Tripura Rural Economic Growth and Service Delivery Project (TRESP)

Integrated Pest and Nutrient Management Plan (IPNMP)

June 2024

Tribal Welfare Department
Government of Tripura

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List of Abbreviations

AESA	:	Agro Ecosystem Analysis
CLF	:	Cluster Level Federation
DoA/H	:	Department of Agriculture and Horticulture
ETL	:	Economic Threshold Leve
GoT	:	Government of Tripura
IPM	:	Integrated Pest Management
IPNMP	:	Integrated Pest and Nutrient Management Plan
NMP	:	Nutrient Management Plan
PG	:	Producer Groups
PIU	:	Project Implementation Unit
PMPs	:	Plans for the Management of Pesticides
PMU	:	Project Management Unit
PoP	:	Packages of Practices
NMP	:	Nutrient Management Plan
SDP	:	State Domestic Product
TRESP	:	Tripura Rural Economic Growth and Service Delivery Project
TWD	:	Tribal Welfare Department
VO	:	Village Organisation

1 Introduction

1.1 Background

The Tribal Welfare Department (TWD), Government of Tripura (GoT) is preparing the Tripura Rural Economic Growth and Service Delivery Project (TRESP) with the assistance of the World Bank. The overall objective of the TRESP is to expedite socio-economic development of Scheduled Tribes through a multi sectoral approach of sustainable livelihood and infrastructure development. The project covers 23 blocks for livelihood improvement support system with special focus on additional provision for improving the economic opportunity through transport connectivity for rural populations and human capital development under education sector in 12 identified aspirational blocks. TRESP will involve construction of school buildings; rural roads; post-harvest and other related infrastructure; diversification of agriculture & horticulture and allied services like livestock (poultry and piggery), fishing natural rubber processing; support to producer groups; improved learning; strengthened service delivery and capacity building activities of TWD, line departments and village committees. The project is envisaged as multi-sectoral in nature, involving multiple implementing agencies. As the nodal agency, implementation of the project will be coordinated by the Tribal Welfare Department as Project Management Unit (PMU) through the Society for TRESP. This Society will be responsible for overall planning, implementation and monitoring of the Project, including coordination with other implementing agencies and support institutions named as Project Implementation Unit (PIU).

1.2 Project Description

TRESP aims at promoting socioeconomic development and improving the quality of life of rural communities living in targeted tribal blocks in Tripura through an integrated approach. It utilizes an area-based approach to tackle multi-dimensional poverty. The project has following four components:

Component 1: Strengthening Foundations for Economic Development. This component aims to improve rural livelihoods in tribal blocks via strategic investments in agriculture and allied sectors and road connectivity. Activities under this component include: (i) Support to rural livelihoods through crop diversification, development of agricultural value chains and improvements in productivity via provision of better agriculture inputs, training, and technology; and (ii) Upgradation and rehabilitation of -400-plus kilometers of roads, establishment of rural transportation hubs, and development of planning and asset management systems.

Component 2: Investing in Human Capital Development. This component aims at improving the learning levels of students from aspirational tribal blocks, increasing their educational attainment and enhancing their preparedness for employment markets. Key activities include: (i) Training of primary school teachers; (ii) Provision of in-service teacher training and structured teaching resources; (iii) Provision of school-based vocational education; and (iv) Strengthening of learning environment and facilities in senior secondary schools in the aspirational tribal blocks.

Component 3: Strengthening Institutions for Service Delivery and Economic Development. This component aims to strengthen the capacity of local institutions so they can deliver on Component 1 and Component 2 activities and contribute to improved service delivery and economic development in TRESP areas. Key activities under this component include development/strengthening of (i) Learning Management System (LMS); (ii) 'Model' Village level plans; (iii) Trainings for TRESP officials and CLF leaders; iv) Decision Support System; v) Beneficiary Management System (BMS); (vi) mobile based citizen service platform; and (vii) grievance redress mechanism. This will also include establishment of an integrated PMU under TWD as well as technical assistance, monitoring and evaluation, and other operating costs of the Project.

Component 4: Contingent Emergency Response. This component will be used to channelize or reallocate funds because of an emergency or natural disaster event for response and reconstruction activities.

1.3 Purpose of the report

Integrated Pest Management (IPM) and Nutrient Management Plan (NMP) IPM has been prepared for managing pest, and for safe and optimal use of permitted pesticides. IPM will emphasis on managing pests that combines cultural, biological, and chemical control strategies into a single complimentary management strategy that maintains long-term control of pest populations with minimal environmental impact and economic loss. Use of pesticides banned by GoI and class IA, IB, II of WHO classification will not be supported under the project. NMP will be provided to the farmers to help them to efficiently meet their production objectives and protect the environment as well. Project will encourage use of organic pesticides and compost. Adoption of fertilizer and pesticides uses will be promoted through trainings based on standard Packages of Practices (PoP). The PoPs will be available with the farmers in the famers' understandable language as well.

1.4 Regulations & Guidelines

Table 1-1 Overview of Regulations and Guidelines

Act Rule	Key Feature	Reason for Applicability
Insecticide Act 1968; Insecticide Rules 1971; Insecticide (Control) Order 1985	The GoI has notified various Acts for the control and prevention of pollution due to pesticides and fertilizers. The Act regulates the import, manufacture, sale, transport, distribution and use of insecticides with a view to prevent risk to human beings or animal	The project activities are likely to involve the use of pesticides. These activities will comply with the requirements of the Insecticide Act – especially with regard to non-use of banned pesticides, safe use of pesticides, etc.
Relevant World Banks 'S ESF		
ESS 1- Assessment and Management of Environmental and Social Risks and Impacts ESS 3- Resource Efficiency and Pollution Prevention and Management	Environmental risk identification and Management is envisaged under ESS1- Assessment and Management of Environmental and Social Risks and Impacts ESS 3- As per Section D of ESS3, if projects involve recourse to pest management measures, the Borrower will give preference to integrated pest management (IPM).	The Project activities may involve using of pesticide/ chemical to some extent, thus introducing Integrated pest and nutrient management plan will be helpful to mitigate the negative impacts.

2 Agriculture Profile of Tripura

Tripura's economy is agrarian, agriculture and related industries are the backbones of the state's economy with more than 44 percent of its population directly dependent on agriculture and related activities, and its contribution to the GSDP is over 30% in 2019-20. Small and marginal farmers account for around 96% of total farmers in the state, compared to 78% throughout the country. Only around 26% of the land is Cultivable, with the remainder being hilly and forested.

The major crops grown in the state are: rice, ragi, jowar, maize, and pulses besides oilseeds and number of cash crops. Cashew, coconut, areca nut, cardamom, chilies, cotton, sugarcane and tobacco are among the other crops produced in the state. The climate of the state is ideal for a wide range of horticultural/plantation crops such as pineapple, jackfruit, tea, rubber, bamboo, and so on. As a result, more than 40% of the land is under various fruit crops. A section of the indigenous population cultivates using the Jhum (slash and burn) method.

2.1 Project Area

Majority of rural households in 23 tribal blocks depend on agriculture and allied sectors for their livelihood but face significant social and economic disadvantages as compared to other blocks. Most households depend on agriculture for a living. Paddy is the primary crop followed by maize, pulses and oilseeds. The gross cropped area is low because of the hilly landscape and small landholdings which results in low productivity and marketable surpluses. The number of farmers in tribal blocks that practice jhum (slash and burn) cultivation is reducing over the years and farmers prefer to grow settled crops and engage in livestock and fishery for better returns and sustainability.

The options and earnings of small producers are restricted by inadequate post-harvest facilities, market access, and agricultural extension.

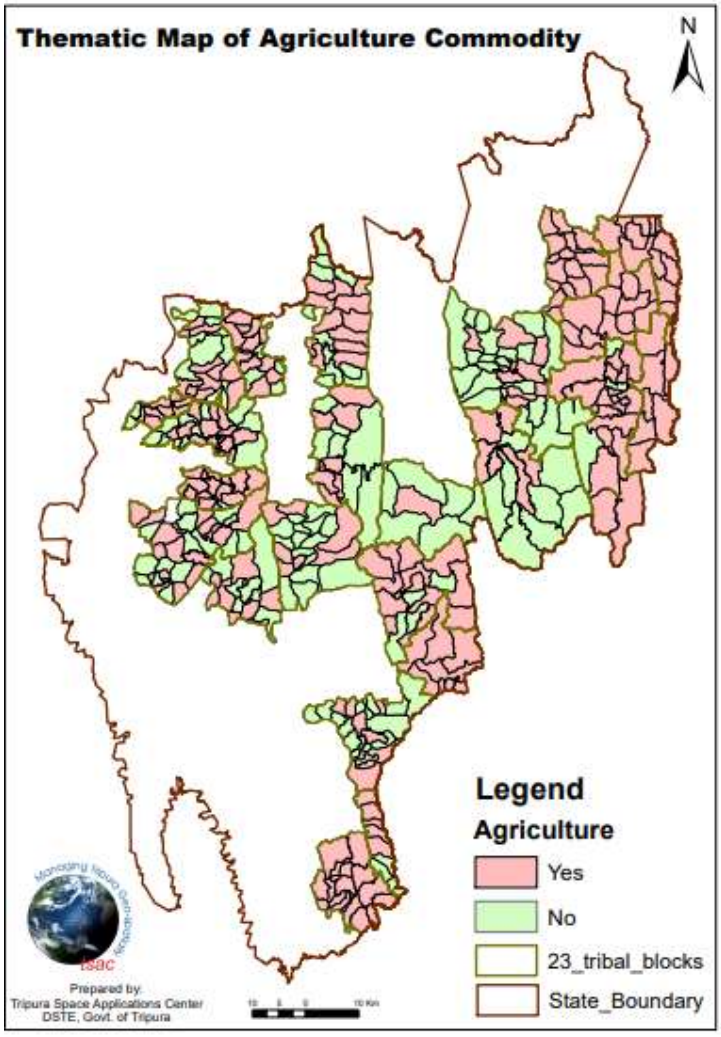

Figure 2-1: Agricultural Commodity under TRESP

The climate in Tripura is favourable for farming and horticulture crops **like pineapple, jackfruit, tea, rubber, ginger, turmeric, and oranges.** Tribal livelihoods also depend heavily on small animals like chickens, pigs, and goats, as well as fishing.

However, due mostly to subpar production practices and technologies, these producers are unable to exploit the full economic potential of their livelihood activities. Despite the existence of several water bodies, the production per acre for fish, for instance, is noticeably low.

2.2 Agro Climatic Profile

Out of the total Geographical area of 10486.43 Sq. Km. the forest cover is over 60 percent and net cropped area of the state is only 255548 hectares (**24% of geographical area**). A large part of the land is upland / tilla land and hilly, with altitudes varying from 15 to 940 meters above sea level. The ICAR has categorized Tripura under the **Agro-climatic zones of Humid Eastern Himalayan Region.** The State of Tripura enjoys a typical monsoon climate with variations ranging from Sub-tropical to temperate conditions in hilly areas. The primary sector i.e. **Agricultural contributes about 64% of total employment in the state and about 48% of the State Domestic Product (SDP).**

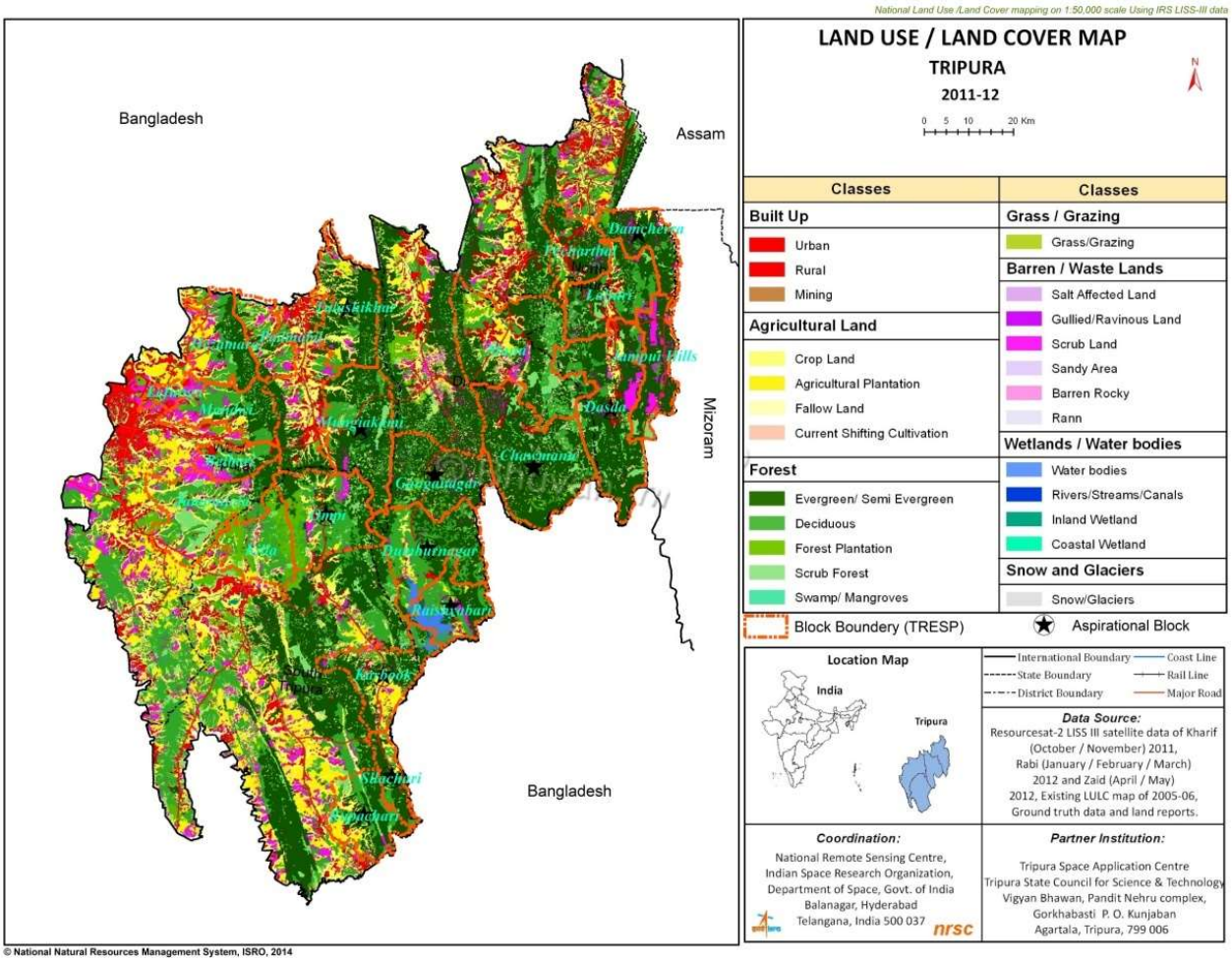

Figure 2-2: Land Use and Land Cover Map of Tripura

3 Potential Risk & Mitigation Measure

The project's components diversification Crops, production enhancement, and scientific cultivation will be accomplished by giving farmers with nutrients (organic/inorganic) as well as insecticides (organic/inorganic).These are water soluble and will have some negative environmental impacts, if not managed. The potential risk has been presented in ensuing sections.

3.1 Potential Risks of Pesticide and Fertilizer Application

The potential impacts include:

- **Pesticide runoff causes contamination of surface water and biota,**
  Residual pesticide from the agriculture fields may leads to water body with runoff which cause dysfunction of the ecological system in surface waters. Aquatic life may get affected in many ways with high pesticide amount, which may cause disappearance of top predators ,reproductive failure of few species and sometime bioaccumulation in fish, which may have negative effects on public health from consuming contaminated fish.
- **Runoff of nutrients** (from fertilizers), particularly phosphorus, causes eutrophication, which results in taste and odour problems in the public water supply, excessive algae growth that deoxygenates the water and fish kills, and eutrophication itself.
- Pesticides can also result in **secondary pest outbreaks** due to the loss of natural enemies and the development of resistance in the target insects/pests, which prevents them from being eliminated with recommended doses; resurgence of pests because they are not completely eradicated and come back repeatedly; destruction of beneficial insects that were natural predators as a result of continuous use of chemical insecticides; and resurgence of pests.
- Pesticides have the potential to **contaminate turf, water, and other vegetation.** Pesticides can be toxic to a variety of other organisms in addition to insects and weeds, such as birds, fish, beneficial insects, and non-target plants. Herbicides can also be dangerous to organisms that are not their intended targets.,
- Pesticides may have a **detrimental influence on the environment** in addition to being harmful to human health. In particular, inappropriate use of pesticides has been linked to: (1) negative effects on non-target organisms (such as decreased populations of beneficial species), (2) water contamination from pesticides or from pesticide drift, (3) air pollution from volatile pesticides, (4) injury on non-target plants from herbicide drift, (5) injury to rotational crops from herbicide residues left in the field, (6) crop injury due to high application rates and wrong application.
- One of the biggest issues for the local population is the lack of information or training for preparation and application of optimum pesticide. Application of pesticides requires the right tools and technology.

3.2 Applicability of the IPNMP to the project

Integrated Pest and Nutrient Management Plan (IPNMP) is applicable under the project TRESP by following ways:

- To promote safe, effective, and environmentally sound pest and nutrient management in Production enhancement, diversification, and scientific ways of cultivation in the agriculture and horticulture sectors.
- To encourage the use of biological control techniques while reducing the use of synthetic fertilizers and pesticides.
- To give instructions on how to safely handle, store, and dispose of pesticides in order to reduce risks to people, animals, and the environment.
- To increase capacity on addressing all the above.

Diversification of Crops, Production Enhancement, and Scientific Cultivation which involve Support in providing nutrients (Organic/Inorganic) and also pesticides (Organic/Inorganic) to the farmers are some of the activities under the project. Although the IPNMP covers a general approach, tools, and mitigation measures, subject matter experts will prepare a Package of Practices specific to each crop that is adopted and supported by the project.

3.3 Approaches to Integrated Pest and Nutrient Management (IPNM)

Integrated pest management is a combination of farmer-driven, environmentally friendly pest control methods. It refers to an ecological approach to pest control (insects, diseases, weeds, rodents, etc.) that uses all methods and techniques, including cultural, mechanical, genetic, regulatory, biological, and chemical in a compatible manner to keep pest population below Economic Threshold Level (ETL). It consists of:

- Managing pests (keeping them below economically damaging levels) rather than seeking to eradicate them,
- Relying, to the extent possible on non-chemical measures to keep pest population low; and
- Selecting and applying pesticides, when they have to be used, in a way that minimizes adverse effects on beneficial organisms, humans, and the environment.

The promotion of Integrated Pest and Nutrient Management (IPNM), ensuring the availability of safe and high-quality pesticides, streamlining quarantine procedures, and human resource development, including the empowerment of women in plant protection skills, are currently the major thrust areas of plant protection in India.

The Key Components of IPNM are:

- Identification of major pests & diseases for the crop in the area
- Identification of the minor pests & diseases for the crop in the area
- Assessment of Economic Threshold Limit (ETL) for major pests /diseases
- Pest monitoring based on Agro Ecosystem Analysis (AESA) and conjunctive use of pheromone traps, sticky traps, etc.
- Use efficiency through judicious and effective nutrient/fertilizer management, which essentially involves adhering to the four R's formula. They are the "right"

fertiliser types, "right" fertiliser doses, "right" application techniques, and "right" application times.

Pest Monitoring:
This is one of the important components for the success of IPM this may vary from crop to crop. In this some methods are:

- AESA (Agro-Eco System analysis) which requires information on different aspects like plant health at different stages, soil conditions and climatic conditions etc.
- Survey or field monitoring: it comprises a regular survey of the field to analyse the pest status in the field.
- Pest monitoring with pheromones and light traps e.g. in rice 5 pheromones traps are recommended per ha. To monitor yellow stem borer moth population.

3.4 IPNM Tools

IPNM involves a range of methods to control pests that can be undertaken both proactively and reactively

Use of Pest Resistant Varieties
Plant resistance to insect pests plays a vital role in the attempt to enhance ecological stability in agricultural crops. In IPM, plant resistance to insects refers to the use of resistant crop varieties to suppress insect pest damage. Another option is to release sterile males of the same species to create competition between the fertile and sterile males which ultimately leads to a decrease in the population of the pest. These sterile can be produced in the laboratory by different methods.

In order to create cultivars resistant to pests, plant pathogens, and herbicides, gene transfer technology is useful. For instance, genetic material from the naturally occurring bacterium Bacillus thuringensis (Bt) is incorporated into cotton, corn, and potatoes to make the plant tissues toxic to insect pests. While the scientific community is awed by its enormous potential for managing pests, it is also concerned about the possibility of increased selection pressure for resistance against it and its effects on non-target natural fauna.

Cultural pest control
Crop production techniques that reduce pest vulnerability are included. A few examples of cultural **techniques used to control the pests include crop rotation, fallowing, altering planting and harvesting dates, altering plant and row spacing, and destroying old crop debris**. Important management strategies include the inter-planting of different crops, the planting of cover crops, and the planting of plants that produce nectar and produce nectar.

Soil testing for nutrient deficiencies based on which fertilizer should be recommended. Soil erosion is stopped by cover crops, which are frequently weed-suppressing grass or legume species. In order to provide organic matter and nitrogen to the succeeding crop, a cover crop can also be used as green manure, which is incorporated into the soil. Growing trap crops on the borders or peripheries of the main crop. Crop

harvesting needs to be close to the ground to avoid inoculum of pest/disease for the next season.

Figure 3-1: Crop Husbandry – Cultural Control Method (ICAR)

Physical or Mechanical controls

These are based on understanding how pests behave. Some examples of physical control are use of Colored ribbon or cassette reels or plastic bags particularly during grain filling stage in Maize and rice field, Using light traps and destroying the captured insects, Putting bamboo sticks with jackfruit latex around the rice field, Cut open piece of citrus/pomelo placed in rice field, putting bamboo stem on field having many lateral branches to allowing birds to sit and eat insects in their eggs, larvae, and pupae stages, Beating of bamboo sticks nearby field, Placement of a statue like human, i.e., human effigies (with stick, straw and clothes) in middle of the field or pseudo-human/ ghost structure of different kinds using earthen painted pots, Removal and destruction of insect pest egg masses, larvae, pupae, and adults, as well as diseased plant parts, whenever possible, use of Local traps. Bird perchers and scarer need to be installed as per the requirement varies from area to area.

Biological controls

These include the **enhancement and maintenance of parasitoids, parasitic nematodes, fungus, and bacteria, as well as parasitoids themselves, which are the natural enemies of pests**. In IPNM programmes, native natural enemy populations are retained, while non-native agents may be discharged under very strict control. Trichogramma species are the most typical parasitoids utilized on a variety of host crops. As biological control agents, a variety of microorganisms have been utilized, such as Trichoderma spp., Verticillium spp., Aspergillus spp., Bacillus spp., and Pseudomonas spp. placement of dead frogs, snails, or crabs that have been crushed and fermented in rice fields, especially during the milking period.

Chemical controls

Pesticides are employed to keep pest populations below levels that are economically harmful when other methods of management are ineffective. Pesticides include both artificial and organic substances. Numerous synthetic compounds are used to create synthetic insecticides. These have quick reactions, are easy to operate, and are inexpensive. Due to the possible harm that pesticides may do to the environment, IPM programmes should ideally only use them as a last resort. Pesticides with few adverse effects on the environment and non-target creatures are the best. These chemicals function in innovative ways and have little impact on the environment. These pesticides fall into the short-lived or specific-use group.

Assessment of Economic Threshold Level

The idea behind this is that most plants can withstand at least some pest damage. Chemical controls are only used in an IPNM programme where the economic threshold is known when the pest's capacity for damage is getting close to the threshold, even when other alternative management practices are being used.

Use of Botanical Pesticides

Botanical pesticide can be prepared in different ways, they can be as simple as unprocessed, crushed plant leaves, plant extracts, plant-based compounds. Pyrethrum, neem, tobacco, garlic, and pongamia formulations are a few examples of botanical pesticides. Broad-spectrum pesticide characteristics can be found in some plants. Botanical pesticides often cause less environmental harm than synthetic materials because of their quick disintegration. It is simpler to transfer them securely. The fact that these can be produced locally by the farmers themselves is the key advantage.

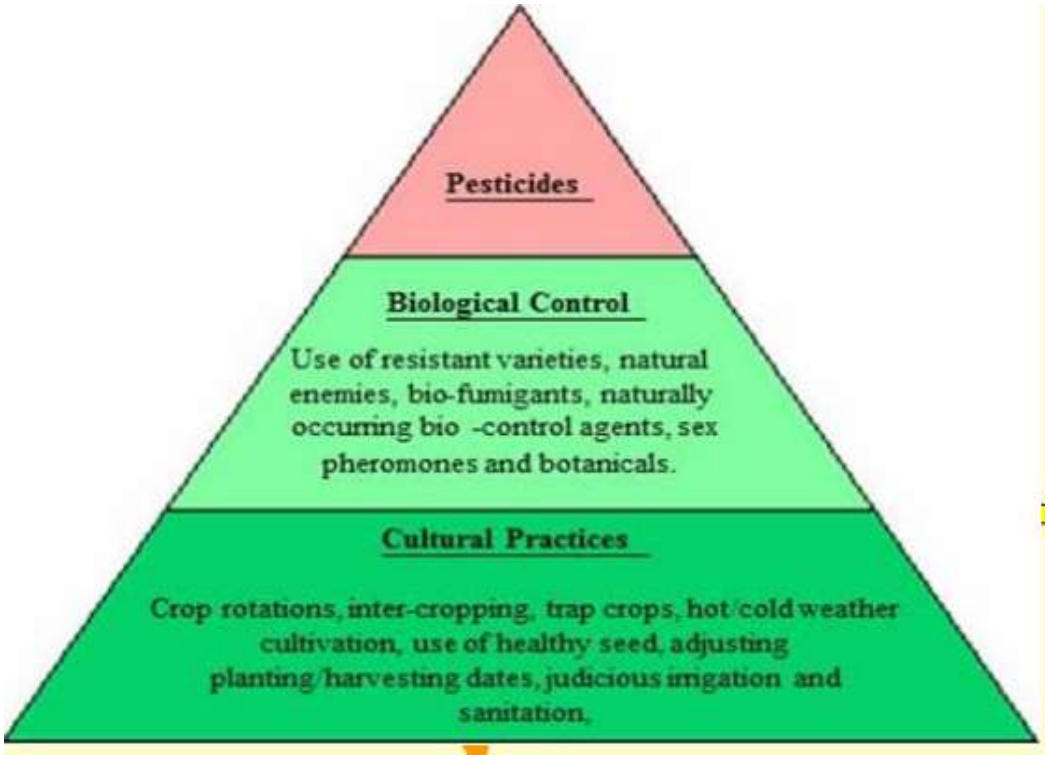

Figure 3-2: IMP Approach (source ICAR)

3.5 Criteria for Pesticide Selection and Use

Any pesticide that is to be purchased for a Bank-financed project must first undergo an evaluation of the type and severity of associated risks, taking into account the intended users and the proposed use. for pesticide selection, Guidelines published by the World Health Organization with regard to the classification of pesticides and their individual formulations are to be followed. When choosing and utilizing pesticides, the following standards must be met:

- They must have minimal negative effects on human health.
- They must exhibit efficacy against the intended species.
- They must have a negligible impact on the ecosystem and non-target species.
- The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies..
- Their use must take into account the need to prevent the development of resistance in pests.

Any pesticides must be produced, packaged, labelled, handled, stored, disposed of, and applied in accordance with guidelines deemed acceptable by the WHO. Formulated products from WHO classes IA and IB, or formulations of products from Class II, are not allowed in the project if (a) there are no restrictions on their distribution and use; or (b) they are likely to be used by, or be accessible to, lay personnel, farmers, or other individuals without the training, tools, and facilities to handle, store, and apply these products properly.

Operational Aspects of **IPNM**

- Choosing the right varietals, managing the seed bed properly, caring for the plants' nutrition and physiology, and controlling weeds and water are all important aspects of growing a healthy crop.
- Improve natural enemies Recognize beneficial insects in the field, learn about insect population dynamics, life cycles, and food webs; comprehend the effects of pesticides on beneficial populations; encourage the survival of predators through habitat management; and create local reference collections.
- Regular field observations should be made to check for signs of damage, changes in insect populations, plant growth and physiology, the relationship between plant stages and insect populations, the impact of the weather, and water and nutrient management.
- Farmers as experts: Farmers can make informed decisions about crop management by using agro-system analysis and data gathered from direct observation.

3.6 The World Bank Operational Guidelines

The World Bank & IFC Pesticide guidelines aim to ensure that the pesticide:

- Must have negligible adverse human health effects.
- Should be effective against target pests and minimal effect on non-target species and the natural environment. The methods, timing, and frequency of pesticide application are aimed to minimize damage to natural enemies.
- Pesticides used in public health programs must be demonstrated to be safe for inhabitants and domestic animals in the treated areas, as well as for personnel applying them.

3.7 Pest Management Guidelines

Integrated pesticide management specifically identifies the following as the key to pest control.

- A categorical preference for bio control methods along with institutional and capacity building for the same.
- Reducing reliance on synthetic chemical pesticides and only if approved by IPNM approach.
- **Does not permit under any circumstance the use of IA, IB and II classified pesticides**. Listing of these chemicals provided by the World Health Organization is given at the end of the report (Annexure 1).
- Recommends the use of Participatory IPNM along with specific investment components for the same.
- Permits category III type chemicals and these are listed at the end of the report. But even these must be used as part of the IPNM strategy. No to all chemical Pesticides if it is likely to be used without training and safety.

IPNMP shall follow the 4Rs concept. This will include nutrient management—by using the appropriate fertilizer source at the appropriate rate at the appropriate time and in the appropriate location. The similar approach of using pesticides and nutrient at crop level has been presented in Table 3-1 &

Table 3-2.

Table 3-1: Major crops under TRESP: its IPNM (Pest Management)

Major Pest/Diseases of the crops					
Ginger	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**
Soft rot/yellows **Cultural control:** • Use of resistant/tolerant varieties to rhizome wilt/ rot. • Crop rotation with maize and soybean. • Plant disease-free seed rhizomes. • Use raised beds. **Biological control:** • Planting of perennial seasonal flowering plants like basil, marigold, fennel etc. along the border to attract and enhance the population of biocontrol agents for managing pests/disease. • Application of neem cake powder treatments @ 0.8t/acre Chemical control: • Drench affected and surrounded beds with mancozeb 0.3% to reduce the spread of the yellow disease.	Bacterial wilt **Cultural control:** • Soil solarization during summer • Planting of disease-free seed rhizomes. • Use crop rotation with non-host crops likepaddy, maize, sorghum etc. • Avoid crop rotation with tomato, potato, chilies, brinjal and peanut, as these plants are hosts for the wilt pathogen. • Use bio-fumigation using cabbage and mustard plant refuses.	Phytophthora foot rot (quick wilt), basal wilt **Cultural control:** •Disease free Planting Materia. •Adequate drainage •Reduced humidity and presence of sunlight reduces the intensity of leaf infection. **Chemical control:** •Metalaxyl M 4% + Mancozeb 64% WP @ 0.25%, 2 or 3 l/vine	-Mealy bug • cured planting material need to be dipped in 0.02% to 0.04% methyl parathion as prophylactic measure. Although mealy bug is not a major pest of pineapple orchids of Tripura -Use disease resident verities like Kew and Queen	Mustard aphids : **Cultural control** – Use tolerant varieties, Early planting to escape the damage and use of yellow sticky traps. **Biological control**– Release, protection and promotion of beneficial insects such as, Ladybird beetles viz., Coccinella septempunctata, Menochilus sexmaculata, and Cheilomones vicina are most effcient pradators of the mustard aphid. **Chemical Control measure** – 2-3 spray of soft soap or insecticidal soap as soon as the aphids start appearing. 2% neem oil or 5% NSKE is also very effective in aphids management. Foliar spray of Verticillium lecanii @ 5 gm/ lit of water. In severe infestation garlic-chilly extract with 2% neem oil and liquid soap is very effective	-Sesame leaf folder: **Controlled by**: • using light trap • Spraying with triazophos or carbosulpha 30% EC, 2ml/lt of water
Bacterial wilt	Rhizome fly	Pollu beetle, Top		Painted bug (Bagrada hilaris)	

Major Pest/Diseases of the crops					
Ginger	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**
Cultural control: • Soil solarization during summer • Planting of disease-free seed rhizomes. • Use crop rotation with non-host crops like paddy, maize, sorghum etc. • Avoid crop rotation with tomato, potato, chilies, brinjal and peanut, as these plants are hosts for the wilt pathogen. • Use bio-fumigation using cabbage and mustard plant refuses.	**Cultural control:** • Destroy stray plants in off season • Select and plant healthy rhizomes. Biological control: • Conserve natural enemies such as ladybird beetle, spiders, chrysopids, Trichogrammatids etc.	shoot borer, Leaf gall thrips **Cultural control:** •Removal of weeds and alternate host •Deep ploughing in summer. **Biological control:** •Release exotic predator, Cryptolaemus montrouzieri @ 10 beetles/vine. **Physical control** Detrash the crop on 150 and 210 DAP.		**Cultural Control:** •Deep ploughing. •Irrigation during first 4 weeks also help in its management. • Burn crop remains of infested field to destroy eggs and other stages to prevent their spread in next year's crop. **Biological control-** Conserve and promote egg parasitoid Gryon sp. (Scelionidae) and the adult parasitoid Alophora sp. (Tachinidae). **Chemical Control measures** – Seed treatment with cow urine and garlic-clove-cinnamon extract help in managing bug during initial growth phase. Prophylactic spray of neem+karanj oil with insecticidal soap through pressure jet on leaves and stem also help in control of pest.	
Rhizome fly **Cultural control:** • Healthy rhizomes for planting. • Intercropping ginger with paddy or other crops reduces or lessens	**Leaf roller** **Cultural control:** • Collect and destroy the egg masses and larvae • Remove alternate weed hosts Biological control:	Scale insects, Minor pests **Biological control:** •In nurseries spraying neem oil 0.3 per cent or		Mustard Sawfly (Athalia lugens proxima) **Cultural Control** • Summer ploughing • Early sowing helps in avoiding the pest problem. • Irrigation in seedling stage	

Major Pest/Diseases of the crops					
Ginger	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**
pest attacks	• Conserve the natural enemies such as ladybird beetle, spiders, chrysopids, Bracon sp, fire ants, dragon fly, praying mantis, ground beetle and Trichogrammatids etc. • Release Trichogramma chilonis @ 20,000/acre.	Neem gold 0.3 per cent or fish oil rosin three per cent is also effective in controlling the pest infestation		Biological - Conserve •Perilissus cingulator (parasitoids of the grubs), Foliar spray of pathogenic bacteria Serratia marcescens which infect the larvae of sawfly. **Chemical Control measure** – •Foliar spray of bitter gourd seed oil (5%) can effectively manages the sawfly.	
Leaf roller **Cultural control:** • Intercropping ginger with paddy or other crops reduces or lessens pest attacks.	**Soft rot** **Cultural control:** • Maintain proper drainage by using 30 cm raised bed and avoiding the water stagnation. • Adopt crop rotation with non-host crops like ragi, paddy, maize, sorghum etc.			White rust/ Downy mildew (Albugo candida) **Cultural Control:** •Use disease free, healthy seed, Destroy weeds which act as collateral host, collect and destroy infected plant parts. Chemical Control measures – •Seed treatment with freshly prepared garlic bulb extract. •Alternatively seeds can also be treated with garlic-clove-cinnamon extract. •Foliar spray of Bordeaux mixture (1%) or copper oxychloride (0.3%) can also manage the pest	

Major Pest/Diseases of the crops					
Ginger	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**
. Nematodes Cultural control: • Intercropping of marigold • Deep plowing or solarized beds of infested fields during summer. • Grow repellant plants: Marigold, , Asparagus, Dahelia etc.	Shoot Borer **Cultural control** • Destroy the infested shoots • Place light traps @ 1 /acre •Collect and kill the trapped moths. • Mulching with green Lantana camara and Vitex negundo leaves @ 2 t/ acre at 40 and 90 days after planting. **Biological control:** • Release of Trichogramma chilonis @ 40,000/acre. • Conserve natural enemies such as Angitia (Dioctes) tronchanterata; Xanthopimpla australis, euloeae, mermethid nematode, earwigs, robber flies and spiders, ladybird beetle, spiders, chrysopids, Trichogrammatids etc. etc. • Spray neem oil (0.5%) at fortnightly intervals.				

Major Pest/Diseases of the crops					
Ginger	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**
Soft rot **Cultural control:** • Ensure proper drainage. • Mulching with green leaves (Vitex negundo)@ 4-4.8 t/acre is at the time of planting (it is repeated @ 2 t/acre 40 and 90 days after planting). Biological control: • Cow dung slurry or liquid manure	**White grub** **Cultural control:** • Uproot the infested plants, collect and destroy the infected plant along with larvae. • Use well decomposed FYM				

Common pest present in the Vegetable crops with their management practices

Bhindi	**Cucurbitaceous Vegetables**	**Cucumber**	**Brinjal/ Chilli**	**Cabbage /Cauliflower**	**Carrot (*Daucus Carota*)**	**Potato**
Fruit and Shoot Borer: Remove all drooping shoots and damaged fruits. Apply sawdust or paddy husk at 500 g/plant or neem leaves or *Eupatorium* leaves at 250 g/plant in basins one week prior to	**Red pumpkin beetle**: Deltamethrin @ 250 ml/acre can be used when 1 adult/10 plants is detected in the nursery and can also use 0.01% methanolic neem seed kernel extract (NSKE) and 0.4% neem oil	Red pumpkin beetle Deltamethrin @ 250 ml/acre can be used when 1 adult/10 plants is detected in the nursery and can also use 0.01% methanolic neem seed kernel extract (NSKE) and 0.4% neem oil.	Fruit and Shoot Borer: -Remove and burning of affected shoots -Manual collection and burning of the infected fruits -Growing moderately resitant varieties like Punjab Barsati and Singnath -Spray of Fenvalerate (0.01%) or cypermethrin (0.012%)	Diamond Back Moth: Cultural control: Removal and destruction of plant remnants, stubbles, debris after harvest and ploughing the field. Trap crop: Sowing 2 rows of bold seeded mustard as a trap crop for every 25 rows of cabbage to attract moths to mustard Grow intercrops such as	Aster leafhopper Place yellow sticky card in the field early in the spring when plants are newly sprouted. Remove weeds from the field edges as these may be reservoir for the pathogen.	Black heart/ scurf: **Cultural control:** • Tubers stored in oxygen deficient structures should not be used. **Chemical control:** • Treat tuber with 6% FS @ 0.415 g/ Kg tubers in 100 ml water for 3-5 minute or soaking potato seed tubers in streptocycline 40 to 100

planting and water daily. Application of *Bacillus macerans or B. circulans* (1.2 x 10^6 cells per pit) before sowing is recommended			two time before flowering and 15-20 days after flowering -Using pheromone traps (20no/ac)	tomato, garlic, coriander and carrot in alternate rows with cabbage Biological control: Release egg parasitoid, T. chilonis/pretiosum Chemical control: fipronil 5% SC @ 320–400 ml in 200 l of water/acre. (last spray should be 15 days before harvesting).		ppm solution for half an hour prior to planting or with carbendazim 25%+ mancozeb 50% WS @ (1.5 + 3.0) to (1.75 + 3.5)
		Epilachna Beetle: -Collection and destruction of adults and grubs in early stage when infestation is less -Application of carbaryl (0.01%) or Quniolphos (0.05%) if serious damage is observed	Ash Weevil: -Application of Neem cake @ 500-100 Kg/ha at the time of planting or drench the soil with neem seed kernal extract (4%) around the plants. -Spray chlorpyriphos (0.05%) 10 and 30 days after planting	Cabbage borer Cultural control: Collect and destroy caterpillars mechanically in the early stages of attack. Chemical control: Malathion 50 EC @ 600 ml in 200-400 l of water/acre.		Root-knot nematode Cultural control: • Plant crop during the 2nd week of October in autumn and in early January to limit rootknot nematode infestation on tubers. • Grow one row of repellent plants like Tagetes patula and T. erecta (African marigold) in between 2 or 3 rows of potatoes. Biological control: • Apply NSKE 4% and neem cake @ 80 Kg/acre.
			Thrips: -Application of monchrotophos or phosphomidon or Dimethoate @0/05% or	Cabbage leaf webber Cultural control: Remove and destroy the webbed leaves with caterpillars within.	Carrot weevil Removing of all debris - reduce sites where weevil can	

			Neem formulation 2-3 ml/lt of water	Set up light traps @ 1/acre. Biological control: Conserve parasitoids such as Cotesia crocidolomiae etc.	survive and persis crop rotation, carrot weevil.	
			Epilachna Beetle: -Collection and destruction of adults and grubs in early stage when infestation is less -Application of carbaryl (0.01%) or Quniolphos (0.05%) if serious damage is observed			

Sources/references:

1. *Status of Agriculture In The TTAADC*
2. *Package of practices of Black peeper cultivation in Tripura*
3. *Pest of Pineapple and their management (Joy P.P. et al., 2013)*
4. *Pineapple cultivation in Tripura (ICAR)*
5. *Production Technology for Brinjal in Tripura (ICAR)*
6. *Production Technology for Sesame in Tripura (ICAR)*
7. *T.P.S a revulaiton potato cultivation (dept. of Agriculture, Tripura); NIPHM and Directorate of Plant Protection, Quarantine & Storage*

Pesticide Management in water

When spraying, pesticide drift must be prevented. Users should follow the instructions provided on the container for pesticide handling safety precautions, application rates, and proper disposal. They shouldn't be used when rain is expected, to reduce pesticide contamination of surface and ground water.

Examine the history of crop production, existing pest problems, and previous pest control methods. Make use of integrated pest management (IPNM) techniques that:

- Use pesticides only when doing so will result in an economic profit for the producer.
- When applying pesticides, do so effectively and at times when there won't be runoff.
- Consider the persistence, toxicity, runoff potential, and leaching potential of products when applying pesticides and there is a choice of registered materials.
- No use of pesticide belonging to category 1 & 2 as classified in the pesticide code.

This management strategy aims to lessen pesticide contamination of groundwater and surface water. The main goal of the pesticide management strategy is to promote the safe and efficient use of pesticides without harming the environment. Plans for the Management of Pesticides (PMPs) specify:

- Identify areas vulnerable to pesticides;
- Monitor water sources for pesticide contamination;
- Prevent pesticides from reaching ground water;
- Respond to pesticide detection.

Guidance on Proper Storage, Handling and Disposal of Pesticides

Exposure to pesticides may occur when handling and spraying pesticides. The exposures to pesticides may occur in following situations:

- When handling the pesticide products during opening of the package, mixing and preparation of the spray.
- When spraying the pesticides.
- When disposing the pesticides solution and containers.

Management measure

- The operator should wear a protective hat and face shield or goggles during spray. Absorption of pesticides occurs mainly through the skin, lungs and mouth. Specific protective clothing and equipment given below must be worn in accordance with the safety instructions on the product label.
    - Broad-rimmed hat (protects head, face and neck from spray droplets).
    - Face-shield or goggles (protects face and eyes against spray fall-out).
    - Face mask (protects nose and mouth from airborne particles).
    - Long-sleeved overalls (worn outside of boots).

  - Rubber gloves.
  - Boots
- Prohibit eating, drinking or smoking while working.
- Wash hands and face with soap and water after spraying and before eating, smoking or drinking.
- Shower or bath at the end of every day's work and wear new clean clothes.
- Wash overalls and other protective clothing at the end of every working day in soap and water and keep them separate from the rest of the family's clothes.
- If the insecticide touches the skin, wash off immediately with soap and water.
- Change clothes immediately if they become contaminated with pesticides.
-

Handling & Storage

1. Pesticides storehouses must be located away from areas where people or animals are housed and away from water sources, wells, and canals.
2. They should be located on high ground and fenced, with access only for authorized persons. However, there should be easy access for pesticides delivery vehicles and, ideally access on at least three sides of the building for fire-fighting vehicles and equipment in case of emergency.
3. Pesticides must NOT be kept where they would be exposed to sunlight, water, or moisture which could affect their stability.
4. Storehouses should be secure and well ventilated.
5. Containers, bags or boxes should be well stacked to avoid possibility of spillage. The principle of first expiry first out should be followed.
6. Stock and issue registers should be kept upto date. Access to the pesticides should be limited to authorized personnel only.
7. The store room should have a prominently displayed mark of caution used for poisonous or hazardous substances. It should be kept locked.
8. Containers should be arranged to minimize handling and thus avoid mechanical damage which could give rise to leaks. Containers and cartons should be stacked safely, with the height of stacks limited to ensure stability.

Transportation

1. Pesticides should be transported in well-sealed and labeled containers, boxes or bags.
2. Pesticides should be transported separately. It should not be transported in the same vehicle as items such as agricultural produce, food, clothing, drugs, toys, and cosmetics that could become hazardous if contaminated.
3. Pesticides containers should be loaded in such a way that they will not be damaged during transport, their labels will not be rubbed off and they will not shift and fall off the transport vehicle onto rough road surfaces.
4. Vehicles transporting pesticides should carry prominently displayed warning notices.
5. The pesticides load should be checked at intervals during transportation, and any leaks, spills, or other contamination should be cleaned up immediately using

accepted standard procedures. In the event of leakage while the transport vehicle is moving, the vehicle should be brought to a halt immediately so that the leak can be stopped and the leaked product cleaned up. Containers should be inspected upon arrival at the receiving station. There should be official reports and follow-up enquiries in the event of fires, spills, poisonings, and other hazardous events.

Disposal of remains of pesticides and empty packaging

1. At the end of the day's work during IRS (indoor residual spray) activities, the inside of the spray pump should be washed and any residual pesticides should be flushed from the lance and nozzle.
2. The rinsing water should be collected and carefully contained in clearly marked drums with a tightly fitted lid. This should be used to dilute the next day's tank loads or disposed properly by the supervisor at disposal sites like pits or digs.
3. Never pour the remaining pesticides into rivers, pools or drinking-water sources.
4. Decontaminate containers where possible. For glass, plastic or metal containers this can be achieved by triple rinsing, i.e. part-filling the empty container with water three times and emptying into a bucket or sprayer for the next application.
5. All empty packaging should be safely disposed according to guidelines.
6. Never re-use empty insecticide containers.
7. The used packages shall not be left outside to prevent their re-use.
8. The packages shall be broken and buried away from habitation.

Disposal of Expired Pesticides

1. Adequate measures should be undertaken to avoid expiry of stocks in storehouses.
2. First Expiry First Out Principle should be strictly followed during stock movements.
3. The expired stock should be returned to manufacturer for disposal as per guidelines preferably through incineration process.
4. The chemical efficacy should be tested before disposal of expired pesticides to find out possibility of usage. The efficacy and active ingredient percentage of pesticides is tested and certified by the authorized testing laboratory.

Health Monitoring

1. In case of accidental exposures or appearances of symptoms of poisoning, medical advice must be sought immediately.
2. In case of organophosphorus (Malathion), regular monitoring of cholinesterase (CHE) level should be carried out and spray-men showing decline in CHE to 50% should be withdrawn and given rest and if needed medical aid.

3.8 Nutrient Management in Agriculture/ Horticulture

Pest control is further aided by integrated plant nutrient management. Crops under stress are more prone to illness and the consequences of pest infestations. Crops that

are stressed include those that are growing in poorly constructed soil, with low or unbalanced nitrogen levels, or with insufficient water availability. Applying pesticides in response to disease or pest attacks is an expensive symptomatic solution to a situation that is better addressed by enhancing the ecological settings and systems in which the crops are grown. Additionally, agricultural goods with less pesticide residues are less dangerous to eat, and healthy plants with an adequate supply of nutrients produce better-quality feed and food that is better for both human and animal health.

In an effort to increase production efficiency, integrated nutrient management approaches will be promoted. In an effort to balance the efficient use of scarce resources and maintain ecosystem sustainability, integrated nutrient management strategies that promote the combined use of inorganic, organic, and biological resources will be promoted. The promotion of effective fertilizer use will include application of appropriate quantities and method of application to minimizes losses. Rather than broadcasting, project will educate farmers to apply fertilizer into the soil directly.

For Nutrient management in the soil:
Integrated use of all the essential nutrients from different sources like chemical fertilizers, organic manures, green manures, bio-fertilizers, legume crops, and locally available plant resources in a balanced proportion will maintain sustainable soil health and productivity.

Use of inorganic fertilizers:
Different types of inorganic products for both micro and macro nutrients are available in the market. However, they are costly as well as harmful to soil health but need to be used with R's formula as mentioned above.

Use of organic manures/ materials:
Due to different agriculture practices and cultivation, there is deterioration in the soil organic matter which is the main source for soil binding as well as a source of different nutrients. Different organic matter such as FYM compost, green manures, poultry manures, vermi-compost, oilcake etc. can be used to maintain soil properties.

Use of biological sources/bio-fertilizers:
Bio-fertilizers are cultivated micro-organism that includes bacteria, fungi, and algae. They are mostly used to increase N and P availability to the plants. Secondly, they don't have any negative effect on the crop ecosystem.

Optimum water utilization:
Plants absorb nutrients in their soluble form, which is only possible with water, but excess water sometimes leads to leaching and runoff. So, optimal water application is important. These days, fertigation is one of the most prevalent techniques for applying fertilizer with water, which not only reduces excess water wastage but also improves the nutrient intake efficiency of the plants.

Nutrient Management at Farm Level

Farmers can get higher benefit from the supply of additional plant nutrients, in the form of organic/ inorganic fertilizer, only after they have made improvement in the biological, physical and hydrological properties of their soil. At the farm level, integrated and synergistic approach will be adopted under IPNM, involving the following:

1. Matching the land use requirements with the land qualities present in the area, i.e., the biological, chemical and physical properties of the soil, and the local climatic conditions (temperature, rainfall etc.);
2. Seeking to improve yield by identifying and overcoming the most limiting factors that influence yield;
3. Better plant management, i.e., (i) planting at the beginning of the rain to increase protective ground cover to enhance infiltration and biological activity and (ii) timely weeding to reduce crop yield losses;
4. Promotion of complementary crop, livestock and land husbandry practices in combination to maximize addition of organic materials and recycle farm wastes, so as to maintain and enhance soil organic matter levels;
5. Land management practices that ensure favorable soil moisture conditions for the proposed land use (e.g. moisture conservation in low rainfall areas, drainage in high rainfall areas);
6. The replenishment of soil nutrients through an integrated plant nutrition management approach like organic manuring, application of crop residues, rhizoidal N-fixation, Phosphorous and other nutrient uptake;
7. Combinations of crop, livestock and land husbandry practices that reduce rainfall impact, improve surface infiltration, and reduce the velocity of surface run-off thereby ensuring soil loss below the 'tolerable' level;
8. Conservation tillage, crop rotation, agro-forestry and soil restorative practices that maintain and enhance the soils physical properties thereby encouraging root development and rainfall infiltration;
9. Promotion of crop-livestock system in project clusters as a part of integrated nutrient management strategy;
10. Nutrient monitoring during growing stage by using colour chart and application of nutrients accordingly.
11. Apart from IPNM, details on Integrated Pest Management (IPM) are outlined in this report.

Table 3-2: Major crops under TRESP its IPNM (Nutrient requirement)

	Nutrient Requirement						
Stages	**Ginger**	**Turmeric**	**Black Pepper**	**Pineapple**	**Mustard**	**Sesame**	**Bhindi (Abelmoschus esculentus)**
Pre Sowing	• Use 20 t/ acre FYM or 8 t / acre. •Use Leguminous green manure crops like pigeon pea, black gram, cowpea, cluster bean, and French bean. •Wood ash can be added to the field as this increases the potash content of the soil	• Use 10 t/ acre Farmyard manure or 4 t / acre •N:P:K 120:50:80 Kg/ac .• Apply castor or neem cake @ 200 Kg/ acre.	• FYM @ 10 kg/vine during May. • Neem cake @ 1 kg/vine can also be applied	• N: P :K @ 600: 400: 600 with 25-30 tonnes of FYM/ha.	• Apply 15-20 tonnes of FYM or compost at the time of field preparation. • N:P:K @ 60-90kg: 60 kg P2O5 : 40 kg K2O per hectare.	• If pH of soil is less than 5 then soil reclamation with lime is recommended	• Apply FYM or compost as basal dose of @12t/ha
Sowing/Planting	Apply P2O5 @ 24 Kg/acre as basal dose at the time of planting/ sowing	• The NPK requirement has to be applied in two or three splits. The first dose of N has to be applied before planting	• Application of lime or dolomite @ 500 g/vine in April - May during alternate years is recommended under highly acid soil conditions.				N:P:K @ 25:8:25 Kg/ha

		through inorganic sources. • P:K 24:16 Kg/ac • In zinc deficient areas, apply zinc sulphate @ 8 Kg/acre.					
Vegetative stage	• Apply 12 Kg of nitrogen and 12 Kg of potash/ acre near the rhizomes on the 40th day after planting. • Apply 24 Kg nitrogen and 24 Kg potash/ acre on the 80th day. • The final dose of 12 Kg nitrogen and 12 Kg potash/acre should be applied at 120th day. • As and when micro-nutrient deficiencies like zinc, manganese etc., are observed, it	• Top dressing of N in three splits is done at regular periods just after each weeding at monthly intervals. • Apply castor or neem cake @ 200 Kg/ acre (if not applied at sowing) along with 24 Kg of Nitrogen through urea near the rhizomes at 40 days after planting. • Apply 24 Kg nitrogen and 16 Kg potash/ acre at 80 days after planting.	• (3 years and above) NPK 50: 50: 150 g/vine/year (General recommendation)	Three Split Doses: 1. Once at onset of Monsoon (June-July) 2. End of rainy season (September-October) 3. Third dose (February-March) • After the fruit harvested and slips and suckers are removed the application of fertilizer have been found effective to promote growth and yield.	Split application of nitrogen has been found useful for rape and mustard crop	N:P:K @ 40: 20: 20 Kg/ha	Another 25 kg N per ha may be applied one month after sowing

	should be corrected by foliar spray. • Foliar application of 0.05% zinc sulphate (60 and 90 DAP), 0.2% of borax (60 and 90 DAP) and 1.0% of ferrous sulphate (60 and 90 DAP) should be done for correcting deficiency of these micronutrients.	• The final dose of 20 Kg nitrogen and 14 Kg potash/ acre should be applied at 120 days after planting followed by eating up of the crop. • Fertilizer application should be completed within 120 days from the time of planting.					

Fertilizer recommendation as per Agriculture department of Tripura and Government of India (Standard Practices)

Fertilization Stage	**Bhindi (Abelmoschus esculentus)**	**Cucurbitaceous Vegetables**	**Cucumber (*Cucumis sativus*)**	**Brinjal /Chilli/Tomato**	**Cabbage /Cauliflower**	**Carrot (*Daucus Carota*)**	**Potato**
Basal Dose FYM along with NPK	@12t/ha N:P:K @ 25:8:25 Kg/ha	@ 20-25 t/ha with half dose of N (35 kg) and full doses of P2O5 (25 kg) and K2O (25 kg).	@ 20-25 t/ha with half dose of N (35 kg) and full dose of P2O5 (25 kg) and K2O (25 kg/ha).	@ 20-25 t/ha N:P: K 75:40:25 kg/ha	@ 25 t/ha N:P: K 150:100:125 kg/ha	Apply 25 t/ha N:P:K 37.5 : 62.5: 50 kg / ha	basal application of FYM (20 t/ha) is required during field preparation. Apply 60 kg N, 100 kg P2O5 and 120 kg K2O as basal.

Another Dose	Another 25 kg N per ha may be applied one month after sowing	The remaining dose of N (35 kg) can be applied in several split doses at fortnightly intervals.	The remaining dose of N (35 kg) can be applied in two equal split doses at the time of vining and at the time of full blooming.	Half the dose of nitrogen, full phosphorus and half of potash may be applied as basal dose before transplanting. One fourth of nitrogen and half of potash may be applied 20-30 days after planting. The remaining quantities may be applied two months after planting.	Apply full dose of P2O5 and half dose of N and K2O before transplanting. Apply remaining half dose one month after transplanting.	Topdressing with 37.5 kg N / ha may be done one month after sowing.	Topdressing with 60 kg N, 30 days after planting at the time of first earthing up is essential.

Sources/references:

1. *Status of Agriculture In The TTAADC*
2. *Package of practices of Black peeper cultivation in Tripura*
3. *Pest of Pineapple and their management (Joy P.P. et al., 2013)*
4. *Pineapple cultivation in Tripura (ICAR)*
5. *Production Technology for Brinjal in Tripura (ICAR)*
6. *Production Technology for Sesame in Tripura (ICAR)*
7. *T.P.S a revulaiton potato cultivation (dept. of Agriculture, Tripura)*
8. *NIPHM and Directorate of Plant Protection, Quarantine & Storage*

The approved specific Package of Practice (PoP) of TRESP shall be referred along with IPNMP for the crops suggested under the TRESP project.

3.9 Awareness on IPNMP

Awareness building on safe use of pesticides among farmers and horticulture/ agriculture workers is another instrument that must be adopted for implementing the PMP in the project.

All supports to pesticide sprayers and equipment must include making available a protective gear. Pamphlets and posters on safe use of pesticides which deal from purchase, transport, storage, application to disposal must be provided to village organizations. In high pesticide use areas, cultural expressions like folk songs can be provided to village organizations.

A major impact of pesticide usage is on water. Reducing pesticide usage by adopting IPNM and permitting only class III pesticides, while substantially reducing pesticide usage, the threat to water contamination reduction is possible. Educating the community not to spray pesticides during or just before a rain must be included in the awareness material. Monitoring the health on the people, especially workers, on a sample basis in high pesticide use area would be another task the project can attempt.

3.10 Institutional arrangement

Implementation of IPNMP shall be done at various levels as suggested in the PIP-TRESP under Agriculture and Horticulture sector. The awareness/ training for IPNMP shall be done through Farmer Field School at various levels suggested in below figure for the agriculture and horticulture sector.

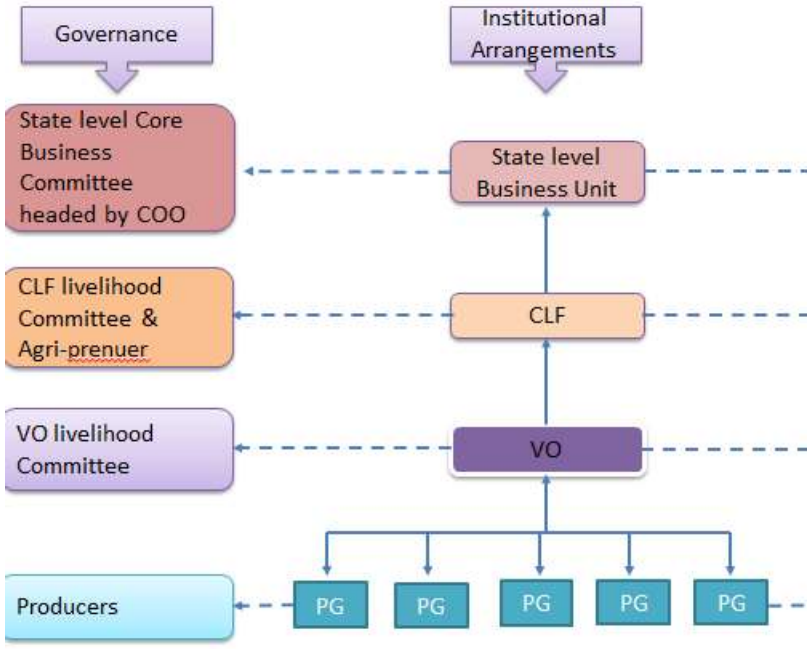

Figure 3-3: Institutional Arrangement IPNM

(Source PIP-TRESP)

- At state level IPNMP through Agriculture and Horticulture Departments would provide the technical backstopping as well as by providing input incentives to

FFS farmers. It would also assist the FFS farmers in procuring inputs needed for implementing IPNM.

- The Farmer Field School is a form of adult education, which evolved from the concept that farmers learn optimally from field observation and experimentation.
- FFS will help farmers tailor their Integrated Pest and Nutrient Management (IPNM) practices to diverse and dynamic ecological conditions.
- In regular sessions from planting till harvest, groups of neighbouring farmers observe and discuss dynamics of the crop's ecosystem.
- Simple experimentation helps farmers further improve their understanding of functional relationships (e.g. pests-natural enemy population dynamics and crop damage-yield relationships).
- In this cyclical learning process, farmers develop the expertise that enables them to make their own crop management decisions.
- Special group activities encourage learning from peers, and strengthen communicative skills and group building.

3.11 Monitoring

The core of IPNM is crop monitoring, which keeps tabs on pests and any possible damage they may caused. This information about the state of the crops and pests now is useful for choosing the most effective pest management strategies. IPNMP will develop a protocol in co-ordination with Agriculture and Horticulture Departments. The following protocol model is proposed:

Table 3-3 Monitoring Protocol

Area to be monitored	Responsibility	Frequency
Verify whether the banned list of pesticides and insecticides are circulated in vernacular to PGs	Nodal officer Agriculture/Horticulture-Block, District and state level, DoA/DoH	Periodic Field Visits to the villages and checking for the lists from villagers
Purchasing/ using of insecticides and pesticides		Checking source of purchasing
Use of Bio- fertilizers and bio-pesticides vermi- compost/ bio-compost		Nos. of villages using/Nos. of villages not using etc. Data collected through field visits to villages, information from VOs, CLF,
Training and Awareness creation		Collect data of untrained persons

The training and monitoring under IPNMP shall be done as per good /recommended practices of Package of Practice and Management provisions of Project Implementation Plan of TRESP.

ANNEXURE

Annexure-1

List of pesticides which are banned, refused registration and restricted in use (As on 01st January 2014)

Table-1: PESTICIDES / FORMULATIONS BANNED IN INDIA

Pesticides Banned for manufacture, import and use				
A.	1	Aldicarb	15	Heptachlor
	2	Aldrin	16	Lindane (Gamma-HCH)
	3	Benzene Hexachloride	17	Maleic Hydrazide
	4	Calcium Cyanide	18	Menazon
	5	Chlorbenzilate	19	Metoxuron
	6	Chlordane	20	Nitrofen
	7	Chlorofenvinphos	21	Paraquat Dimethyl Sulphate
	8	Copper Acetoarsenite	22	Pentachloro Nitrobenzene
	9	Dibromochloropropane	23	Pentachlorophenol
	10	Dieldrin	24	Phenyl Mercury Acetate
	11	Endrin	25	Sodium Methane Arsonate
	12	Ethyl Mercury Chloride	26	TCA (Trichloro acetic acid)
	13	Ethyl Parathion	27	Tetradifon
	14	Ethylene Dibromide	28	Toxaphene(Camphechlor)
Pesticide formulations banned for import, manufacture and use				
B.	1	Carbofuron 50% SP	3	Methomyl 24% formulation
	2	Methomyl 12.5% L	4	Phosphamidon 85% SL
Pesticide / Pesticide formulations banned for use but continued to manufacture for export				
C.	1	Captafol 80% Powder	2	Nicotin Sulfate
Pesticides Withdrawn				
D.	1	Dalapon	5	Paradichlorobenzene (PDCB)
	2	Ferbam	6	Simazine
	3	Formothion	7	Warfarin
	4	Nickel Chloride		

Table-2: PESTICIDES REFUSED REGISTRATION

Sl. No.	Name of Pesticides	Sl. No.	Name of Pesticides
1	Ammonium Sulphamate	10	Fentin Acetate
2	Azinphos Ethyl	11	Fentin Hydroxide
3	Azinphos Methyl	12	Lead Arsenate
4	Binapacryl	13	Leptophos (Phosvel)
5	Calcium Arsenate	14	Mephosfolan
6	Carbophenothion	15	Mevinphos (Phosdrin)
7	Chinomethionate (Morestan)	16	2,4, 5-T
8	Dicrotophos	17	Thiodemeton / Disulfoton
9	EPN	18	Vamidothion

Source: *Tripura Farmers Portal and kisan Call Center (https://farmersportal.tripura.gov.in/bannedpesticide.html)*

Table-3: PESTICIDES RESTRICTED FOR USE IN INDIA

Sl. No.	Name of Pesticides	Details of Restrictions
1	Aluminum Phosphide	The Pest Control Operations with Aluminum Phosphide may be undertaken only by Govt./Govt. undertakings /Govt. Organizations / Pest Control operators under the strict supervision of Govt. Experts or experts whose expertise is approved by the Plant Protection Advisor to Govt. of India except Aluminum Phosphide 15% 12g tablet and Aluminum Phosphide 6 % tablet. *[RC decision circular F No. 14-11(2)-CIR-II (Vol. II) dated 21-09-1984 and G.S.R. 371(E) dated 20th may 1999]. [1]Decision of 282nd RC held on 02-11-2007 and, [2]Decision of 326th RC held on 15-02-2012.* The production, marketing and use of Aluminum Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminum Phosphide are banned completely. (S.O.677 (E) dated 17thJuly, 2001)
2	Captafol	The use of Captafol as foliar spray is banned. Captafol shall be used only as seed dresser. (S.O.569 (E) dated 25thJuly, 1989) The manufacture of Captafol 80 % powder for dry seed treatment (DS) is banned for use in the country except manufacture for export. (S.O.679 (E) dated 17thJuly, 2001)
3	Cypermethrin	Cypermethrin 3 % Smoke Generator, is to be used only through Pest Control Operators and not allowed to be used by the General Public. [Order of Hon'ble High Court of Delhi in WP(C) 10052 of 2009 dated 14-07-2009 and LPA-429/2009 dated 08-09-2009]
4	Dazomet	The use of Dazomet is not permitted on Tea. (S.O.3006 (E) dated 31st Dec, 2008)
5	Diazinon	Diazinon is banned for use in agriculture except for household use. (S.O.45 (E) dated 08th Jan, 2008)
6	Dichloro Diphenyl Trichloroethane (DDT)	The use of DDT for the domestic Public Health Programme is restricted up to 10,000 Metric Tones per annum, except in case of any major outbreak of epidemic. M/s Hindustan Insecticides Ltd., the sole manufacturer of DDT in the country may manufacture DDT for export to other countries for use in vector control for public health purposes. The export of DDT to Parties and State non-Parties shall be strictly in accordance with paragraph 2(b) article 3 of the Stockholm Convention on Persistent Organic Pollutants (POPs). (S.O.295 (E) dated 8th March, 2006) Use of DDT in Agriculture is withdrawn. In very special circumstances warranting the use of DDT for plant protection work, the state or central Govt. may purchase it directly from M/s Hindustan Insecticides Ltd. to be used under expert Governmental supervision. (S.O.378 (E) dated 26thMay, 1989)
7	Fenitrothion	The use of Fenitrothion is banned in Agriculture except for locust control in scheduled desert areas and public health. (S.O.706 (E) dated 03rdMay, 2007)
8	Fenthion	The use of Fenthion is banned in Agriculture except for locust control, household and public health. (S.O.46 (E) dated 08th Jan, 2008)

Sl. No.	Name of Pesticides	Details of Restrictions
9	Methoxy Ethyl Mercuric Chloride (MEMC)	The use of MEMC is banned completely except for seed treatment of potato and sugarcane. (S.O.681 (E) dated 17thJuly, 2001)
10	Methyl Bromide	Methyl Bromide may be used only by Govt./Govt. undertakings/Govt. Organizations / Pest control operators under the strict supervision of Govt. Experts or Experts whose expertise is approved by the Plant Protection Advisor to Govt. of India. [G.S.R.371 (E) dated 20thMay, 1999 and earlier RC decision]
11	Methyl Parathion	Methyl Parathion 50 % EC and 2% DP formulations are banned for use on fruits and vegetables. (S.O.680 (E) dated 17thJuly, 2001) The use of Methyl Parathion is permitted only on those crops approved by the Registration Committee where honeybees are not acting as pollinators. (S.O.658 (E) dated 04th Sep., 1992.)
12	Monocrotophos	Monocrotophos is banned for use on vegetables. (S.O.1482 (E) dated 10thOct, 2005)
13	Sodium Cyanide	The use of Sodium Cyanide shall be restricted for Fumigation of Cotton bales under expert supervision approved by the Plant Protection Advisor to Govt. of India. (S.O.569(E) dated 25thJuly, 1989)

Source: *Tripura Farmers Portal and kisan Call Center (https://farmersportal.tripura.gov.in/bannedpesticide.html)*

Table-4: Insecticides / Pesticides Registered under section 9(3) of the Insecticides Act, 1968 for use in the Country (As on 31/12/2014):

Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide
1	2,4-Dichlorophenoxy Acetic Acid	87	Dinotefuron	173	Novaluron
2	Acephate	88	Dithianon	174	Nuclear polyhyderosis virus of Helicoverpaarmigera
3	Acetamiprid	89	Diuron	175	Nuclear polyhyderosis virus of Spodoptera litura
4	Alachlor	90	Dodine	176	Orthosulfamuron
5	Allethrin	91	D-trans Allethrin	177	Oxadiargyl
6	Alphacypermethrin	92	Edifenphos	178	Oxadiazon
7	Alphanaphthyl Acetic Acid	93	Emamectin Benzoate	179	Oxycarboxin
8	Aluminum Phosphide	94	Endosulfan*	180	Oxydemeton-Methyl
9	Ametroctradin	95	Ethephon	181	Oxyfluorfen
10	Ampelomycesquisqualis	96	Ethion	182	Paclobutrazol
11	Anilophos	97	Ethiprole	183	Paraquat dichloride
12	Atrazine	98	Ethofenprox (Etofenprox)	184	Penconazole
13	Aureofungin	99	Ethoxysulfuron	185	Pencycuron
14	Azadirachtin (Neem Products)	100	Ethylene Dichloride and Carbon Tetrachloride mixture (EDCT Mixture 3:1)	186	Pendimethalin
15	Azimsulfuron	101	Etoxazole(FI)	187	Penoxsulam
16	Azoxystrobin	102	Famoxadone	188	Permethrin
17	Bacillus sphaericus	103	Fenamidone	189	Phenthoate
18	Bacillus thuringiensis var.	104	Fenarimol	190	Phorate

Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide
	galleriae				
19	Bacillus thuringiensis var. israelensis	105	Fenazaquin	191	Phosalone
20	Bacillus thuringiensis var. kurstaki	106	Fenitrothion	192	Phosphamidon
21	Barium Carbonate	107	Fenobucarb (BPMC)	193	Picoxystrobin
22	Beauveria bassiana	108	Fenoxaprop-p-ethyl	194	Pinoxaden
23	Bendiocarb	109	Fenpropathrin	195	Prallethrin
24	Benfuracarb	110	Fenpyroximate	196	Pretilachlor
25	Benomyl	111	Fenthion	197	Primiphos-methyl
26	Bensulfuron Methyl	112	Fenvalerate	198	Profenophos
27	Beta Cyfluthrin	113	Fipronil	199	Prohexadione Calcium
28	Bifenazate	114	Flonicamid	200	Propanil
29	Bifenthrin	115	Fluazifop-p-butyl	201	Propaquizafop
30	Bispyribac Sodium	116	Flubendiamide	202	Propergite
31	Bitertanol	117	Fluchloralin	203	Propetamphos
32	Bromadiolone	118	Flufenacet	204	Propiconazole
33	Buprofezin	119	Flufenoxuron	205	Propineb
34	Butachlor	120	Flufenzine	206	Propoxur
35	Captan	121	Flusilazole	207	Pseudomonas fluorescens
36	Carbaryl	122	Fluvalinate	208	Pymetrozin (FI)
37	Carbendazim	123	Forchlorfenuron	209	Pyrachlostrobin
38	Carbofuran	124	Fosetyl-Al	210	Pyraclostrobin+Epoxiconazole
39	Carbosulfan	125	Gibberellic Acid	211	Pyrazosulfuron ethyl
40	Carboxin	126	Glufosinate Ammonium	212	Pyrethrins (pyrethrum)
41	Carfentrazone Ethyl	127	Glyphosate	213	Pyridalyl
42	CarfentrazoneEthyl+ Chloropropionic acid	128	Hexaconazole	214	Pyriproxyfen
43	Carpropamid	129	Hexazinone	215	Pyrithiobac sodium
44	Cartap Hydrochloride	130	Hexythiazox	216	Quinalphos
45	Chlorantraniliprole	131	Hydrogen Cyanamide	217	Quizalofop ethyl
46	Chlorfenapyr	132	Imazamox	218	Quizalofop-P-tefuryl
47	Chlorfluazuron	133	Imazethapyr	219	S-bioallethrin
48	Chlorimuron ethyl	134	Imidacloprid	220	Sodium Cyanide
49	Chlormequat Chloride (CCC)	135	Imiprothrin	221	Spinosad
50	Chlorothalonil	136	Indoxacarb	222	Spiromesifen
51	Chlorpropham	137	Iprobenfos (Kitazin)	223	Streptomycin + Tetracycline
52	Chlorpyriphos	138	Iprodione	224	sulfosulfuron
53	Chlorpyriphos Methyl	139	Iprovalicarb	225	sulphur
54	Chlothianidin	140	Isoprothiolane	226	Tebuconazole
55	Chromafenozide	141	Isoproturon	227	Temephos
56	Cinmethylene	142	Kasugamycin	228	Tetraconazole(FI)
57	Clodinafop-propargyl	143	Kresoxim Methyl	229	Thiacloprid
58	Clodinafop-propargyl+Sodium acifluorfen	144	Lambdacyhalothrin	230	Thifluzamide
59	Clomazone	145	Lime Sulphur	231	Thiobencarb (Benthiocarb)
60	Copper Hydroxide	146	Linuron	232	Thiodicarb
61	Copper Oxychloride	147	Lufenuron	233	Thiomethoxain
62	Copper Sulphate	148	Magnesium Phosphide	234	Thiometon

Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide	Sl. No.	Name of the Pesticide
			Plates		
63	Coumachlor	149	Malathion	235	Thiopanatemethyl+ Pyraclostrobin
64	Coumatetralyl	150	Mancozeb	236	Thiophanate-Methyl
65	Cuprous Oxide	151	Mandipropamid	237	Thiram
66	Cyantraniliprole	152	Mepiquate Chloride	238	Tolfenpyrad
67	Cyazofamid	153	Mesosulfuron Methyl + Iodosulfuron Methyl Sodium	239	Transfluthrin
68	Cyfluthrin	154	Metaflumizone	240	Triacontanol
69	Cyhalofop-butyl	155	Metalaxyl	241	Triadimefon
70	Cymoxanil	156	Metalaxyl-M	242	Triallate
71	Cypermethrin	157	Metaldehyde	243	Triasulfuron
72	Cyphenothrin	158	Metarhiziumanisopliae	244	Triazophos
73	Dazomet	159	Methabenzthiazuron	245	Trichoderma harzianum
74	Deltamethrin (Decamethrin)	160	Methomyl	246	Trichoderma Viride
75	Diafenthiuron	161	Methoxy Ethyl Mercury Chloride (MEMC)	247	Tricholorofon
76	Diazinon	162	Methyl Bromide	248	Tricyclazole
77	Dichloro Diphenyl Trichloroethane (DDT)	163	Methyl Chlorophenoxy Acetic Acid (MCPA)	249	Tridemorph
78	Dichloropropene and Dichloropropanemixure (DD mixure)	164	Methyl Parathion	250	Trifloxistrobin
79	Diclofop-Methyl	165	Metiram	251	Trifluralin
80	Diclorvos (DDVP)	166	Metofluthrin	252	Validamycin
81	Dicofol	167	Metolachlor	253	Verticillium lecanii
82	Difenoconazole	168	Metribuzin	254	Zinc Phosphide
83	Diflubenzuron	169	Metsulfuron Methyl	255	Zineb
84	Dimethoate	170	Milbemectin	256	Ziram
85	Dimethomorph	171	Monocrotophos		
86	Dinocap	172	Myclobutanil		

Source: *Tripura Farmers Portal and kisan Call Center (https://farmersportal.tripura.gov.in/bannedpesticide.html)*