ANNEXURE-VII
PEST MANAGEMENT PLAN

1. Introduction

The project investments may increase the use of higher pesticides and other chemical inputs by promoting improved management practices in agriculture and horticulture as well as through increasing crop intensification due to improved access to water resources and area under irrigation. While such improvements on one hand will augment the production and income of the farmers, on the other hand due to its excessive and inappropriate use it would affect the natural resources, environmental services and food systems. In order to protect the environment and its services the project will promote the adoption of Integrated Pest Management approach. As part of the ethical practices, the project will not recommend or use pesticides which are banned, refused registration and restricted in use by the Central Insecticides Board as on October 2015 in any of its demonstrations and promotion.

Main pests and diseases: The main crops grown in project area are paddy, sugarcane, coconut, banana, pulses and vegetables. The major risks due to the breakout of pests and diseases in paddy crop especially in Cauvery delta zone are yellow stem borer (*Scirpophaga incertulas*), leaf folder (*Cnaphalocrocis medinalis*) and brown plant hopper (*Nilaparvata lugens*) and blast and blight during the main growing seasons[i] (TNAU, 2017) at moderate to severe intensity. Some of the pests like thrips, gall midge, earhead bug and whorl maggot have emerged as major pests in paddy. During 2009 onwards, certain new insects like rice leaf mite (*Oilgonychus oryzae*) attained the pest status and occurring at the intensity of light to moderate. Similarly in sugarcane, early shoot borer (*Chilo infescatellus*) and root grub *(Holotrachia serrata)* have emerged as main pests. Black headed caterpillar (*Opisina arenosella*) in Coconut, blister beetle *(Mylabris pustulata)* in redgram and Fusarium wilt in Banana have also become important pests.

Awareness and current practices: The field visits in the consultation process as well as Focus Group Discussions with men and women farmers in the 12 sub basins indicates that the main reason for the indiscriminate use of chemical pesticides are lack of sufficient knowledge in identification pest and diseases, its symptoms, mode of infection and integrated management practices. Hence farmers perceive the practice of pest and disease management as a routine cultivation practice similar to tillage and weeding. As a result of 4-5 rounds of indiscriminate usage of chemical spraying are adopted by vegetable growers. At present, farmers access to information on pest management is largely restricted to input dealers and support from Dept of agricultural extension services are limited. Due to vested interests and company's push input dealers are marketing chemicals to farmers without considering its adverse impacts.

2. Status of current use of agro-chemicals in the state

The particulars on pesticides consumption in the State over a period from 1982-83 to 2014-15 is provided in table 1. It clearly shows that there is a drastic reduction in the consumption of chemical pesticides since 1982-83 to till last year, however, the pesticide consumption within the last two decades indicated an increasing trend.

Table 1. Details of pesticide consumption in the state from 1982-83 to 2014-15

No	year	Consumed (Technical Grade in MT)
1	1982-83	7437
2	1983-84	10367
3	1984-85	10926
4	1985-86	8667
5	1986-87	8642
6	1987-88	8237
7	1988-89	8594
8	1989-1990	9970
9	1990-1991	3923
10	1991-92	4840
11	1992-93	4890
12	1993-94	5010
13	1994-95	3394
14	1995-96	2080
15	1996-97	1851
16	1997-98	1809
17	1998-99	1730
18	1999-2000	1685
19	2000-01	1663
20	2001-02	1577
21	2002-03	1605
22	2003-04	1434
23	2004-05	2466
24	2014-15	2096

Source: Tamil Nadu An Economic Appraisal – 2005-06, Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai and For the year 2014-15 – 12th Five year plan of Tamil Nadu, 2012-17, Volume I, Government of Tamil Nadu

The reasons attributed to the reduction in the use of pesticides from 1982-83 to 2014-15 is due to the adoption of Integrated Pest Management practices. But at same time, it is important to note that there is an increasing trend was observed in the use of bio-pesticides, since 1997-98 as could be seen from the following table 2.

Table. 2. Bio-pesticides Distribution in Tamil Nadu

Year	Quantities distributed	
	Dust in MT	Liquid in Lts
1997-98	16.80	103986
1998-99	18.30	98890
1999-2000	23.00	90320
2000-2001	23.60	87400
2001-2002	22666	72736
2002-2003	23301	72736
2003-2004	22507	67006
2004-2005	20682	63593
Recent data is not available		

Source: Tamil Nadu an Economic Appraisal – 2005-06, Evaluation and Applied Research Department, Government of Tamil Nadu, Chennai.

3. Major crops and pests

The major pests and diseases occurring in the main crops grown in project areas, its time of occurrence as well as stages of crop in which its impact was more are given in table 3.

Table 3. Important pests and diseases – major crops

S. No.	Major Crop	Key Pests	Disease(s) caused	Time of occurrence and duration of attack
1	Paddy	✓ Leaf folder (*Cnapholocrocis medinalis*) ✓ Stem borer (*Scirpophaga incertulas*) ✓ Thrips (*Stenchaetothrips biformis*) ✓ Brown plant hopper(*Nilaparvata lugens*) ✓ Leaf mite (*Oilgonychus oryzae*) ✓ Ear head bug(Leptocorisa oratorius)	✓Sheath Blight(*Rhizoctonia solani*) ✓ Leaf and neck blast(*Pyricularia grisea*)	Leaf folder, stem borer, ear head bug and thrips attack can be seen throughout the crop stages as well as irrespective of the seasons whereas brown plant hopper attack is more in samba season when humidity is more and leaf mite attack is more in first and summer season from vegetative to flowering stage Sheath blight infection is more during samba season during panicle development phase of the crop, Leaf and neck blast infection will be more in both June- July and Oct-Nov planting seasons at the stage of active tillering and flowering phases

2	Sugarcane	Early shoot borer(*Chilo infescatellus*) Root grub *(Holotrachia serrata)*	Red rot (*Colletotrichum falcatum*)	Early shoot borer attack is more upto 15-90 DAP and late shoot borer upto 90 – 120 DAP, crops grown in the special season (june-sep) are more prone to this attack, rootgrub attack is more in ratoon crops as well as during drier season due to inadequate soil moisture Red rot disease occurs at all stages of the crop,
3	Ground nut	Aphids*(Aphis craccivora)* Red hairy caterpillar(*Amsacta albistriga)*		Aphids attack is more in vegetative and drier part of the growing season and red hairy caterpillar incidence will be more in the time of onset of monsoon
4	Redgram	Pod borer (Heliothis armigera) Blister beetle*(Mylabris pustulata)*	Root wilt(*Fusarium sp)*	Wilt occurs 4 to 6 weeks after sowing and blister beetle attack is more during flowering period and pod borer at the time of pod setting to maturity
5	Coconut	Rhinocerous beetle (*Oryctes rhinoceros*) Red palm weevil (*Rhynchophorus ferrugineus*) Black headed caterpillar(*Opisina arenosella*)	Ganoderma wilt *(Ganoderma lucidum)*	All the three pests attack the grown up trees which are bearing the nuts are most affected and wilt also affect the tree in all stages of the crop
6	Banana	Nematode (*Radopholus similis*) Stem weevil (*Cosmopolites sordidus*)	Bunchy top virus Root rot (Fusarium sp)	Stem weevil infection more in pre flowering phase and nematode at different stages of the crop, bunchy top virus and fusarium wilt at the early stages of growth
7	Jasmine	Bud worm(*Hendecasis duplifascialis*) Red spider Mite attack (*Tetranychus urticae*)	-	Bud work during the flowering stage of the crop and mite at all stages especially during drier period and summer months it multiplies quickly
8	Turmeric	-	Rhizome rot (*Pythium graminicolum)*	During early stages of rhizome formation to maturity when soil moisture is high
9	Chillies	Fruit borer (*Helicoverpa*	-	During the fruiting stage when its started forming

		armigera)		
10	Pulses – black gram and greengram	Pod borer (*Helicoverpa armigera*)	Powdery mildew(*Erysiphe polygoni*)	During the pod formation stage and powdry mildew during the vegetative to flowering phase and infection multiply faster in late kharif and early rabi season

4. Step-wise PMP and Strategies

4(a). Details of PMP with its strategies

PMP		
Negative list of pesticides	The project will not finance procurement of these pesticides	See table Table 4 (banned pesticides) and also a list of CIA, 1968 approved pesticides crop wise can be referred in weblink http://cibrc.nic.in/
IPM – key PMP strategy	Project will finance demonstration, procurement of, training on available IPM packages	Refer table 5 for proposed IPM principles and see Annexure for the detailed pests and IPM packages for specific crops at Sub basin levels
Recommended list of pesticides and/or suggested alternatives	The project will generate awareness on procurement of these alternatives	Lists of registered biopesticides are given in table 8 and 9
Training and Capacity Building	lists/locations/approximate season and potential target beneficiaries to be covered under training which includes raining on handling, safe use and disposal	Training calendar is provided

As indicated above, the project will not finance or recommend the procurement of any of these pesticides or formulations. The List of banned pesticides in India as per Central Insecticides Act, 1968 was given in Table 4. The list also has the details related to pesticides which are refused for registration and restricted in use in India.

Table 4. LIST OF PESTICIDES WHICH ARE BANNED, REFUSED REGISTRATION AND RESTRICTED IN USE by CENTRAL INSECTICIDES BOARD (As on 20th October 2015)

I. **PESTICIDES / FORMULATIONS BANNED IN INDIA**

Pesticides Banned for manufacture, import and use

1. Aldicarb (vide S.O. 682 (E) dated 17th July 2001)
2. Aldrin
3. Benzene Hexachloride
4. Calcium Cyanide
5. Chlorbenzilate (vide S.O. 682 (E) dated 17th July 2001)
6. Chlordane
7. Chlorofenvinphos
8. Copper Acetoarsenite
9. Dibromochloropropane (DBCP) (vide S.O. 569 (E) dated 25th July 1989)
10. Dieldrin (vide S.O. 682 (E) dated 17th July 2001)
11. Endrin
12. Ethyl Mercury Chloride
13. Ethyl Parathion
14. Ethylene Dibromide (EDB) (vide S.O. 682 (E) dated 17th July 2001)
15. Heptachlor
16. Lindane (Gamma-HCH)
17. Maleic Hydrazide (vide S.O. 682 (E) dated 17th July 2001)
18. Menazon
19. Metoxuron
20. Nitrofen
21. Paraquat Dimethyl Sulphate
22. Pentachloro Nitrobenzene (PCNB) (vide S.O. 569 (E) dated 25th July 1989)
23. Pentachlorophenol
24. Phenyl Mercury Acetate
25. Sodium Methane Arsonate
26. Tetradifon
27. Toxaphene(Camphechlor) (vide S.O. 569 (E) dated 25th July 1989)
28. Trichloro acetic acid (TCA) (vide S.O. 682 (E) dated 17th July 2001)

Pesticide formulations banned for import, manufacture and use

1. Carbofuron 50% SP (vide S.O. 678 (E) dated 17th July 2001)
2. Methomyl 12.5% L
3. Methomyl 24% formulation

4. Phosphamidon 85% SL

Pesticide / Pesticide formulations banned for use but continued to manufacture for export

1. Captafol 80% Powder (vide S.O. 679 (E) dated 17th July 2001)
2. Nicotin Sulfate

Pesticides Withdrawn

(Withdrawal may become inoperative as soon as required complete data as per the guidelines is generated and submitted by the Pesticides Industry to the Government and accepted by the Registration Committee. (S.O 915(E) dated 15th Jun,2006)

1. Dalapon
2. Ferbam
3. Formothion
4. Nickel Chloride
5. Paradichlorobenzene (PDCB)
6. Simazine
7. Sirmate (S.O. 2485 (E) dated 24th September 2014)
8. Warfarin (vide S.O. 915 (E) dated 15th June 2006)

II.PESTICIDES REFUSED REGISTRATION

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

16	Mevinphos (Phosdrin)
17	Thiodemeton / Disulfoton
18	Vamidothion

III. PESTICIDES RESTRICTED FOR USE IN THE COUNTRY

S.No.	Name of Pesticides	Details of Restrictions
1.	Aluminium Phosphide	The Pest Control Operations with Aluminium 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 [1]Aluminium Phosphide 15 % 12 g tablet and [2]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 Aluminium Phosphide tube packs with a capacity of 10 and 20 tablets of 3 g each of Aluminium Phosphide are banned completely. (S.O.677 (E) dated 17th July, 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 25th July, 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 17th July, 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 Tonnes 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 purpose. The export of DDT to Parties and State non-Parties shall be strictly in accordance with the 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 26th May, 1989)
7.	Fenitrothion	The use of Fenitrothion is banned in Agriculture except for locust

		control in scheduled desert area 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)
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 a 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: http://www.cibrc.nic.in/list_pest_bann.htm

Integrated Pest Management

The details of IPM – the available and recommended IPM measures for key crops of project areas are given sub basin wise. The following are the broad components and strategy of IPM in increasing order of complexity.

Table 5. Key components of IPM approach

IPM Component	Notified Component Practices
Cultural practices	• Preparation of nurseries or main fields free from pest infestation by removing plant debris, trimming of bunds, treating of soil and deep summer ploughing which kills various stages of pests. • Proper drainage system in field be adopted. • Testing of soil for nutrients deficiencies on the basis of which fertilizers should be applied. • Selection of certified seeds and treating seeds with fungicide or biopesticides before sowing for seed borne disease control. • Selection of seeds of relatively pest resistant/tolerant varieties which play a

IPM Component	Notified Component Practices
	significant role in pest suppression. • Adjustment of time of sowing and harvesting to escape peak season of pest attack. • Rotation of crops with non-host crops. It helps in reduction of incidence of soil borne diseases. • Proper plant spacing which makes plants more healthy and less susceptible to pests. • Optimum use of fertilizer. Use of FYM and biofertilizers to be encouraged. • Proper water management (alternate wetting and drying to avoid water stagnation) as the high moisture in soil for prolonged period is conducive for development of pests especially soil borne diseases. • Proper weed management. • Root dip or seedling treatment in pest infested area. • Inter-cropping or multiple cropping wherever possible. All the crops are not preferred by each pest species and certain crops act as repellents, thus keeping the pest species away from preferred crops resulting in reduction of pest incidence. • Harvesting as close as to ground level. This is because certain developmental stages of insect pests/diseases remain on the plant parts which act as primary inoculums for the next crop season. Hence, harvesting crops at ground level will lessen the incidence of pests in next season. • Before planting, nursery plants be sprayed/dipped in copper fungicide/biopesticide solutions to protect the plants from soil borne diseases. • Keeping bee hives or placing flower bouquets of pollinizer cultivars facilitate better pollination and subsequent fruit set.
Mechanical practices	• Removal and destruction of egg masses, larvae, pupae and adults of insect pests and diseased parts of plants wherever possible. • Installation of bamboo cage cum bird perchers in the field and placing parasitized egg masses inside them for conservation of natural enemies and withholding of pest species wherever possible. • Use of light traps and destruction of trapped insects. • Installation of bird scarer in the field where required. • Installation of bird perches in the field for allowing birds to sit and feed on insects and their immature stages viz., eggs, larvae and pupae. • Use of pheromone traps for monitoring and suppression of pest population. • Use of pheromone traps for mass trapping.
Biological practices	• Biocontrol is use of living organisms to control unwanted living organisms (pests). It involves deliberate use of parasitoids, predators and pathogens to maintain pest population at level blow those causing economic loss either by introducing a new bioagent into the environment of pest or by increasing effectiveness of those already preset in the field. Different kinds of bioagents are biopesticides or bio-parasitoids , bio-fungicides, bio-nematicides etc
Chemical practices	• Use of chemical pesticides is the last resort when all other methods fail to keep the pest population below economic loss. Although there is a great advancement in pest management research, yet pesticides would continue to play an important role in crop protection in view of complexity of pest

IPM Component	Notified Component Practices
	problems. Therefore, use of pesticides should be need based, judicious, based on pest surveillance and economic threshold level (ETL) to minimise not only the cost involved, but also to reduce associated problems, following aspects need to be considered: • ETL and pest defender ratio must be observed • Relatively safer pesticides should be selected • If pest is present in strips or isolated patches, whole field should not be sprayed.

5. Strategies for implementation

Farmer Field school method adopting AEA approach: Agro-Ecosystem Analysis (AEA) approach is recommended to facilitate the holistic understanding and knowledge building on pest and diseases considering the soil conditions, plant growth, weather parameters, stage of crop etc. The approach promotes field observation and group discussion which leads to discussion among farmers and take a collective decision to manage the pests. This AEA approach can be facilitated adopting Farmer Field School method of building the capacity of men and women farmers. Since the IPM strategy is a knowledge intensive process and activity, improving women and men farmer's capacity on pest and diseases and its management by understanding its life cycle and skills to identify pests and diseases is necessary.

Plant Clinic Approach: The second potential strategy planned to promote is facilitating 'Plant Clinics' that is promoted by CABI international at the village level to provide technical inputs in identifying pests, monitoring the extend of damage and effective control measures. It provides an array of technological solutions for crop issues along with cultural, biological and chemical for enhancing plant health and economic benefits. The Plant Clinic is equipped with digital microscope, tablet and laptop with qualified agriculture expert as plant doctor. It will be regularly conducted during the cropping season at the interval of 15 days. Both men and women farmers are encouraged to visit the clinic with samples of the affected crops and discuss the potential solutions. The farmers will collect the recommendations for affected crops immediately in face to face and also get it in their mobile phone as SMS for keeping that message for input preparation or purchase. The plant doctors also spread awareness about judicious use of pesticides and recommend locally available cultural, biological, and chemical field inputs.

Suggested methods for the implementation of IPM

Activity	Suggested Methods
Awareness building	▪ Cover at least 30% farmers per village in first year from project start ▪ Cover the remaining 70% by the end of second year (in both cases 40% are women farmers)
Identification of potential farmers and organizing Farmer Field Schools	▪ Identify 30 interested women and men farmers according to the project norm in each village (which have been selected under the project) within 15 days of awareness building and promote Farmer Field Schools(FFS) for the major crops
Capacity building	▪ Staff and line department training completed in 1st year ▪ One FFS/season /village facilitated for two years – 30 farmers per FFS with 40% - women farmers ▪ Training for other interested farmers completed after FFS through Training of Trainers approach (TOT) – one farmer to ten farmer – Horizontal transfer of knowledge on IPM and totally reaching 300 farmers in a season on IPM methods per village with 40% women farmers
Facilitating Plant Clinics	▪ Promote the practice of IPM package by organizing Plant Clinic sessions in the villages (one plant clinic per 750-1000 households) ▪ 50% of the farmers in each village practice IPM in atleast one acre per farmer per season to observe results and link it with learning
Use of Bio-fertilizers/bio-pesticides	▪ At least 10% reduction in use of chemical fertilizers achieved every year ▪ At least 25% increase in the use of biopesticides achieved every year ▪ 50% reduction achieved in use of chemical fertilizers and pesticides after 5 years
Monitoring and Evaluation	▪ Formation of joint monitoring team (staff and community) within one year from project start ▪ Monitoring schedule for each half-yearly prepared and implemented ▪ Monitoring reports be prepared for each monitoring visit and compiled annually to show progress
Process documentation	▪ Annual progress reports on IPM status prepared giving coverage, replication and sustainability ▪ Knowledge, practice and coverage change documented

IPM measures for Sub basins

Among all the basins studied, the commonly cultivated crops among most of the sub-basins are paddy, coconut, banana, vegetables and sugarcane. Invariably in almost all the pests and diseases farmers have been practicing only chemical pesticides application as a main control measures. In many cases they are not in a position to describe about the pests or disease infection. They have been receiving information from agriculture input dealers and invariably they apply two to three sprays of pesticides irrespective of the pest problems based on crop stages.

The following table provides the crops grown, type of pests occurring in the field as well as adopted control measures, these information were collected during the consultations which should be revisited again

Cheyyar sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf folder Blast	Following two sprays of chemical pesticides based on the technical guidance of input dealers Two sprays of fungicide
Sugarcane	Early shoot borer Root grub	3 sprays of pesticides
Groundnut	Leaf minor Leaf spot	Two sprays – could not specify the name of the chemicals used

Uppar Palar sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf folder	Following two sprays of chemical pesticides based on the technical guidance of input dealers
Sugarcane	Early and late shoot borer	3 sprays of pesticides
Groundnut	-	-
Redgram	Pod borer	One spray of pesticides
Vegetables	Fruit borer and sucking pests	Two sprays of pesticides

Upper Bhavani sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted

Coconut	Rhinocerous beetle Red palm weevil	-
Banana	Nematode Bunchy top virus Stem borer	Application of nematicide – one round - Application of pesticides – 2 times depending upon the infestation

Krishnagiri to Pambar

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Stem borer Leaf folder Thrips Green hopper Brown plant hopper	Following two sprays of chemical pesticides based on the technical guidance of input dealers
Sugarcane	Internode borer Early shoot borer	One or two depending on the degree of infestation
Vegetables		-
Jasmine	Bud worm Mite attack	-
Coconut	Black headed caterpillar	-
Fingermillet	-	-
horsegram	-	-

Vaniyar sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted

Paddy	Leaf folder Stem borer	one or two prays of chemical pesticides
Sugarcane	Early shoot Borer Root grub	-
Turmeric	Rhizome weevil	Three sprays of chemical fungicides

Ponnaiyar sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf folder Stem borer	Three sprays of chemical pesticides
Vegetables	-	-
Maize	-	-

Lower Vaigai Sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf folder Stem borer	Two sprays of chemicals
Chillies	Fruit borer	-
Seasmum	Phyllody	-

Pazayaru Sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Stem borer	2 sprays of chemical pesticides
Coconut	-	-

banana	-	-
Rubber	-	-
Vegetables	-	-

Gadana sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf and sheath blast Stem borer	3 times chemical pesticide spraying
Vegetables	-	

Thirumanimuthar sub basin

Commonly cultivated crops	Commonly occurring pests and diseases	Control measures currently adopted
Paddy	Leaf folder	Following two sprays of chemical pesticides based on the technical guidance of input dealers
Sugarcane	Early shoot borer	-
Groundnut	-	-
Coconut	Rhinocerous beetle Ganoderma wilt	-
Cotton	-	-

The specific IPM measures suggested for the commonly occurring pests are as follows

1. **Paddy – Stem borer (*Scirpophagaincertulas*)**
   The ETL of stem borer attack is 2 egg mass per M2 or 10% dead heart or one moth per m2 or 25 moths per trap per week.
   - Practice of destruction of stubbles after the harvest break the life cycle of the pests and reduce the carry over load to next crop

- Removing the tip of the seedlings while transplanting the seedlings because the adults lay eggs on the leave tips.
- Reduce the use of nitrogenous fertilizers and practice split application of fertilizers – three to four times helps to avoid the over growth
- Recommended to harvest the straw close to the ground level
- Setting up of bird perches using wooden sticks and ropes @ 20-25/ha
- Setting up of pheromone traps for yellow stem borer @ 20-25/
- Biopesticide release such as Egg parasitoid namely *Trichogrammajaponicum, T. chilonis* an @ 50,000 –1,00,000 adult/ ha by tying the cards in the field ha starting from 15 days after planting at 7-10 days intervals 5-6 times
- Spraying of *Beauveriabassiana* product @ 1kg/ha or *Bacillus thuringiensis* @1kg or 1lit/ha
- When the infestation is above ETL safer/less toxic/easily bio degradable chemical pesticides are recommended

2. Paddy – Brown Plant Hopper (*Nilaparvatalugens*)

The ETL of BPH is 10-15 hoppers per hill

- Plant early in the season and plan for synchronous planting
- Wider spacing between plants and rows are recommended since its multiplication is more under high humidity conditions
- Reduce the application of chemical nitrogenous fertilizers and split the application during different stages of the crop growth
- Avoid water stagnation in the field at the time of pest infestation, field should be dry and enough aeration should be facilitated by titling the plants on the borders
- Alternate wetting and drying practice of cultivation can be adopted in the prone areas
- Control the population of myrid bugs by physical means as it helps to transmit the eggs and nympal stages of the hopper to other plants
- Early maturing varieties as well as crop rotation with non-rice crops helps to break the cycles
- Setting up of yellow sticky traps to attract and kill hoppers
- Pour kerosene in the flooded fields and drag a rope to dislodge the plants, during this stage insects fall in to water and drain the water after six hours
- Foliar application of Neem Seed Kernal Extract @5% or neem oil 0.5%
- When the infestation is above ETL safer/less toxic/easily bio degradable chemical pesticides are recommended

3. Paddy – Leaf folder (*Cnaphalocrocismedinalis*)

The ETL of the pest is 2 damaged leaves with larva per hill

- Early planting of paddy seedlings
- Providing wide spacing between plants and rows helps to get more sunlight and aeration which prohibits its growth
- Reduced application of nitrogenous fertilizers since the fresh green growth invites female flies to lay eggs which should be avoided to pest population surge

- Practice crop rotation with pulses and oil seeds
- Setting up of light traps to attract and kill adults.
- Keeping the bunds without much grass growth helps to avoid the pests survival
- Shade around the field should be avoided because shading provides conducive atmosphere for its multiplication
- The infected leaves can be mechanically removed and larvae can be destroyed manually
- Dragging a rope across the field to dislodge larvae of leaf-folder to kerosenized water in the field
- Release of egg parasotoid*Trichogrammachilonis* @ 1 lakh / ha starting from 15 Days after planting for 2-3 times at 7-10 days intervals.
- Spray biopesticides like *Bacillus thuringiensis* @1kg or 1lit/ha twice at 7-10 days
- When the infestation is above ETL chemical pesticides are recommended intervals in the evening hours. Foliar spray of NSKE @5% or neem oil 0.5%

4. Ear Head bug – (*Leptocorisaacuta)*

The ETL level is one bug/hill

- Bait - place fermented parts of either rotten frog or snail or crab or dry fish as bait in 20-25 places in a ha to attract and divert pests from sucking milk of rice grain
- Spray theextract of 2.5kg garlic + 500g tobacco leaves with wetting agent in one ha field at the time of milky stage
- When infestation crosses the ETL use safer/less toxic/easily bio degradable.

5. Blast (*Pyriculariagrisea*)

- Practice summer ploughing to reduce the load of fungal spores
- Cultivate tolerant or resistant varieties wherever suitable
- Plan for early planting
- Seed treatment with *Trichodermaviridii* @ 4g /kg of seeds before sowing
- Apply balanced fertilizers and less amount of nitrogenous fertilizers
- Keep the fields free from weeds that acts as an alternate hosts
- Destroy crop residues of last crop to eradicate the source of spores
- Spray leaf extract of tulsi @ 250g in 10 litres of water for two times at 10 days interval

6. Sugarcane: Early shoot Borer(C*hiloinfescatellus)*

ETL for the pest is 15% dead hearts

- Early planting of setts during Dec- Jan helps to avoid the insect infestation
- Locally suitable resistant varieties can be cultivated depending upon the sugar mills preferences. (eg. CO 312, CO 421, CO 661, CO 917 and CO 853)
- Mulching with crop residues or trashes on the ridges helps to reduce the space for the insects to infest.
- Intercultural operations and hand weeding helps to disturb the soil

- Earthing up the soil around the base of the plant 45 days after plating minimize the damage
- Removal and destroy the dead hearts from the field
- Growing onion/coriander as an intercrop in the early stage of planting
- Use pheromone traps @ 4 nos. /ac helps to monitor the pests and the lure should be changed once in a month
- Installation of light traps one per acre to cover the adult moths
- Use of biopesticides like the release 125 gravid females of *Sturmiopsisinferens* a tachinid parasite per acre helps to reduce the growth of the pests or release of Trichogrammachilonis @ 20,000 per acre at ten days interval for two times
- When the infestation is above ETL safer/less toxic/easily bio degradable are recommended

7. Sugarcane – Root grub (*Holotrichiaconsanguinea*)

ETL level is detection of 2 to 3 live larvae per 100 sampled stalks

- Crop rotation with other crops like pulses, paddy break the pest build up in the soil
- Summer ploughing with deeper depths helps to expose the pupa and other forms
- Avoiding rationing in the affected field of the pests and
- Maintaining field capacity to saturation point of soil moisture through irrigation helps to affect the insect growth

8. Coconut Rhinozerous beetle (*Oryctesnasicornis*)

- Mechanically remove the different life stages of the beetle from the attacked palms using beetle hook and destroy it.
- Set up pheromone trap for rhinoceros beetle @ 1 trap/10 trees by fixing it to the plant at 0.6 to 1 m height to trap and kill the beetles.
- Soak castor cake at 1 Kg in 5 litres of water in small mud pots and keep them in the coconut gardens to attract and kill the adults.
- Apply mixture of neem seed powder + sand (1: 2) @ 150 g/palm or neem seed kernel powder + sand (1: 2) @ 150 g/palm in the base of the 3 inner most leaves in the crown or Place medium size naphthalene balls in the leaf axils in the top and cover it with fine sand.
- Use of biocontrol agents like green muscardine fungus (*Metarrizhiumanisopliae*) by spraying 250ml mixed with 750ml water in manure pits and other breeding sites of the beetle. Or release of *Baculovirusoryctes* inoculated adult rhinoceros beetle @ 6 beetles/acre reduces the leaf and crown damage caused by this beetle.

- Maintain the coconut garden should be clean without tree residues

9. Coconut – Red Palm weevil *(Rhynchophorusferrugineus*)

- Avoid the cutting of green leaves.
- Place pheromone trap @ 1 trap/10 trees by fixing it to the plant at 0.6 to 1 m height to trap and kill the beetles.
- Set up of attractant traps (mud pots) containing sugarcane molasses 2½ Kg or toddy 2½ l (or pineapple or sugarcane activated with yeast or molasses) + acetic acid 5 ml + yeast 5 g + longitudinally split tender coconut stem/ logs of green petiole of leaves of 30 numbers in one acre to trap adult red palm weevils in large numbers

10. Turmeric – Rhizome rot (*Pythiumgraminicolum*)

- It is a soil borne fungus and spread through infected rhizomes and care should be taken while selecting the planting materials
- Treat rhizomes with 3g Mancozeb mixed in one litre of water for one hour and shade dry before planting
- Select field with light soils like red and loamy soils to avoid water stagnation since the infestation will be more under moist conditions
- Advised to grow disease tolerant varieties like Suguna and Sudarshan and promote intercropping with maize or pearl millet
- Crop rotation with pulses are advised to break pest build up in the field
- Advised to do summer ploughing and burn the infected crop residues
- The infected plants in the field should be moved out and drench the field with chemical fungicides like Trichodermaviridie

11. Budworm in Jasmine - *Hendecasisduplifascialis*

- Cleaning: regular pruning and hygienic maintenance of bushes
- Physically picking and destroying the affected buds with larvae
- Place light trap in the field to attract the adult moths
- Spray 5% neem seed kernel extract and
- In extreme cases spray safer/less toxic/easily bio degradable during evening times when flowers opens

12. Stem borer in Banana - *Odoiporuslongicollis*

- Keep the field clean by uprooting and removing the affected plants and old leaves
- place banana stem traps (longitudinal) around the field to monitor the weevil activity

- On the cut surface of the traps apply 20 g Beauveriabassiana, Matarhiziumanisopliae and keep the traps near the banana plant facing cut surface to soil
- Spray Azadirachtin @ (5 ml/litre) for two or three times at three weekly intervals.

Training and capacity building programmes: The training and capacity building programmes for both the agriculture officers and men and women farmers will be conducted by focusing on the following two main themes:

A) IPM demonstrations – recommend and set targets for covering project areas with IPM demonstrations and
B) providing pesticide handling training to potential project beneficiaries, including demonstration and use of proper equipment for spraying of pesticides

Table 6. Training calendar

Content	Target group	Resource organizations
IPM demonstrations		
i). Awareness building	Women and men farmers in the villages of selected sub basins	-
ii). Social mobilization	Department of Agriculture officers	Dhan foundation and M.S.Swaminathan Research Foundation (MSSRF), Chennai
iii) Agro Ecosystem Analysis (AEA)	Agriculture officers to conduct FFS for five days	Centre for Plant Protection Studies, TNAU, Coimbatore
iv) Different IPM technologies	Agriculture officers	Centre for Plant Protection Studies, TNAU, Coimbatore
v) Plant clinics - organizing Plant clinics at the village level –	Agriculture department	CABI, New Delhi, MSSRF, Chennai in partnership with CPPS, TNAU, Coimbatore
vi) Demonstrations and use of proper equipment for spraying pesticides	Men and women farmers	Agriculture officers
vii) Facilitation skills on Farmer Field school – communication and monitoring	Agriculture officers	LEISA network, Tamil Nadu
viii) conducting demonstrations and facilitating FFS	Men and women farmers	Agriculture officers

ix) Biopesticides and other bioproducts	Men and women farmers	Centre for Sustainable agriculture, Hyderabad and LEISA network,
x) Conducting Plant Clinics at the village level	Men and women farmers	MSSRF

Safe handling measures: Safe handling of the pesticides play an equal importance to ensure the safety issues while using it. Hence training programme will give due importance to promote best practices on Safe Practices on Procurements, Storage, Handling, Use and Disposal of pesticides by user groups. The programme will make an attempt to address the following measures (Table 7).

Table 7. Do's and Don'ts in safe use of pesticides by the farmers while purchasing and using

Areas	Do's	Don'ts
While Purchasing	▪ Purchase pesticides/biopesticides only from Registered pesticide dealers having valid Licence. ▪ Purchase only just required quantity of pesticides for single operation in a specified area. ▪ See approved labels on the containers/packets of pesticides. ▪ See Batch No., Registration Number, Date of Manufacture/ Expiry on the labels. ▪ Purchase pesticides well packed in containers.	▪ Do not purchase pesticides from foot path dealers or from un-licenced person ▪ Do not purchase pesticide in bulk for whole season ▪ Do not purchase pesticides without approved label on the containers ▪ Never purchase expired pesticide ▪ Do not purchase pesticides whose containers are leaking/loose/ unsealed
During Storage	▪ Store the pesticides away from house premises. ▪ Keep pesticides in original containers. ▪ Pesticides/weedicides must be stored separately. ▪ Where pesticides have been stored,area should be marked with warning signs. ▪ Pesticides be stored away from the reach of the children and live stocks. ▪ Storage place should be well protected from direct sunlight and rain	▪ Never store pesticide in house premises. ▪ Never transfer pesticides from original to another containers. ▪ Do not store insecticides with weedicides. ▪ Do not allow children to enter the storage place. ▪ Do not allow children to enter the storage place. ▪ Pesticides should not be exposed to sunlight or rain water
While handling	▪ Keep pesticides separate during transportation.	▪ Never carry/transport pesticides along with

	▪ Bulk pesticides should be carried tactfully to the site of application.	food/fodder/other eatable articles. ▪ Never carry bulk pesticides on head, shoulder or on the back.
While preparing spray solution	▪ Always use clean water. ▪ Use protective clothings viz., hand gloves, face masks, cap, apron, full trouser, etc. to cover whole body. ▪ Always protect your nose, eyes, ears, hands, etc. from spill of spray solution ▪ Read instructions on pesticide container label carefully before use. ▪ Prepare the solution as per requirement. ▪ Granular pesticides should be used as such. ▪ Avoid spilling of pesticides solutions while filling the spray tank. ▪ Always use recommended dosage of pesticide. ▪ No activities should be carried out which may affect your health	▪ Do not use muddy or stagnant water. v Never prepare spray solution ▪ Without wearing protective clothings. Do not allow the pesticide/its solution to fall on any body parts. ▪ Never avoid reading instructions on container's label for use. ▪ Never use left out spray solution after 24 hours of its preparation. ▪ Do not mix granules with water. ▪ Do not smell the spray tank. ▪ Do not use overdose which may affect plant health and environment. ▪ Do not eat, drink, smoke or chew during whole operation of pesticides.
Selection of Equipments	▪ Select right kind of equipments. ▪ Select right sized nozzles. ▪ Use separate sprayer for insecticides and weedicides.	▪ Do not use leaky or defective equipments. ▪ Do not use defective/non-recommended nozzles. ▪ Do not blow/clean clogged nozzles with mouth. Instead use tooth brush tied with sprayer. ▪ Never use same sprayer for both weedicides and insecticides.

Sources: Farmer's portal - http://farmer.gov.in/IpmDoDont.aspx

Promotion of Biopesticides: There are several beneficial microbial and botanical extracts are function as suitable safe alternatives are available in the state. Efforts will be made to identify the suitable products and project will make special efforts and design strategies to promote the use at the farmer level. Following are the list of

registered Biopesticides under CIA, 1968 (Table 8). The potential sources to purchase the above products in Tamil Nadu are given in Table 9.

Table 8. List of Approved biopesticides – alternatives to chemical pesticides

No.	Name of the Biopesticide
1.	*Bacillus thuringiensis var. israelensis*
2.	*Bacillus thuringiensis var. kurstaki*
3.	*Bacillus thuringiensis var. galleriae*
4.	*Bacillus sphaericus*
5.	*Trichoderma viride*
6.	*Trichoderma harzianum*
7.	*Pseudomonas fluoresens*
8.	*Beauveria bassiana*
9.	NPV of *Helicoverpa armigera*
10.	NPV of *Spodoptera litura*
11.	*Neem based pesticides*
12.	Cymbopogan
13	*Verticilium lecanii*
14	*Metarhizium anisopliae*
15	*Ampelomyces quisqualis*
16	*Hirsutella thompsonii*

Source: http://cibrc.nic.in/

Table 9. List of firms producing Bio-pesticides and approved by TNAU for purchase

Department of Agricultural Microbiology, Agriculture College and Research Institute, Tamil Nadu Agricultural University Prof and Head MADURAI-625 104 (0452-422956 fax: 422785 e-mail: s_anthoniraj@yahoo.com	Biofertilizer Production Unit, Department of Agriculture, Govt. of Tamil Nadu Gundusalai Road, Sommandalam, CUDDALORE-607 001 (TN)
Biofertilizer Production Unit, Department of Agriculture, Govt. of Tamil Nadu Agricultural Chemist Sakkottai, THANTAVUR-612 401 (TN)	Biofertilizer Production Unit, Department of Agriculture, Govt. of Tamil Nadu Jamal Mohd. College Post, Khajamalai, TRICHY-620 020 (TN)
KRIBHCO Sidco Garment Complex, Thiruvika Industrial Estate, Guindy, CHENNAI-32	Regional Research Station Tamil Nadu Agricultural University, PIYUR-635 112 Via-Kaveripattinam Dharmapuri District (04343-50043

Monarch Bio-Fertilisers and Research Centre 12, SIDCO Industrial Estate, Thirumazhisai, CHENNAI-602 107 (TN) (6272780	Lakshmi Bio-Tech Nellikuppam Road, Thottapattu, CUDDALORE-607 109 (TN) (04142-210136
Biofertilizer Production Unit Agricultural Chemist, Biofertilizer Production Unit, Seelanaickenpatty, SALEM-636 201 (TN)	Tamil Nadu Agricultural University Prof. & Head Dept. of Agricultural Microbiology, COIMBATORE-3 (TN) (431222 ext. 294 Fax: 0422-431672 e-mail: vctnau@vsnl.com
T Stanes & Company Limited 8/23-24, Race Course Road, COIMBATORE-641 018 (TN) (0422-211514, 213515 Fax: 217432 e-mail: tstanes@vsnl.com	The SIMA Cotton Development and Research Association Shanmukha Manram, Post Box No. 3871, Race Course, COIMBATORE-641 018 (TN) (0422-211391 Tele-Fax: 0422-216798
Southern Petrochemical Industries Corporation Limited, SPIC Ltd. Biotechnology Division, Chettiar Agaram Road, Gandhi Nagar, Porur, CHENNAI-600 116 (TN) (044-4768064 Tele-Fax: 044-4767347 e-mail: biotech.por@spic.co.in	Biofertiliser Unit-Manali, Madras Fertilizers Limited Chief Manager –Bioproducts Commercial Group, Madras Fertilizers Ltd., Manali, CHENNAI-600 068 (TN) (044-5941001 ext. 2750 Fax: 5941010 e-mail: edcomm@mfl.tn.nic.in
Main Biocontrol Research Laboratory (Unit of Tamilnadu Cooperative Sugar Federation) 2E/1, Rajeshwari Vedhachalam Street, CHENGALPATTU-603 001 (TN) (04114-431393	Biofertilizer Production Unit, Agricultural Chemist, Biofertilizer Production Unit, KUDUMIAMALAI-622 104 Distt. Pudukkottai

Source: http://agritech.tnau.ac.in/org_farm/orgfarm_biofertilizertechnology.html#List