities to exclusive dependence on pesticide-based control
- Need for strategies which increase profits for the producer while decreasing costs to the consumer.

Common insect pests, host involve, IPM measures are as follows:

Table 4.4: Common Insect Pests, Host Involve, IPM Measures

Group of pests	Name of Pest	Animals affected	Measures Using IPM
Flies	Black Flies	Cattle, swine, horses, sheep, goats, fowl and to a lesser extent dogs and cats.	The common control measures of insects are basically same in principle. The measures are- (a) Biological control (b) Chemical control(c) Mechanical Control and (d) Immunological control. (a) Biological control is always an attractive option to include in IPM systems. In veterinary entomology, the utility of this component is probably limited to manure breeding flies. Hymenopterous parasites have frequently been incorporated into IPM systems to control house flies and stable flies, while predatory beetles and competitors (e.g. dung beetles) have been utilized in the management of horn flies (*Haematobia irritans*). Insect pathogens, particularly viruses, bacteria and fungi, have generally been neglected as biocontrol agents for pests of veterinary importance. (b) Chemical control will probably always be a component of IPM systems. The judicious use of pesticides - whether traditional classes of compounds (e.g. organophosphates, carbamates, formamidine s and synthetic pyrethroids) or newer groups of compounds (e.g. insect growth regulators or avermectin-like products) - forms an integral part of almost every IPM system. (c) Mechanical control can provide a simple and uniquely valuable addition to some IPM systems. For example, effective manure management and disposal can reduce fly populations by as much as 50% in cattle
	Cattle Grubs	Cattle (However, occasionally horses and people have hosted cattle grubs)	
	Deer Flies	Most domestic animals except fowl.	
	Face Fly	Cattle and Horses	
	Horn Fly	Mostly cattle, but will feed on horses, sheep and goats	
	Horse Flies	Mostly cattle and horses, but may bite swine, sheep, goats, dogs and humans.	
	Horse Bots	Horses, mules and donkeys.	
	House fly	All	
	Stable Fly	Cattle, swine, horses, sheep, goats, dogs and will bite humans.	
	Sheep Bot	Sheep and goats.	
	Sheep Ked	Sheep (some success on goats and may bite people).	

Group of pests	Name of Pest	Animals affected	Measures Using IPM
Lice	Sucking Lice	Most domestic animals except cats and fowl.	feedlots. Similar results have also been reported from poultry egg-layer operations. Trapping also has a potential role in reducing fly populations in the vicinity of confined livestock and poultry. Trapping is also increasingly used with success in the control of tsetse flies. This technology relies on dependable attractants, functional trap design, proper trap placement and regular servicing. In the case of integrated tick management systems, mechanical control components have included vegetation management as well as wildlife host management. (d) Immunological control of ectoparasites of livestock and poultry has been an effective component of integrated control in the past and will, undoubtedly, assume an even greater role in the future. Through cloning methodologies and gene insertion, it became now to possible to incorporate arthropods resistance or tolerance into breeding herd. Fundamental information on the immunological responses of livestock and poultry to natural and synthetic antigens has provided hope for the development of vaccines. Vaccines for use in controlling ticks, biting flies and even internal livestock parasites are on the verge of commercialization.
	Chewing Lice	Most domestic animals except swine	
Mite	Choriptic mange mite	Cattle, horses, sheep and goats (different variety or subspecies for each species of host). Common on cattle and sheep but seldom diagnosed.	
	Demodectic mange mite	Cattle, swine, horses, goats, dogs and cats (different species of mite for each host species).	
	Psoroptic mange mite	Different species or subspecies parasitize cattle, horses, sheep, goats, and rabbits.	
	Sarcoptic mange or scabies mite	Different species affect different kinds of animals. Swine, horses, sheep, goats, dogs and humans.	
Mosquito		All	
Ticks		All	

4.5 Major Diseases and their Control Measures IPM

Various risk factors play an important role in the prevalence of parasitic diseases in Bangladesh. Environmental factors include agro-ecological conditions, animal husbandry practices such as housing system, de-worming practices, pasture management, temperature, rainfall, landscape, feeding management and livestock rearing systems are favorable to insect and parasitic problem in the country. Insects/ pests cause serious harm/ damage to livestock as well as are the common vectors of different diseases in livestock.

These largely determine the type, incidence and severity of various parasitic diseases. Other risk factors such as the host species, sex of the animal, age, body condition and breed/genotype, parasite species and intensity of the worm population, have an effect on the development of gastrointestinal parasitic infestation.

In recent years, the Trans-boundary Animal Diseases (TADs) are spreading outrageously due to increase animals' movement, globalization of animals and its product trade, conflict and civil unrest-difficulty of enforcement of quarantine, increase smuggling, inflows of food aid, enhancement of privatization of Livestock sector and sub-sectors. Besides these, some countries like Bangladesh are geographically vulnerable to invasions of TADs. As for example, Theileriasis & Anaplasmosis were first time detected in Bangladesh in 1992, and appeared as fatal disease today. Considering all the facts

the diseases may transmit from a country to other in the world at any time and controlling method also be modified accordingly, so following table shows worldwide distribution with controlling IPM.

Table 4.5: Controlling Diseases of Livestock

Disease	Vector	Causative organism	Host	Symptoms	Area	Treatment
African horse sickness	Culicoid midge	*Orbivirus* (virus)	Equids	Fever, lung, heart or mucous membrane symptoms.	Europe, Africa	Vaccination
Babesiosis	Tick	*Babesia* (protozoan)	Human, cattle	Fever then red urine, anemia, death	South Europe and Africa, Asia*	Anti-protozoal, Antibiotics
Blue tongue disease	Culicoid midge	*Orbivirus* (virus)	Cattle, sheep	Fever, salivation, swelling of face and tongue	Europe, Africa, Asia	Vaccination
Chagas disease (American trypanosomiasis)	Various assassin bugs of subfamily Triatominae	*Trypanosoma cruzi* (protozoan)		Mild symptoms, then chronic heart or brain inflammation	Central and South America	Antiparasitic drugs; treatment of symptoms
Dengue fever	Mosquito	Flavivirus (virus)		Fever then arthritis	(Sub) tropics and South Europe, Asia*	Observation/supportive treatment
Tick-borne encephalitis	Tick	Tick-borne encephalitis virus		Ill with flu then meningitis	Central and North Europe	Prevention and vaccination
Heartland virusdisease	Tick	Heartland virus		Fever, lethargy, headache, myalgia, diarrhea, nausea, loss of appetite, anorexia, thrombocytopenia, leukopenia, arthralgia	Missouri and Tennessee, USA	Supportive treatment
Leishmaniasis	Sandfly	*Leishmania* (protozoan)		Fever, damage to the spleen and liver, and anemia	South hemisphere and Mediterranean Countries	Treatment of infected

Disease	Vector	Causative organism	Host	Symptoms	Area	Treatment
Lyme disease	Tick	*Borrelia burgdorferi* (bacterium)	Deer, human	Bull's-eye pattern skin rash around bite, fever, chills, fatigue, body aches, headache, joint pain. Sometimes neurological problems.[1]	Europe, North Africa, and North America	Prevention and antibiotics
Malaria	Mosquito	*Plasmodium* (protist)	Human	Headache then heavy fever	(Sub) tropics, Asia*	Prevention and anti-malaria
Plague	Flea		Rats, Human			Prevention and Antibiotics
Pogosta disease Synonyms: Karelian fever Ockelbo disease Sindbis fever	Mosquito	Sindbis virus		Skin rash, fever, in severe cases - arthritis	Scandinavia, France, Russia	unknown
Rickettsial diseases: Typhus rickettsial pox Boutonneuse fever African tick bite fever Rocky Mountain spotted fever etc.	Tick, lice	*Rickettsia* species (bacteria)		Fever with bleeding around the bite	Global	Prevention and antibiotics
African trypanosomiasis(sleeping sickness) Trypanosomasis	Tsetse fly	*Trypanosoma brucei* (protozoan) T.vivox, T. evanci	Wild mammals, cattle, human Canine spp.	Fever, joint pain, swollen lymph nodes, sleep disturbances Anorexia, Temp.,Anemea, Swelling of limb node, tearing, death.	Sub-Saharan Africa, Asia*	Various anti-protozoal drugs. Diminazene acetate.
Filariasis	Mosquito	*Wuchereria bancrofti*	Human	Fever, swelling of limbs	Africa, Asia*.	Various drugs

Disease	Vector	Causative organism	Host	Symptoms	Area	Treatment
West Nile disease	Mosquito	West Nile virus	Birds, human	Fever, headaches, skin rash, body aches.	Africa, Asia, North America, South and East Europe	None
Bovine anaplasmosis	Tick & other insect	Anaplasma merginalae	Bovidae	Fever, anemia, debilitation, death	Asia*, Africa, Australia, US	Specific anti-protozoal drug, Vaccine(not available in Bangladesh)
Theileriasis	Tick & other insect	Theileriasis spp.	Bovidae	Fever, anemia, debilitation, death	Asia*, Africa, Australia, US	Specific anti-protozoal drug.

N.B * = Diseases are prevailing in Bangladesh at present.

4.5.1 Controlling Diseases of poultry Birds using IPM

Poultry are infested with a variety of insects and infestation that live on the skin and feed on skin debris, feathers and blood. This activities can lower growth rate, reduce egg production and if the infestation is heavy, cause debilitation and death of birds. In addition, poultry houses can be a breeding source for a variety of flies that may be vectors of poultry diseases. The common poultry diseases are as follows:

Table 4.6: Common Poultry Diseases and Controlling Measures using IPM

Group of Insects	Name of insects	Causing harm/diseases	Vectors of diseases	Control measures using IPM
Beetles	Litter beetles-darkling beetle (Alphitobius diaperinus)	Considerable damage to insulation of infrastructure housing areas where they crieate nuisance	Marks disease, Avain flu, Salmonella, F. pox, coccidiosis, Botulism,N.D, cecal and tapeworm.	Insecticides after removal of birds.
Poultry lice	Brown chicken lice, poultry body lice, Large chicken lice, Shaft lice, Chicken head lice, Flaft lice.	Chew dry skin, Scales and Feather. Appetite loss weakned, reduse, loss of wt.		Insecticides-dust, spray, dipping
Poultry mites	Chicken mite, Northern fowl mite, Scaly leg mite,	Blood suck, emmaciation, lower egg production, Death,		Insecticides-dust, spray, dipping, Treat crates, crevies and rough spots.
Bed bugs	Common bed bugs	Suck blood		Insecticides treatment with cracks, nest and other areas.
Other less important insects	Chigger's mite. Biting midges Black flies Hump blacked flies	Suck blood	Malaria like diseases.	Chemical method of control.
Flies	Blow flies Little house flies	Severe nuisances	As vector of transmitting diseases - *Escherichia coli*, *Salmonella* sp., *Shigella'* sp., and others.	Chemicals-spray, baits, dust. Manure management-sanitation, use of combination or rotation of insecticides and application method.

Controlling diseases of livestock and poultry using IPM:

Controlling of Livestock and poultry diseases from insect are basically the control method of insects. Several insect control methods are available but in general the use of chemicals and mechanical methods are popular in Bangladesh.

5. Strategies for Implementation of Pest Management Plan

Livestock Health & Management in Bangladesh goodly interrelated to agriculture as because most of the feeds ingredients, green grasses of livestock come from crop by-product and agricultural fields. Use of pesticide, insecticide or drug in agricultural sector for pest management obviously effect on livestock management. Considering possibilities the implementations of strategies of Pest Management Plan (PMP) measures that will be promoted in the project in two major sub-sectors include agricultural pest management and livestock pest management.

In agriculture: (1) Reduce pesticide application amount through project activities, (2) Forbid using unregistered pesticide in project activities, (3) Forbid using the type I pesticide of the World Health Organization in project activities, and (4) Promote IPM techniques.

In Livestock sector, includes (1) Prepare model planning for application of anthelmintic to control helminthiasis (2) Identification of endo and ecto parasites by laboratory examination, (3) Drugs should be selected safe and short withdrawal period. (4) Emphasize capacity building of Livestock sector.

5.1 Fundamentals of PMP Planning

When developing a pest management plan, it is important to:

- consider why need a plan for DRMP
- know what the plan to achieve by the project components
- understand the invasive species and other animals in DRMP area
- consider the principles of pest management
- consider other pest management plans
- set achievable objectives through implementation of the PMP.

Before finalizing a pest management objective, it is also important to consider the interaction between pests and other issues such as land, water, vegetation and cultural heritage.

5.1.1 Steps to planning PMP

The following 6 steps will assist in effective pest management planning:

1. Understand the pest issue
2. Develop a draft pest management plan
3. Consultations
4. Finalize and implement the plan
5. Monitoring
6. Evaluate and review the overall results

5.1.2 Principles of Pest Management

Eight principles of pest management are suggested to follow as common basis for the management of pest animals throughout project area of DRMP. The consideration of all these principles is critical to the success of any pest management activity, regardless of scope and scale. These are:

1. Integration: Pest management in livestock management is an integral part of managing natural resources and agricultural systems.

2. Public awareness: Public awareness and knowledge of pest must be raised to increase the capacity and willingness of individuals to participate in control.
3. Commitment: Effective pest management requires shared responsibility, capability, capacity and a long-term commitment by land owners/ managers, the community, industry groups and government. Those that create the risks associated with pest species introduction or spread and those that benefit from the pest management should help to minimize the impacts of pest animals and contribute to the costs of management.
4. Consultation and partnership: Consultation and partnership arrangements among the users, local communities, industry groups, government agencies and local governments must be established to achieve a collaborative and coordinated approach to management.
5. Planning: Planning for pest management should be based on risk management to ensure that resources target the priorities identified at local, regional, and national levels.
6. Prevention and early intervention: Preventive pest management is generally more cost-effective than other strategies and is achieved by: preventing the spread of pest species, and viable parts of these pests, especially by human activity early detection and intervention.
7. Best practice: Pest management must be based on ecologically and socially responsible practices that protect the environment and the productive capacity of natural resources while minimizing impacts on the community. It should balance feasibility, cost-effectiveness, sustainability, humaneness, community perceptions, emergency needs and public safety.
8. Improvement (research, monitoring and evaluation): Research about pest and regular monitoring and evaluation of control activities is needed to make evidence-based decisions and improve pest management practices.

5.2 Steps in Setting up IPM in DRMP

5.2.1 Identify the implementation team

Transition to a PMP program requires a diverse, action-oriented PMP Committee. This PMP Committee will be an environmentally conscious committee lead by the Project Director at PMU/PIU, DLS. A representative of the District Livestock Office and Farmers Group will be members of this Committee. The leader of this team should be familiar with pests, pesticides and pesticide regulations. This arrangement is appropriate, because implementation of an IPM program can be tracked as a performance indicator.

PMP leadership is guided by pest management principles and environmental issues. Leadership with such academic background and experience qualifies to serve as an authority to supervise PMP implementation. Other team members include Environmental, Agriculture Extension, agronomists, crop protection experts (entomologists, pathologists), aquaculture expert, health officer and Fisheries officer.

5.2.2 Decide on the scale of implementation

To determine the scale of implementation, a strategic approach will be taken. IPM will be clearly defined and discussed by the PD as is done for all other development projects. A representative of the District Livestock Offices must attend these meetings to help explain the IPM approach and give examples of similar documented success studies. Through these discussions comprehension will be achieved, and potential objections will be addressed with successful practical examples.

5.2.3 Review and set measures objectives for the PMP

The PMP Committee will set measurable objectives and refine the IPM indicators relevant to their district; and determining factors such as:

- When the IPM program will start
- How much it will cost
- What will be accomplished by choosing IPM
- How success shall be monitored

The determination of above must be done prior to IPM implementation. Additionally, measurable goals will be set, to track:

- Pest management costs;
- Monitoring of pest activity before and after implementation of the IPM program;
- Number of calls related to pest problems and toxic chemical use reduction.

Furthermore, the time when the shift to IPM will occur must be discussed and agreed upon prior to implementation. The initial step will be to establish an implementation timeline that includes time to execute all of the steps outlined in the implementation plan. It is imperative to include time to organize the administration of the IPM and conduct any farmer training as well as manage the IPM process.

The IPM Committee will gather information on previously implemented or currently being implemented IPM programs; the time it took to develop them and how successful they have been. They will obtain the budgetary and any technical information for the previously implemented IPM programs and analyze the elements to establish lessons to learn. Field visits to currently running programmes will be conducted to get a practical insight.

Reduced pesticide use is the substantive yardstick in measuring an IPM's ability to create a safer environment. Baseline study will be conducted and therefore an information database that includes annual quantities of pesticides used will be designed to enable comparative analysis to the previous years. The goal will be a downward trend over time or ideally, a specific reduction amount, ultimately leading to a scant usage of highly toxic pest control chemicals.

5.2.4 Analysis current housekeeping, maintenance and pest control practices

While preparing to make a transition to IPM, the PMP Committee will familiarize itself with the organization's current policies and practices with respect to structural maintenance, sanitation and pest control. Occasionally, current practice may be consistent with IPM principles. Familiarization will provide the flexibility necessary to adapt to, and prepare for the necessary changes.

Structural maintenance is arguably the most efficient way to keep pests out of a facility because it physically stops pests from entering wherever possible. Structural maintenance will therefore be a regular part of the IPM. Cracks, crevices or other unnecessary openings in the building exterior that can be used by pests as harborage areas or entry points regardless of size, will be sealed appropriately. Sanitation deprives pests of food and water. A sanitation plan must therefore be accounted for in the development of an IPM. Staff must be provided with special sanitation training.

5.2.5 Establish a system of regular IMP inspection

PMP's central focus is regular facility inspections. Such inspections are the "life blood" for a continuous cycle of IPM activities that may or may not include chemical treatments. Activities will include:

a) Routine Inspections
b) Pest Identification
c) Selection of Control Methods
d) Monitoring and Evaluation

IPM inspections must emphasize on the four "zones" of pest activity:

a) Entry points
b) Water sources
c) Food sources
d) Harborage areas.

During inspections, all existing pest issues and potential problem areas, inside and outside, must be noted for follow-up.

For in-house IPM programs, the greatest inspection challenge will be establishing routine, proactive surveillance by trained specialists. To ensure this is done, the EMC or an independent consultant will conduct inspections and audits twice a year.

5.2.6 Define the treatment policy selection

A clear written policy on how the facility will respond to pests, when they appear, must be developed. Included in the policy will be definitions of both non-chemical and chemical treatment options and the sequence or prioritization in which they will be considered. It should be unequivocal on when and where chemical treatments are appropriate. Finally, it should include an "approved materials" list to ensure informed choices when chemical treatments are applied.

The key to an effective IPM is to correctly identify pests that have invaded the area before. Due to pest behaviour variations from one species to the other, the appropriate response will vary accordingly.

Once the pest is identified and the source of activity is pin-pointed, the treatment policy will call for habitat modifications such as exclusion, repair or better sanitation. These counter measures can drastically minimize pest presence before chemical responses are considered. Additional treatment options—chemical and non-chemical can then be tailored to the biology and behaviour of the target pest.

The final step in the pest response cycle is Monitoring. The information gained through on-going monitoring of the problem will facilitate determination of supplemental treatment options if required.

5.2.7 Establish communication protocols

Communication protocols must be developed to assist environmental services, facility maintenance, facility management and service providers. IPM is a cooperative effort and therefore effective communication between various parties is essential for success. PMP Committee and farmers must document pest sightings.

The PMP Committee will make recommendations and notify District Livestock Officer for pesticide treatments. They will also communicate with the maintenance team to make the necessary repairs.

5.2.8 Develop farmer training plans and policies

The Farmer Groups will serve as a pool of "inspectors" charged with reporting pest sightings to expedite response times and help limit the scope of new infestations. Training sessions will be conducted to acquaint farmers with IPM principles and their responsibilities for the success of the IPM program.

5.2.9 Track progress and reward success

Measurable objectives set at the beginning, must be measured against the IPM program's performance at least once a year. Documentation to facilitate the evaluation process is as follows:

a. Detailed description of the parameters and service protocols of the IPM program, stating the ground rules;
b. Specific locations where pest management work was performed;
c. Dates of service;
d. Activity descriptions, e.g., baiting, crack-and crevice treatment, trapping, structural repair; hygiene and
e. Log of any pesticide applications, including:
    - Target pest(s);
    - The brand names and active ingredients of any pesticides applied;
    - PCB registration numbers of pesticides applied;
    - Percentages of mix used in dilution;
    - Volume of pesticides used expressed in kilograms of active ingredient;
    - Applicator's name(s) and certification identity (copy of original certification and re-certification should be maintained);
    - Facility floor plan on which all pest control devices mapped and numbered;
    - Pest tracking logs (sightings and trap counts);
    - Action plans, including structural and sanitation plans, to correct any pest problems;
    - Pest sighting memos for IPM Committee to use in reporting pest presence to District Executive Committee (DEC); and
    - Using these records, and the goals of the IPM program (increased efficacy, lower costs and reduced pesticide use), the IPM Committee must see:
        - Fewer pest sightings and farmer complaints;
        - Lower monitoring-station counts over time;
        - Lower costs after the first 12-18 months, once IPM's efficacy advantage has had time to take effect; and
        - Downward trend in volume or frequency of chemical pesticide usage
        - Reduced pest infestations on the fishes

IPM is a team effort, therefore, the PMP Committee will track and report the program's successes following each evaluation; and encourage good practices by recognizing farmers who played a role. Communicating the success of the program in reducing toxic chemical use and exposure, reducing

pest complaints and lowering costs will help farmers to understand the purpose of the program and appreciate its success. The more they understand, the more likely they will participate willingly in helping expand and institutionalize the IPMP.

After the program has been in place for long enough to show significant results, it is recommended for the PMP Committee to work with DLS to publicize successes more broadly and to demonstrate the environmentally responsible approach to effective pest management and control. PMP Committee and DLS will lead theexample by sharing success with other stakeholders.

5.3 Principles Governing Selection of Pesticides

Selection of pesticides, under the DRMP project will be guided by the consideration of several pest management approaches for cultural, physical and biological measures before resorting to application of chemical pesticides.

The use of pesticides must be guided by the principles of cost efficiency, safety to humans, the bio-physical environment and effectiveness in controlling the pests. Pesticides selection will be made in accordance with the World Bank guidelines for the selection of pesticides (World Bank Operational Manual, Good Practice (GP) 4.03) as follows:

- Pesticides requiring special precautions should not be used if the requirements are not likely to be met;
- Pesticides to be selected from approved list, taking into consideration of: toxicity, persistence, user experience, local regulatory capabilities, type of formulation, proposed use, and available alternatives;
- Type and degree of hazard and availability of alternatives; and the following criteria will be used to restrict or disallow types of pesticides under Bank loans:
    a. **Toxicity**: acute mammalian toxicity, chronic health effects, environmental persistence and toxicity to non-target organisms;
    b. **Registration status** in the country and capability to evaluate long-term health and environmental impacts of pesticides.

5.4 Pesticides to be Acceptable to DRMP

The selection of pesticides to be acceptable under the project will be in line with(a) the World Bank Safeguard Policy OP 4.09 on pest management, and will depend on (b) the hazards and risks associated with pesticide use, and (c) the availability of newer and less hazardous products and techniques such as bio-pesticides.

In addition to the toxic characteristics of the pesticide, the hazards associated with pesticide use depend on how the pesticides are handled. Precautions to minimize environmental contamination and excess human exposure are needed at all stages from manufacture, packaging and labelling, transportation, and storage to actual use and final disposal of unused and contaminated containers.

The guidelines in Annex A provide internationally accepted standards on pesticides to minimize the hazards associated with pesticide use.

The use of pesticides under the project will also be guided by the FAO Publication on International Code of Conduct on the Distribution and Use of Pesticides 1991; *FAO Guidelines for the Packaging, Storage, Good Labeling Practice, Transportation and Disposal of Waste Pesticide and Pesticide Containers 1985*.

5.5 Pest Management Plan (PMP)

The Integrated Pest Management and Monitoring Plan (IPMP) is to be developed from the impacts and mitigation measures identified at the implementation stage based on the principles mentioned in this chapter and also the available techniques for farms and processing industries. The IPMP should include impacts from application of chemical as well as non-chemical pesticides. The reason why chemical pesticides are included is that in the initial stages of implementation of the IPM, chemical pesticides will still be used but will be gradually phased out as the IPM gets established.

When coming up with the IPMP, the following steps should be considered and documented:

- Identify the main pests affecting livestock in the region, assess the risks to the operation, and determine whether a strategy and capacity are in place to control them.
- Where possible, apply early-warning mechanisms for pests and diseases (i.e., pest and disease forecasting techniques).
- Select resistant varieties and use the cultural and biological control of pests, diseases, and weeds to minimize dependence on pesticide (chemical) control options. An effective IPM regime should:
    - Identify and assess pests, threshold levels, and control options (including those listed below), as well as risks associated with these control options.
    - Rotate crops to reduce the presence of insects, disease, or weeds in the soil or crop ecosystems.
    - Support beneficial bio-control organisms—such as insects, birds, mites, and microbial agents—to perform biological control of pests (e.g., by providing a favourable habitat, such as bushes for nesting sites and other original vegetation that can house pest predators and parasites).
    - Favour manual, mechanical weed control and/or selective weeding.
    - Consider using mechanical controls—such as traps, barriers, light, and sound to kill, relocate, or repel pests.
    - Use pesticides to complement these approaches, not replace them.
    - Prior to procuring any pesticide, assess the nature and degree of associated risks and effectiveness, taking into account the proposed use and the intended users.

The purpose of the IPMP is to ensure that the identified impacts related to application of pesticides are mitigated, controlled or eliminated through planned activities to be implemented throughout the project life. The IPMP also provides opportunities for the enhancement of positive impacts. The IPMP gives details of the mitigation measures to be implemented for the impacts; and the responsible institutions to implement them.

Implementation of the IPMP may be slightly modified to suit changes or emergencies that may occur on site at the time of project implementation. The plan therefore should be considered as the main framework that must be followed to ensure that the key potential negative impacts are kept minimal or under control.

In this regard, flexibility should be allowed to optimize the implementation of the IPMP for the best results in pest management. The IPMP consists of generic or typical environmental impacts that are derived from the site investigations, public consultations and professional judgment. This is because the specific and detailed impacts cannot be predicted without details for the project design and

construction activities as well as the specific project locations. The IPMP will however, provide guidance in the development of more detailed IPMP's, once the project design and construction details are known. Site specific Integrated Pest Management and monitoring plans will depend on the scope of identified major impacts to be addressed in the implementation of the DRMP. Presented in Table 5.1 below is a typical environmental management and monitoring plan, which should be updated during implementation of the DRMP.

5.6 Pest Monitoring Plan

Successful implementation of the DRMP Integrated Pest Management Plan in the project locations will require regular monitoring and evaluation of activities under taken by the farmers to be involved in the project. The focus of monitoring and evaluation will be to assess the build-up of IPM capacity among the farmers and processing industries and the extent to which IPM techniques are being adopted in production, and the economic benefits that farmers derive by adopting IPM. It is also crucial to evaluate the prevailing trends in the benefits of reducing pesticide distribution, application and misuse.

Indicators that require regular monitoring and evaluation during the programme implementation include the following:

1. Number of farmers engaged in IPM capacity building in the project locations
2. Number of farmers who have successfully received IPM training in IPM methods
3. Number of trainees practicing IPM according to the training instructions
4. Number of women as a percentage of total participating in IPM and successfully trained
5. Number of youth as a percentage of total participating in IPM and successfully trained
6. Number of farmers as a percentage of total applying IPM
7. Rate of IPM adoption (number of people as a percent of total) every year
8. Improvement in farm production due to adoption of IPM as a percent of production without IPM
9. Increase in farm revenue resulting from adoption of IPM practices, compared with revenue from conventional practices
10. Improvement in the health status of farmers
11. Extent to which crops and livestock are produced using chemical pesticides compared with total crop production
12. Efficiency of pesticide use and handling
13. Reduction in chemical pesticide poisoning and environmental contamination
14. Number of IPM participatory research project completed
15. Overall assessment of activities that are going according to IPMP; activities that need improvement; and remedial actions required

Table 5.1: Integrated Pest Management and Monitoring Plan.

Item No.	Potential Issues/ Concerns	Cause of Concern	Control/ Mitigation Measures	Responsible Person/ Institution and Cost per year per district (Tk.)	Standards/ Regulation	Monitoring Institution	Monitoring Frequency
1.	Increase in yield		Implement a long term IPM programme to sustain productivity and combat negative effects of chemical pesticides.	DRMP, participating institutions and farmers cost included in the IPMP overall cost	IPMP	PMP Committee lead by PD, DRMP	Semi-annually
2.	Soil degradation	Persistent use of chemical pesticides	Apply pond soil conditioning measures which include IPM Train farmers in proper handling and application of pesticides	Farmers	IPMP	PMP Committee lead by PD, DRMP, EMC	Quarterly
3.	Poisoning of non-target species including natural biological agents	Lack of knowledge of chemical pesticide potency Equipment malfunction Use of wrong type of equipment Wrong time and method of application (spraying)	Supervise and control use of chemical pesticides so that only approved and recommended ones are used Provide PM equipment Regularly maintain and clean equipment as recommended by supplier Dispose old equipment as recommended by manufacturer Provide recommended protective gear Use recommended and appropriate protective gear Conduct trainings in IPM	DRMP and participating farmers Cost: As estimated for capacity building	IPMP	PMP Committee lead by PD, DRMP, EMC, DoF	Quarterly
	Health and safety risks	Exposure to pesticides	Provide protective clothing and ensure it is used.	Agro-dealers, Transporters and Farmers	Labor regulations DoE regulations	Min. of Labor, DAE, DoF and PD, DRMP	Semi-annually

			Train farmers in proper pesticides handling. Routine medical examination				
4.	Air pollution and contamination	Exposure of pesticides to air. Disposal of pesticides remains in the open Disposal of pesticides containers and equipment in the open air	Store pesticides in closed containers Dispose chemical remains according to supplier recommendations. Train farmers in appropriate spraying techniques to avoid chemicals being blown away by wind Train farmers to maintain spray equipment in efficient operational order	Pesticides Suppliers, Farmers	Pesticides and equipment manufacturer's recommendations. Air pollution standards.	DoE, DRMP	Quarterly
		Illegal disposal of pesticides	Prohibit disposal of pesticides wastes into open dumps where they will be blown away by wind	Agro-dealers AGCOM	EMC ECR of DoE	EMC, City/District authority, DoE	Half-yearly
5.	Pest resistance	Lack of appropriate knowledge in pesticides application	Train farmers on correct application of pesticides	Farmers, DRMP	Different Laws	DRMP	Half-yearly
6.	Reduced environmental and health risks		Initiate education programmes Establish demonstration plots to disseminate information on environmental and health benefits of biological control agents to the communities for them to appreciate the advantages	DRMFP	EMC	MoEF, DoE, DLS	Half yearly

5.7 Strategy to Implement PMP Effectively

The strategies to be followed for implementation of PMP are as follows:

a) Surveillance, Assessment, Monitoring and Reporting
b) Training or capacity building
c) Awareness development

5.7.1 Surveillance, Assessment, Monitoring and Reporting

At present, 'National Agriculture Technology Project'-2 (NATP-2) on Livestock Development under Livestock Department is going on under that various components are addressed related to livestock production.

In livestock component of NATP the CIG farmers with the help of livestock personnel and other NGO's partners is implementing the plan according to regular assessment of de-worming, insect control program, oversee the hygiene & cleanliness of farms also assesses through surveillance of post application effectiveness of drugs. Regular monitoring is one the key point of success of pest management program. Successful outcome may ensure by recruitment of specialist in the sector. Research cell will monitor the efficacy of pesticide /insecticide/ drugs against pest regularly. They will also monitor the drug resistance status of pesticide /insecticide /drugs. In this connection DLS's capacity will be strengthened followed by assessing the capacity.

DLS personnel will monitor PMP activities related with safe use of pesticides and implementation of proposed Integrated Pest Management Plan (PMP) intended to Livestock Development. They will make an effort to learn whether the farmers are currently using any hazardous pesticides/ insecticides/drugs/chemicals impacting human, livestock and environmental health or the current use of pesticide is unsafe or overdosed. Based on the assessment, an Environmental Management Plan (EMP) indicating application of IPM will be suggested to livestock farmers.

The Project will recruit a specialist who would ensure implementation of pest management plan. The Specialist would need to visit farmer's level and observed application of pest management measures. Upazila level Livestock Officer (ULO), Upazila Agriculture Officer (UAO) and Upazila Fisheries Officer will be given the local authority to review the monitoring program of PMP, as most of the cases the activities of pest management process and methods are similar and associated to each other.

After performing the assessment and monitoring the progress, achievement, problems, shortcomings, opportunity, etc. will be reported to authority for taking necessary steps to effective implementation of PMP.

Bi-annual workshop of elite farmers, scientist, project personnel and related actors will be called for discussion on the opportunities or challenges encountered during the implementation period of PMP which will be helpful to effective implementation the project.

5.7.2 Training

Training programs on various aspects of the pest and disease management and judicious use of chemical pesticides should be organized by the DRMP for the farmers, pesticides dealers and retailers. It would be the responsibility of the Safeguard Specialist to train the relevant staff in the DRMP. Resource persons from relevant projects of DAE, DLS and DOF should be enlisted well

ahead of time, contacted beforehand and requested to prepare lecture notes keeping the educational and other qualifications of the trainee farmers in view. Following training programs will be provided under DRMP:

a) Farmers' training
b) Pesticides dealers' training
c) Livestock extension personnel.
d) Animal health personnel and pharmacist training

Farmers 'Training

The goal of farmers' training is to strengthen safety of farmers and let them achieve master skill on biological control of ordinary pest, strengthen the ability for economically and effectively controlling pest, including: know how to identify pest, know how to adopt correct prevention and control measures and know how to adopt appropriate prevention and control measures to the agriculture and livestock.

Livestock farmers should be trained up on various aspects of livestock management, environmental bio-security, endo and ecto- parasitism and their control measures. Training in dormitories is a more formal avenue of training which is often not popular with smallholder farmers who have various family and community obligations. It may be more appropriate for training of trainers (TOT).

Training on IPM would be conducted through "farmer to farmer" approach. For this, a group of core trainers among the farmers will be developed.

Pesticide Dealer's Training

A specific training program will be organized for the dealers / retailers / pharmacist of pesticides/medicine to make them aware about toxicity of pesticides/drugs and rules of use so that they can disseminate this information to the farmers. This is needed because, in practice, the dealers/ retailers while selling pesticides help the farmers in selecting the appropriate pesticide for specific insect or disease give guidance to dose determination, dilution ratio, frequency of application, etc. Their training curricula may be prepared by actual experts in the fields of disease and insect control for crops, livestock and fisheries. The best practice, of course, would have been to give dealership/ retailer ship license to only those candidates having diplomas in crops, pharmacist for livestock and fisheries sectors.

Livestock Extension Personnel Training

Livestock extension personnel are very close and core actors to livestock farmers and animals as well. They can help the farmers to boosting up the knowledge on parasitic problem and management aspects. Intensive pest management training should be effective along with training on livestock development and extension.

Animal Health Personnel and Pharmacist Training

Animal health personnel such as veterinarian, sub-technical staff, animal health practitioner, pharmacist, etc. are directly or indirectly involved in treating the animals. In most of the cases proper selection, actual doses (under/over dose), safety margin, toxic effect, withdrawal period, residual

effect, etc. of anthelmintic can be maintained with the specific training of the personnel. Sometimes agricultural pesticide or insecticide has been used for insect or arthropods control for livestock management, that are somewhat new arena for animal health personnel For in this reason specific training on use of the above chemicals, toxic action, residual effect, contamination etc, should be highlighted in training module.

Some Other Issues Pertaining to Training

The most important activities of pest management training, when practiced by the trained farmers, will also be utilized by other farmers through both personal contacts and visual observations if announcement about the training courses are made in market places beforehand. Provision of knowledge sharing meeting of farmers and workers organized by GO/NGO will be helpful to mitigate many of the problems of management system. Common farmers gathering have an effective impact on good management practices in livestock by knowledge sharing with each other.

Waste Disposal in Related to Pest Management

a) Veterinary medical waste

Veterinary drugs may need to be disposed of for various reasons including expiry, spoilage or simply because they are no longer needed. There are two classes of expired medicines: unopened and opened. Unused expired drugs can be returned to place of purchase. Many manufacturers will take them back for disposal. Modified live virus vaccines should be rendered non-infectious before disposal to prevent the virus from potentially infecting workers or animals. Freezing or adding bleach to the bottle can do this. When disposing of expired medicines, do not attempt to empty or wash bottles - discard them with their contents.

b) Animal health care products

Any leftover or re-useable animal health care products should be returned to the place of purchase or stored in the original container in a secured storage area. Often, these products have recommendations for disposal printed on their labels. Items those are not usable or have expired beyond the best-before date can be returned to the place of purchase or taken to a hazardous waste depot for proper disposal.

c) Veterinary sharp wastes

Sharps are veterinary and laboratory materials capable of causing cuts or punctures. Sharps include needles, syringes, scalpel blades, slides, cover slips, pipettes, broken glass and empty or expired pharmaceutical containers. There are risks of needle stick injuries or cuts when these materials are not handled or disposed of properly. Certain drugs or vaccines may cause reactions or infections if present on broken glass or used needles that break the skin. Blood on used needles, collection tubes or other equipment may contain viruses or bacteria that can cause illness following a cut or needle stick injury. To safely dispose of sharp items:

a) Separate sharps from other waste.
b) Use a labeled, puncture-proof container with a sealed lid for needles and surgical blades. Special containers can be obtained from many local veterinary clinics.

c) Containers must be labeled clearly as containing sharps and must not be used for recycling.
d) Do not use containers that allow easy access to the contents. Ensure children or animals cannot remove the lid. A plastic jug with a narrow mouth or a pail with a narrow opening in the lid also works well.
e) Use another pail or rigid container for pharmaceutical bottles and syringes.
f) Do not burn disposal containers. Use disposal facilities that are set up to accept the waste.
g) Other animal health products

Items including antibiotics, parasite treatments, vaccines, implants and banned drugs should be disposed of immediately after use. In addition to returning those products back to the place of purchase, can be taken them to a hazardous waste facility to be disposed of properly. Regular consultation should be conducted with supplier or veterinarian about products that may have been banned. Disposal of rodenticide or other pesticide baits and carcasses should be in accordance with the requirements specified on the product label.

d) Avoid Fly-tipping

Fly-tipping is the illegal dumping of waste on land that is not an approved disposal site. Fly-tipping poses a threat to health and the environment and is expensive to clean up. Any farmer, may become a victim of fly-tipping.

e) Preparation of manure management plan

Farm animal's manure is excellent media for pest propagation and agent of environment pollution. Proper manure management is an important issue for pest management plan.

Manure management plan should include the preparation of a field-by-field risk map (risk of causing water pollution) and an assessment of the need for any extra slurry or dirty water storage. The principle manure management plan should:

- Prevent direct discharge of manure or wastewater into surface waters or onto adjacent neighbors' property.
- Prevent any nuisance conditions that interfere with normal use and enjoyment of neighbors' property.
- Enhance the operational efficiency of the dairy unit.
- Collect and use dairy manure and wastewater for beneficial purposes such as fertilizer, compost, or bedding.
- One can draw up one's own plan or obtain professional advice from a consultant.

Manure management plan should be clearly set out and as per following steps:

- By considering slope, soil type and the position of watercourses and water supplies, one should identify fields or parts of fields where livestock manures should never be spread. These non-spreading areas could be marked on a farm map (in red).
- Identify where livestock manures should not be spread under certain conditions or where application rates should be restricted. These very high risk areas (orange) and high-risk areas (yellow) could be marked on the farm map. The remaining areas could be marked as lower risk (green).

- Calculate the minimum area of land needed for spreading livestock manures by using a maximum field application rate of 250 kg total nitrogen per hectare per year. One can use standard tables or an analysis of manures for this.
- Assess availability of sufficient land to spread livestock manures within the relevant restrictions.
- Assess whether extra storage is needed for slurry or dirty water.
- Update the manure management plan if livestock numbers increase, the dirty yard area gets bigger, or other changes affect the volume of slurry or dirty water produced.

f) Disposal of dead animal

Livestock and poultry deaths may occur no matter how well an operation is managed. Disposing of dead animals quickly and effectively is important to reduce the risk and spread of disease. Carcasses can be a source of disease if scavenged by wildlife or pets. Some of these diseases can then be passed back to livestock or even humans. Carcasses are also unsightly, odorous and a breeding site for flies. The choices for disposal could be burial, incineration, composting, rendering and natural disposal (except for animals that have been euthanized with drugs and chemicals or if the animal is known or suspected to have died from an infectious or reportable disease). The dead animal should be disposed of within 48 hours of death.

g) Anaerobic digestion

Anaerobic digestion of farm waste is one of the scientific methods of proper disposal. It minimizes contamination of chemicals, prevent fly and other insect propagation those are harmful to farm animals as well as environment. The principle of anaerobic digestion is breakdown of organic matter by bacteria in the absence of oxygen. This natural process can create: biogas - renewable energy source for heat and power; biomethane - biogas that has had the impurities, carbon dioxide and water removed so it can be used as a fuel for vehicles; digestate - nutrient-rich organic fertilizer or soil conditioner.

h) Efficient disposal of antibiotics, hormones and growth promoters

Now a day use of antibiotics, hormones and growth promoters in farm animals is a common phenomenon in the country. More over different groups of antibiotics are also practicing in the treatment of disease condition produced by pests. Unethical practice of these products or chemicals are responsible for resistant of harmful organisms, hindrance of safe food production and environmental pollution. Effective and efficient disposal, prohibition of use according to rules and regulations, awareness development of users is essential to mitigate the harmful effect.

Practically pathogens, including antibiotic-resistant pathogens, antimicrobials (doxycycline, bacitracin, avoparcin, tetracyclines, penicillin, virginiamycin, tylosin, erythromycin, lincomycin, flavophospholipol, monensin, carbadox, spiramycin, tiamulin, salinomycin, sulfamethizole, roxarsone) used for growth promotion and disease prevention, synthetic hormones used for growth promotion and reproduction control, natural hormones are retaining in livestock excreta (Hutchison et.al. 2004; Tueber-2001). Antimicrobials, when used in low sub-therapeutic doses in feed and water, are called “growth promoters”. They are used by industry to reduce subclinical populations of pathogenic microorganisms in gut mass, lessening metabolic drain, prevent irritation to the intestinal

lining, increase food passage through gut, allowing increased daily gain (4-16%) and feed utilization (2-7%) (Hardy-2002).

Antibiotic resistant pathogens in excreta become available in the environment to wildlife and grazing livestock, and can contaminate crops. Many pathogens have long survival after excretion, e.g., Salmonella bacteria and High Path Avian Influenza virus can survive for months after excretion (Chee-Sanford-2001). Studies show there is horizontal gene transfer of antibiotic resistant genes in farm animal colons and there is stable maintenance of resistance transferred genes (e.g., tetracycline, erythromycin, ampicillin, vancomycin, clindamycine resistance common) (Shoemaker -2000). Anaerobic digestion destroyed only 59% of oxytetracycline in manures in 64 days. Various studies showed methane production was reduced from 20-80% when manures contain antibiotics, depending on the concentration of antibiotics in the manures (Wulf-2006). However, composting destroyed 95% of oxytetracyline in manures within first week. Antibiotics found intact and reported in sewage sludge were ciprofloxacin, doxycycline, norfloxacin, ofloxacin, and triclosan (Gibbs-2006).

Availability of Pesticide/Insecticide/Drug

In addition to specific training of different stakeholders and proper disposal of farm waste an important issue of pest management is to make available of a safe, none or least toxic, effective pesticide/insecticide/drug with proper document. Still then it is very necessary to be awarded on residual and harmful effect on livestock and environment with its appropriate disposal. Regular de-worming program of livestock should be strengthened with the cooperation of DLS and other NGO's. De-worming campaign from DLS may strengthen the activities in overwhelming.

5.7.3 Awareness Building

The promotion of IPM and sound pesticide/ anthalmintic use, will be effective by organizing awareness program involving CIG, non-CIG farmers and different stakeholders. Awareness will be raised through demonstrations, discussion meetings, dissemination of information about pest arrival, distribution of leaflet, booklet, etc.

Discussion Meetings

Discussion meetings of the farmers among themselves on regular basis will help dissemination of the IPM techniques and their benefits and aware farmers.

Demonstrations

Demonstration of the improved technologies has become one of the most effective strategies for dissemination of useful technologies to the farmers. Therefore, extreme care should be taken from the beginning to the end of conducting demonstration on various IPM techniques.

Dissemination Information about Pest Arrival

Arrangements should be made to disseminate information on pests that pose a threat to crops and public health especially at the beginning of the season. Additionally, information on control programs already in operation should also be made public in appropriate manner.

5.8 Personal Protection

a) Design of personal protective equipment, dresses, other utensils should be distributed
b) Delivery to the CIG members or users may be free of cost for the first time.
c) The retailers of pesticides should be invited to discussion meetings and the protective equipment and dresses should be demonstrated in their shops.
d) Pamphlets should be printed and given to the stakeholders.

5.9 Budget for Pest Management Plan

It is assumed that some of the PMP measures will be part of the normal responsibility of the respective government ministries, agro-dealers, transporters, fish farmers and other relevant stakeholders, within their institutional mandates and budgets.

It is important to appreciate that some of the stakeholder institutions may not have sufficient capacity to manage environmental and social impacts of pesticides and to adequately monitor implementation of the enhancement and mitigation measures. Therefore, it is necessary to train them. The cost of training for the managing impacts is necessary to build it within the BSCMFP budget. The table also include costs for conducting awareness and sensitization campaigns on pesticides application, management and adoption of IPM in the project areas. Costs for setting-up, adoption and use of IPM by fish farmers are also necessary to consider. The costs for managing and monitoring various mitigation and enhancement measures indicated in Table 5.2 should be estimated for throughout the project period i.e. 5 years.

Table 5.1: Budget Proposal of PMP

Sl. No.	Items/Measure	Estimated cost US$
1	Survey of present status (including meeting, workshop, etc.)	10,000
2	Capacity building of DLS (man power, Laboratory, Communication, IT, etc.)	40,000
3	Development of Training module, tools, etc.	20,000
4	Skill development through training of diff. stakeholders	20,000
5	Awareness development and sensitization through campaign/ proclamation/dissemination.	40,000
6	Updated technology transfer	
7	Equipment/appliances distribution	40,000
8	Medicine/drug/chemical, etc. distribution	20,000
9	Prevention and control program of pest- borne fatal diseases	10,000
	Total	200,000

The summary of Consultation Workshop on Pest Management: Consultation workshop was an important segment of preparing the strategy of PMP Conducted four consultation workshops at Manikganj, Savar, Dhaka, Narayanganj and Gazipur. There were 88 respondents participated in checklist query on PMP. Among the respondents' different stake holders such as Farmers, Feed seller, Meat processors. Medicine seller, Milk collector and seller, Different level officials of DLS, Experts and Scientists on Livestock, etc. The options of respondents were as follows.

i. **Common pests available are**- Insect, Arthropods, Lice, Tick, Mosquito, Fly, Rat, Mouse, Vulture, Cat, Dog, Fox, House Lizard Snake, Birds.

ii. **Harmful effect**- Suck blood, Extract nutrient, produce diseases, Transmission of diseases, Decrease production, Impede safety food production, Decrease quality of product, Increase mortality rate.

iii. **Pest control methods**: De-worming, use of pesticide, Chemicals, Mosquito net and other equipment, Daily bath practice, Mosquito Coil, Proper Management of Cow dung and Farm Management, Use of Trap and special net, Cleanliness, Disinfectant, Bio-security, Vaccination though is not yet practiced in Bangladesh.

iv. **Possible harmful effect from pest control measures**-Toxicity in water, Toxicity in feeds, Environmental pollution, Feed pollution, Drug resistance, Capital loss, Public annoyance, Production loss, may cause public health hazards.

v. **Waste production in farm**: Dung-Droplets, Dead animals, Waste water, Unused medicine, Vaccine, Equipment, Appliances, Bottle and Packet, Unused and rotten food, Saliva, Vomit, Litters waste, Slurry, Blood, Unused organic matter, Food leftover, Rotten egg which are favorable media for multiplication and growth of pest.

vi. **Dung-Droplets management system**: Reservoir, Open field or Space, In bio-gas plant, Open to river, canal, pond, ditch, Agricultural filed, Composting, Fuel, Direct burning

vii. **Other Waste Management**-Buried, Burned, Thrown out here and there, Waste pit, Bio fertilizer production

viii. **Steps to proper management-** Awareness development, Training of related personnel, make available of necessary equipment and appliances at ease, impose of related Acts and Rules, Modernization and establish specific location to keep waste, Use media tools, Special initiative from government, Skilled labor, Research

ix. **How waste can impede food safety**-Through Pesticide, Anthalmintic, Chemicals, Germs**,** Odor, Production reduction, Environmental pollution, Improper processing and preservation of food, Use of antibiotic

x. **Steps to provide safe food-** Pest and its control measures are related to safe food production. Some steps are necessary along with PMP which are- food preparation at hygienic place, Proper processing, Proper preservation, Proper transportation and supply, Awareness development, Implementation of Acts and Laws, Proper packaging, preserving nutrient quality, use of food grade packaging materials, Quality manufacturing ingredients, maintain self-life, Maintain withdrawal period of medicine, Drugs and chemicals, Bio-security

xi. **Training for safe preparation and pollution free environment-** Farmers, Workers, Health worker, Veterinarian, Livestock worker, Agricultural worker, Consumers, Medicine producer and supplier, NGO worker, Waste management worker, Food stockiest, Media personnel, Political and Administrative personnel, Planner, Slaughter house worker, Food processor at home, Child, Feeds producer, Entrepreneur, Specialist, etc.

Consultation workshop has opined vividly about the pests, their effect, control measures, and ways to minimize the problem through training of stakeholders and other support services.

Appendix A: Banned drugs in animal health sector in Bangladesh

Food safety is a term broadly applied to food quality that may adversely affect human health. There are major areas of concern over the presence of residues of antibiotics in animal-derived foodstuffs with regard to human health. The term "antibiotic growth promoter"(APG) is used to describe any medicine that destroys or inhibits bacteria and is administered at a low, sub therapeutic dose. The use of antibiotics for growth promotion has arisen with the intensification of livestock farming. APG's are restricted to avoid residual effect of antibiotics in animals subsequently in human.

Locally and globally banned steroid hormones Decason, Oradexon, Prednisolon, Betnenal, Cortan, Steron and Adam-33 are being sold on the local market in the name of veterinary medicine. These steroids and hormones in animals are prohibited in the country according to the Animal Feed Act-2010.

Besides these Nitrofurans (Furazolidone, Furaltadone, Nitrofurantoin, Nitrofurazone) Chloramphenicol, Injectable Diclofenac sodium are also banned in poultry and livestock treatment in the country.

A) List of Banned pesticides in Bangladesh: (Ref. Approved-66PTAC&95PTASC-PPW Registered Pesticide Banned)

SL	Trade name of Products	Registration Number	Name of Company
1	Diazinon 14G	AP-08	Shetu Coporation Limited
2	Bizguard 2P	AP-09	Ciba-Geigy (Bangladesh) Limited
3	Roxion 40 EC	AP-11	International Services (BD) Limited
4	Dankavapon 100 EC	AP-13	Shetu Corporation Limited
5	Damfin 2P	AP-19	Ciba-Geigy (Bangladesh) Limited
6	Diazinon 90L	AP-20	Ciba-Geigy (Bangladesh) Limited
7	Danmfin 950 EC	AP-25	Ciba-Geigy (Bangladesh) Limited
8	Dichlorvos	AP-27	Bayer (Bangladesh) Limited
9	Curaterr 3G	AP-30	Bayer (Bangladesh) Limited
10	2,4-D Na Salt	AP-34	Bayer (Bangladesh) Limited
11	Folithion ULVC 98	AP-36	Bayer (Bangladesh) Limited
12	Methybron	AP-38	Excell Trading Company
13	Heptachlor 40 WP	AP-39	Krishi Banijya Protisthan
14	Chlordane 40 WP	AP-40	Krishi Banijya Protisthan
15	Aerovap 100 EC	AP-41	Liza Enterprise Limited
16	Aerodriel 20 EC	AP-42	Liza Enterprise Limited
17	Aeromal 57 EC	AP-44	Liza Enterprise Limited

SL	Trade name of Products	Registration Number	Name of Company
18	Padan 10G	AP-52	Data Enterprises Limited
19	Fenitrothion 98	AP-53	Farm Chemical Corporation Limited
20	Carbin 85 WP	AP-54	Farm Chemical Corporation Limited
21	Diamal 57 EC	AP-55	Farm Chemical Corporation Limited
22	Detia Gas EXT	AP-56	Farm Chemical Corporation Limited
23	Dichlorvos 100 EC	AP-57	Farm Chemical Corporation Limited
24	Methyl Bromide 98	AP-57	Farm Chemical Corporation Limited
25	Malathion 57 EC	AP-68	BPI Limited
26	Curaterr 3G	AP-69	Bayer (Bangladesh) Limited
27	Dieldrin 20 EC	AP-73	Shell Company of Bangladesh Limited
28	Bidrin 24 WSC	AP-74	Shell Company of Bangladesh Limited
29	Malathion 57 EC	AP-78	Burmah Eastern Limited
30	Vapona	AP-79	Shell Company of Bangladesh Limited
31	Bidrin 85 WSC	AP-80	Shell Company of Bangladesh Limited
32	Dieldrin 50 WP	AP-82	Shell Company of Bangladesh Limited
33	Dieldrin 40 WP	AP-83	Shell Company of Bangladesh Limited
34	Furadan 3G	AP-85	FMC International S.A.
35	Actellic 2% Dust	AP-99	Bangladesh Manufacturers Limited
36	Quickphos	AP-102	Agrani Traders
37	Torque 550g/l	AP-115	International Services (BD) Limited
38	Ridan 3G	AP-131	Rupali Sangstha Limited
39	Bkzne 14G	AP-135	B. K. Traders
40	Aerocypermethrin 10 EC	AP-137	Liza Enterprise Limited
41	Karmex	AP-145	Beximco Agrochemicals Limited
42	Carbaryl 85 WP	AP-147	Shetu Corporation Limited
43	Agridan 3G	AP-154	Shetu Pesticides Limited
44	Tecto 2% Dust	AP-157	Alco Pharma Limited
45	Manex-II	AP-163	Shetu Corporation Limited
46	Phytox MZ 80	AP-164	Liza Enterprise Limited
47	Uniflow TM Sulphur	AP-167	Shetu Corporation Limited
48	Fenkil 20 EC	AP-169	Agrani Traders
49	Sunfuran 3G	AP-171	Shetu Corporation Limited

SL	Trade name of Products	Registration Number	Name of Company
50	Hekthion 57 EC	AP-178	Farm Chemical Corporation Limited
51	Poligor 40 EC	AP-180	Farm Chemical Corporation Limited
52	Melbromid 98	AP-185	Horizon Trade Limited
53	Mebrom	AP-186	Bengal Wings Trade Limited
54	Agrine 85 WP	AP-187	Edgro (Private) Limited
55	Drawizon 60 EC	AP-190	Keeco Pesticides Limited
56	Gastoxin	AP-195	Bright Corporation
57	Cekomethrin 10 EC	AP-219	Premier Traders
58	Cythrin	AP-220	Bari & Company Limited
59	Cekuthoate 40 EC	AP-225	Premier Traders
60	Arifos 20 EC	AP-229	Bari & Company Limited
61	Malathion 57 EC	AP-230	Sabrina Trading Corporation
62	Cardan 5G	AP-234	Bari & Company Limited
63	Diazinon 14G	AP-236	Liza Enterprise Limited
64	Rizinon 60 EC	AP-239	Bari & Company Limited
65	Zincphosphide	AP-258	Liza Enterprise Limited
66	Davison Glyphosate	AP-266	Shete Pesticides Limited
67	Morestan 25 WP	AP-269	Beximco Agrochemicals Limited
68	Manzate 200	AP-301	Auto Equipment Limited
69	Dimecron 100 SL	AP-22&276	Novartis (Bangladesh) Limited
70	Pillarcron 100 SL	AP-148	Shetu Pesticides Limited
71	Benicron 100 WSC	AP-06	Sabrina Trading Corporation
72	DDVP 100 W/V	AP-03	ACI Formulations Limited
73	Chemo DDVP 100 EC	AP-245	Chemsfil Bangladesh Limited
74	DDVP 100 EC	AP-151	McDonald Bangladesh (Pvt) Limited
75	Nogos 100 EC	AP-26&274	Novartis (Bangladesh) Limited
76	Phosvit 100 EC	AP-56	Data Enterprises Limited
77	Daman 100 EC	AP-325	Petrochem (Bangladesh) Limited
78	Azodrin 40 WSC	AP-336	BASF Bangladesh Limited
79	Nuvacron 40 SL	AP-18&275	Novartis (Bangladesh) Limited
80	Megaphos 40 SL	AP-175	McDonald Bangladesh (Pvt) Limited
81	Phoskil 40 SL	AP-339	United Phosphorus (Bangladesh) Ltd

SL	Trade name of Products	Registration Number	Name of Company
82	Kadette 40 WSC	AP-284	Bisco Pesticide & Chemical
83	Monophos 40 WSC	AP-328	Alpha Agro Limited
84	Monodrin 40 WSC	AP-07	Sabrina Trading Corporation
85	Corophos 40 SL	AP-342	Corbel International Limited
86	Luphos 40 SL	AP-388	ACI Formulations Limited
87	Amcodrin 40 SL	AP-340	Atherton Imbros Company Limited
88	Vitacron 40 SL	AP-341	Shetu Marketing Company
89	Monotaf 40 WSC	AP-331	Auto Equipment Limited
90	Tamaron 40 SL	AP-188	Haychem (Bangladesh) Limited
91	Folithion 50 EC	AP-32	Haychem (Bangladesh) Limited
92	Macuprax 65%	AP-65	Bayer Crop Science Limited
93	Zithiol 57 EC	AP-126	Rhone Poulenc Bangladesh
94	Delapon Na-84	AP-66	Rhone Poulenc Bangladesh
95	Anthio 25 EC	AP-64	Rhone Poulenc Bangladesh
96	Zolone 35 EC	AP-67	Rhone Poulenc Bangladesh
97	Rentokill CC Type 75%	AP-221	Getco Limited
98	Paramount CC Type	AP-300	BD Associate and Company
99	Darsban 20 EC	PHP-5	Auto Equipment Limited
100	Darsban 20 EC	PHP-85	Auto Equipment Limited
101	Basudin 10G	AP-23	Syngenta Bangladesh Limited
102	Diazinon 60 EC	AP-24	Syngenta Bangladesh Limited
103	Mortin King Mosquito Coil	PHP-54	Reckitt Benckiser Bangladesh Limited
104	Mortin Mosquito Coil	PHP-101	Reckitt Benckiser Bangladesh Limited
105	Sarfium 56%	AP-689	Sar Trade Fertilizer Limited
106	Sicofen 20 EC	AP-624	Genetica
107	Cythrine 10 EC	AP-310	ACI Formulations Limited
108	Diazonyl T-60	AP-283	ACI Formulations Limited
109	Salmathion 57 EC	AP-1066	Agrimax Bangladesh Limited
110	Basamid Granular	AP-205	BASF Bangladesh Limited
111	Ducord 17 EC	AP-793	BASF Bangladesh Limited
112	Argold 10 EC	AP-409	BASF Bangladesh Limited
113	Dicofol 18.5 EC	AP-359	McDonald Bangladesh (Pvt) Limited

SL	Trade name of Products	Registration Number	Name of Company
114	Carbaryl 85 WP	AP-150	McDonald Bangladesh (Pvt) Limited
115	Amitage 20 EC	AP-476	McDonald Bangladesh (Pvt) Limited
116	Neoron 500 EC	AP-551	Syngenta Bangladesh Limited
117	Anvil 5 SC	AP-472	Syngenta Bangladesh Limited
118	Ridomil Gold MZ 68 WG	AP-377	Syngenta Bangladesh Limited
119	Folio Gold 440 SC	AP-1133	Syngenta Bangladesh Limited
120	Dolma 5G	AP-1226	Syngenta Bangladesh Limited
121	Sonnet 50 SP	AP-1488	Syngenta Bangladesh Limited
122	Basudin 10GR	AP-532	Syngenta Bangladesh Limited
123	Ricon 60 EC	AP-533	Syngenta Bangladesh Limited
124	Paprika 50 EC	AP-1250	Syngenta Bangladesh Limited
125	Touchdown	AP-404	Syngenta Bangladesh Limited
126	Touchdown HiTech 500SL	AP-873	Syngenta Bangladesh Limited
127	Dual Gold 960 EC	AP-1111	Syngenta Bangladesh Limited
128	Lintur 70 WG	AP-633	Syngenta Bangladesh Limited
129	Koranda	AP-794	Auto Crop Care Limited
130	Seda 50 SP	AP-420	Auto Crop Care Limited
131	Lorsban 15G	AP-371	Auto Crop Care Limited
132	Autoguard 25 EC	AP-1147	Auto Crop Care Limited
133	Focus 50 SC	AP-828	Auto Crop Care Limited
134	Alert 50 EC	AP-648	Auto Crop Care Limited
135	Quinguard 25 EC	AP-1106	Auto Crop Care Limited
136	Fendor 5G	AP-279	Auto Crop Care Limited
137	Edfen 50 EC	AP-191	Sea Trade Fertilizer Limited
138	Malatox 57 EC	AP-286	Sea Trade Fertilizer Limited
139	Edthoate 50 EC	AP-307	Sea Trade Fertilizer Limited
140	Metasystox R 25 EC	AP-493	United Phosphorus (Bangladesh) Ltd
141	Sumithion 3% Dust	AP-156	Shetu Corporation Limited
142	Sumibas 75 EC	AP-255	Shetu Corporation Limited
143	Arozin 30 EC	AP-383	Bayer CropScience Limited
144	Basta SL 15	AP-265	Bayer CropScience Limited
145	Baycarb EC 500	AP-488	Bayer CropScience Limited

SL	Trade name of Products	Registration Number	Name of Company
146	Curaterr 5G	AP-490	Bayer CropScience Limited
147	Cupravit 50 WP	AP-489	Bayer CropScience Limited
148	Hinosan EC 50	AP-491	Bayer CropScience Limited
149	Labaycid 50 EC	AP-492	Bayer CropScience Limited
150	Sunrice Super 315 EC	AP-1777	Bayer CropScience Limited
151	Benefiter 315 SC	AP-2105	Bayer CropScience Limited
152	Thiodan 35 EC	AP-1147	Bayer CropScience Limited
153	Fantush 300 EC	AP-2569	Asia Trade International
154	Ultima 40 WG	AP-2560	Mimpex Agrochemicals Limited
155	Abate 15 G	PHP-118	BASF Bangladesh Limited
156	Fendona 1.5 SC	PHP-84	BASF Bangladesh Limited
157	Edfen 50 EC	PHP-40	Sea Trade Fertilizer Limited
158	Coopex 25 WP	PHP-191	Bayer CropScience Limited
159	Sislin 2.5 EC	PHP-192	Bayer CropScience Limited
160	Crack down	PHP-193	Bayer CropScience Limited
161	Resigen 50 E	PHP-194	Bayer CropScience Limited
162	Resigned OS	PHP-196	Bayer CropScience Limited
163	Bilshot M 46.5 EC	AP-586	Pharma & Farm
164	Pharzeb 80 WP	AP-784	Pharma & Farm
165	Phartap 50 SP	AP-605	Pharma & Farm
166	Cypercid 10 EC	AP-523	Pharma & Farm
167	Glyphar 41 SL	AP-896	Pharma & Farm
168	Topsin M 70 WP	AP-193	Data Enterprises Limited
169	Homai 80 WP	AP-179	Data Enterprises Limited
170	Padan 50 SP	AP-555	Data Enterprises Limited
171	Diazinon 14G	AP-554	Data Enterprises Limited
172	Diazinon 60 EC	AP-557	Data Enterprises Limited
173	Diazinon 90 ULVC	AP-560	Data Enterprises Limited
174	Trebon 10 EC	AP-161	Data Enterprises Limited
175	Bassa 50 EC	AP-142	Data Enterprises Limited
176	Elsan 50 EC	AP-556	Data Enterprises Limited
177	Elsan 92 ULVC	AP-558	Data Enterprises Limited

SL	Trade name of Products	Registration Number	Name of Company
178	Vitavax 200B	AP-559	Pioneer Equipment & Chemical Co.
179	Pyriban 20 EC	AP-381	Agro Development Services Co. (Pvt) Ltd
180	Aimal 57 EC	AP-1136	Agro Development Services Co. (Pvt) Ltd
181	Asset	AP-364	Agrodev United
182	Padan 4 G	AP-372	Krishi Kallyan Limited
183	Diazinon 10GR	AP-385	Krishi Kallyan Limited
184	Limithion 57 EC	AP-264	ACI Formulations Limited
185	Knockout Liquid Insect Sprya	PHP-28	Shetu Pesticides Limited
186	Victor 1G	PHP-340	Shetu Pesticides Limited
187	Night Queen Mosquito Coil	PHP-46	Shetu Pesticides Limited
188	Sovathion 50 EC	AP-240	Shetu Pesticides Limited
189	Pillartex 50 EC	AP-414	Shetu Pesticides Limited
190	Kap 50 EC	AP-216	Shetu Pesticides Limited
191	Dipterex 80 SP	AP-561	United Phosphorus (Bangladesh) Ltd
192	Cekufon 80 SP	AP-257	Shetu Pesticides Limited
193	Palash 57 EC	AP-312	Petrochem (Bangladesh) Limited
194	Pounce 1.5G	AP-419	FMC Chemical International AG
195	Acekro 20 EC	AP-318	McDonald Bangladesh (Pvt) Limited

B) Banned drugs in Animal health sector in Bangladesh

Food safety is a term broadly applied to food quality that may adversely affect human health. There are major areas of concern over the presence of residues of antibiotics in animal-derived foodstuffs with regard to human health. The term "antibiotic growth promoter"(APG) is used to describe any medicine that destroys or inhibits bacteria and is administered at a low, sub therapeutic dose. The use of antibiotics for growth promotion has arisen with the intensification of livestock farming. APG's are restricted to avoid residual effect of antibiotics in animals subsequently in human.

Locally and globally banned steroid hormones Decason, Oradexon, Prednisolon, Betnenal, Cortan, Steron and Adam-33 are being sold on the local market in the name of veterinary medicine. These steroids and hormones in animals are prohibited in the country according to the Animal Feed Act-2010.

Besides these Nitrofurantoin, Chloramphenicol, Injectable Dichlofenac are also restricted in poultry and livestock treatment in the country.

Appendix B: Checklist for PMP under DRMP project of Department of Livestock Services

Name of despondence: Occupation:

Mobile No: Address:

i. Pest Include- Insect/Arthropods/Lice/Tick/Mosquito/Fly/Rat/Mouse/Other….
ii. Harmful effect from to Livestock- Suck blood/Extract nutrient/Produce diseases/Transmission of diseases/Decrease production/Impede safety food production/Other……
iii. Pest Control Methods: De-worming/Use of pesticide/Chemicals/Mosquito net and other equipment/Other…..
iv. Possible harmful effect from pest control methods-Toxicity in water/Toxicity in feeds/Environmental pollution/ Feed pollution/Drug resistance/ Other…..
v. Waste production in farm-Dung-Droplets/Dead Animals/Waste Water/ Un used medicine, vaccine, equipment, appliances/ Other…….
vi. Dung-Droplets management system-Reservoir/Open field, Space/In bio-gas plant/Open to river, canal, pond, ditch/Other……..
vii. Other Waste management-Buried/Burned/Thrown out here and there/Other…….
viii. Steps to proper management- Awareness development/Training of related personnel/Available and make ease of necessary equipment and appliances/Impose of related Acts and Rules/Other……..
ix. How waste can impede food safety-Through contamination of Pesticide/Anthalmintic/ Chemicals/Germs/Others……..

x. Steps to provide safe food- Food preparation at hygienic place/proper processing/properly preservation /properly transportation and supply/Other
xi. Training for safe food preparation and pollution free environment- Training of Farmers/Workers/Health worker/Veterinarian/Livestock worker/Agricultural worker/Medicine producer and supplier/NGO worker/Slaughter house worker/Other…….

Signature: