ANNEXURE VI:INTEGRATED PEST AND NUTRITION MANAGEMENT PLAN

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6.1 Introduction

The project interventions on improved irrigation may lead to agricultural intensification and associated use of agro-chemicals such as pesticides and fertilizers. Therefore, the EMF of the project includes a strategy to introduce Integrated Pest and Nutrient Management (IPNM) to the farmers in the project area. The project will support IPNM as the key strategy to enable farmers to combat pests, diseases and nutrient deficiencies. Effective implementation of IPNM practices will reduce the risk of water pollution through leaching of chemicals from farmlands to water sources, both surface and sub-surface.

6.2 Objectives of IPNM

IPNM seeks to promote and support safe, effective and environmentally sound pest and nutrient management.

The specific objectives relating to pest management are the following:

1. Minimize crop loss, augment farm production with scientific application of synthetic pesticides;
2. Reduce environmental pollution caused due to the application of synthetic pesticides;
3. Introduction and adoption of biological and cultural methods for managing pests below the Economic Threshold Level (ETL);
4. Reduction in health hazards arising due to chemical pesticides during handling;
5. Minimizing pesticide residues through the application of appropriate doses;
6. Promotion of bio pesticides.

The specific objectives relating to nutrient management are the following:

1. Improving and sustaining soil fertility and land productivity;
2. Reducing environmental degradation due to overuse of synthetic fertilizers;
3. Addressing nutrient deficiencies identified through systematic soil testing;
4. Introduction and adoption of organic methods for meeting plant nutrition needs.

6.3 Baseline Assessment

6.3.1 Agricultural Crops

Three season crop cultivation is observed in project districts. However, summer cultivation is limited only in 6 project districts and cultivated area is very insignificant with respect to Kharif and Rabi cultivation. Cereal, Pulses and vegetable are main crop types cultivated in project districts. Paddy is the main crop cultivated during kharif season whereas pulses and vegetable are cultivated during Rabi season. Oilseed is also cultivated in moderate amount during Rabi season. District wise (considering only 99 project blocks) as well as crop type cultivated area is tabulated below.

Table 1: Season as well as crop wise area cultivated (considering 99 project blocks)

District	Crop	Kharif (Ha.)			Rabi (Ha.)			Summer (Ha.)			Total (Ha.)		
		Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total
Balasore	Cereals	25041	62984	88025	3499	0	3499			0	28540	62984	91524
	Pulses				3000	1623	4623			0			
	Oilseeds				2232	670	2902			0			
	Vegetables	5119	9045	14164	9935	1184	11119			0	15054	10229	25283
Bargarh	Cereals	40476	38904	79380	2978	0	2978			0	43454	38904	82358
	Other cereals	566	0	566	163	0	163			0	729	0	729

District	Crop	Kharif (Ha.)			Rabi (Ha.)			Summer (Ha.)			Total (Ha.)		
		Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total
	Pulses	2113	19335	21448	0	5961	5961			0	2113	25296	27409
	Oilseeds	1666	9044	10710	618	1407	2025			0	2284	10451	12735
	Fibres	0	2004	2004	0	0	0			0	0	2004	2004
	Other crops	1189	1225	2414	1039	718	1757			0	2228	1943	4171
Bhadrak	cereals										84899	30039	115298
	Pulses										6493	6145	12638
	Oil seeds										2024	170	2194
	Fibre										345	0	345
	other crop										17088	533	17621
Bolangir	Cereals	30862	96633	127495	371	0	371	3393	0	3393	34626	96633	131259
	Coarse cereals	252	4482	4734	534	0	534				786	4482	5268
	Pulses	1914	50486	52400		53589	53589	1558		1558	3472	104075	107547
	Oil seeds	1290	7569	8859		5471	5471	6569		6569	7859	13040	20899
	Fibres		26408	26408								26408	26408
	Vegetables	3394	14295	17689	8516	2520	11036				11910	16815	28725
Boudh	Cereals			20810			760			0			21570
	Coarse Cereals			90			85			0			175
	Pulses			5110			6215			0			11325
	Oil seeds			1285			541			0			1826
	Fibres			90			0			0			90
	Vegetables			1580			3006			0			4586
	Spices			233			254			0			487
	Others			0			10			0			10
Gajapati	Cereals	2200	600	2800	97	0	97	203	0	203	2500	600	3100
	Coarse Cereals	221	5124	5345	24	0	24	16	0	16	261	5124	5385
	Pulses	0	2520	2520	0	535	535	0	0	0	0	3055	3055
	Oil seeds	0	435	435	216	159	375	40	0	40	256	594	850
	Fibre	0	100	100	0	0	0	0	0	0	0	100	100
	Vegetables	325	2105	2430	489	960	1449	231	0	231	1045	3065	4110
	Spices	0	1230	1230	27	45	72	13	0	13	40	1275	1315
Ganjam	Cereals	166707	20704	194360	75	0	75	705	0	705	174436	20704	195140
	Coarse Cereals	18447	31050	49497	1881	83	1964	867	33	900	21195	31166	52361
	Pulses	399	32999	33398	767	154793	155560	2285	27123	29408	3451	214915	207625
	Oilseeds	5659	16639	22298	10214	2033	12247	2513	11521	14034	18386	30193	48579
	Fibres	0	2960	2960	0	0	0	0	0	0	0	2960	2960
	Vegetables	30780	20265	52489	11315	6585	17900	12125	0	12125	55664	26850	82514
	Spices	2434	144	2578	2816	450	3266	0	0	0	5250	594	5844
	Others	0	0	0	0	0	0	2939	0	2939	2939	0	2939
Jajpur (includes all blocks)	Cereals	57450	66170	123620	2860	0	2860	0	0	0	60310	66170	126480
	Coarse cereals	970	2000	2970	100	0	100	0	0	0	1070	2000	3070
	Pulses	440	5170	5610	10530	56350	66880	0	0	0	10970	61520	72490
	Oil seeds	1240	1110	2350	31020	2560	33580	0	0	0	32260	3670	35930
	Fibres	1470	300	1770				0	0	0	1470	300	1770
	Vegetables	9080	2100	11180	12740	0	12740	0	0	0	21820	210	23920
	Condiments and Spices	880	450	1330	4520	0	4520	0	0	0	5400	450	5850
	Sugarcane	0	0	0	2070	0	2070	0	0	0	2070	0	2070
Kalahandi	Cereals	70560	97176	167736	30757	0	30757	0	0	0	101317	97176	198493
	Coarse cereals	5166	14766	19932	849	0	849	0	0	0	6015	14766	20781
	Pulses	0	68243	68243	3476	96756	100232	0	0	0	3476	164999	168475
	Oil seeds	1731	11660	13391	9338	20769	30107	0	0	0	11069	32429	43498
	Fibre	0	44174	44174	0	0	0	0	0	0	0	44174	44174
	Condiments & Spices	864	344	1208	2634	0	2634	0	0	0	3498	344	3842
	Sugarcane	0	0	0	1880	0	1880	0	0	0	1880	0	1880
Kandhamal	Cereals	4849	12546	17395	196	0	196	0	0	0	5045	12546	17591
	Coarse cereals	1208	4497	5705	37	0	37	0	0	0	1245	4497	5742
	Pulses	0	3940	3940	227	3568	3795	0	0	0	227	7508	7735
	Oil seeds	13	4642	4655	215	6560	6775	0	0	0	228	11202	11430
	Fibre	0	11	11	0	0	0	0	0	0	0	11	11
	Vegetables	2334	2750	5084	2717	0	2717	0	0	0	5051	2750	7801
	Condiments & Spices	83	6847	6930	141	0	141	0	0	0	224	6847	7071
Keonjhar	Cereals	58454	89667	148121	2974	0	2974	0	0	0	61428	89667	151095
	Coarse cereals	3005	18165	21170	165	0	165	0	0	0	3170	18165	21335
	Pulses	0	23040	23040	2578	37602	40180	0	0	0	2578	60642	63220
	Oil seeds	0	13691	13691	3293	10067	13360	0	0	0	3293	23758	27051
	Fibre	1420	1867	3287				0	0	0	1420	1867	3287
	Vegetables	10076	15595	25533	20489	0	20489	0	0	0	30565	15595	46160
	Condiments & Spices	994	2412	3406	4561	0	4561	0	0	0	5555	2412	7967

District	Crop	Kharif (Ha.)			Rabi (Ha.)			Summer (Ha.)			Total (Ha.)		
		Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total	Irrigated	Rain fed	Total
	Sugarcane	0	0	0	50	0	50	0	0	0	50	0	50
Mayurbhanj	Cereals	80411	147288	81072	1478	0	1478	3494	0	3494	85383	147288	232671
	Coarse cereals	0	206	206	0	0	0	0	0	0	0	206	206
	Pulses	1002	26848	27850	2250	29267	31517	98	0	98	3350	56115	59465
	Oil seeds	134	2732	2866	9547	10980	20527	1083	0	1083	10764	13712	24476
	Fibre	0	1670	1670	0	0	0	0	0	0	0	1670	1670
	Vegetables	13120	40429	53549	30054	5315	35369	0	0	0	43174	45744	88918
Nabarangpur	Cereals	13072	40032	53104	3075	0	3075	0	0	0	16147	40032	56179
	Pulses	0	3158	3158	390	825	1215	1186	0	1186	1576	3983	5559
	Oil seeds	0	0	0	452	0	452	0	0	0	452	0	452
Nuapada	Cereals	13464	24946	38410	810	0	810	0	0	0	14274	24946	39220
	Coarse cereals	0	2550	2550	0	0	0	0	0	0	0	2550	2550
	Pulses	0	19920	19920	0	14844	14844	0	0	0	0	34764	34764
	Oil seeds	4942	5483	10425	3750	359	4109	0	0	0	8692	5842	14534
	Fibre	40	3610	3650	0	0	0	0	0	0	40	3610	3650
	Any other	1513	1173	2686	3200	167	3367	0	0	0	4713	1340	6053
Subarnapur	Cereals	2870	10600	13470	250	0	250	100	0	100	3220	10600	13820
	Coarse cereals	10	50	60	2	0	2	0	0	0	12	50	62
	Pulses	1125	5085	6210	927	4098	5025	200	0	200	2252	9183	11435
	Oil seeds	40	349	389	270	380	650	150	0	150	460	729	1189
	Fibre	0	145	145	0	0	0	0	145	145	0	290	290
	Any other	726	644	1370	1200	50	1250	0	0	0	1926	694	2620

Source: District Irrigation Plan – 2016 <https://pmksy.gov.in/mis/rptDIPDocAllDistrict.aspx?SOBbuGJosmNKnx2PPqk1sJzoFivaooTkhWIoGMassifVYOaDyxFfOTOQQVKug6/bRGdOIMUHhda6BXFpRuVqJ/gY0o5s8TKm6RZxaceTGFWF3jwSakR9XdsPhEdtHrF3sqx1dN8wzkRu5ZW6tCcTZwfx19+4PaFNe/EgFF8t0idodIzpp+pMy3Ry+FUnn6x9>

6.3.2 Cropping Practices

It seems from response given by respondents that, adoption of SRI process of rice cultivation has gained momentum. Majority of farmers are well aware about SRI process of rice cultivation. However, practice of crop rotation is significantly low in sampled project area even after moderate knowledge on its potentiality to increase soil fertility. Mixed cropping and inter-cropping practice are also very low in sampled project area. Use of soil amendment to maintain soil pH level is found as one of best practices adopted by farmers of sampled area.

Table 2: Cropping practice and soil amendment

MIP	Block	Mixed cropping	Intercropping	Soil amendment	Crop rotation
Dhandamunda MIP, Nabarangpur	Chandahandi	Never	Never	No	Yes
Jallibandha MIP, Ganjam	Ganjam	Never	Never	Yes	No
Talakholaghai, Mohanpur MIP, Ganjam	Khallikote	Never	Never	No	No
Bisipur MIP, Mayurbhanj	Karanjia	Never	Never	No	No
Khaibandha MIP, Balasore	Nilagiri			Yes	No
Cradigappa MIP, Kandhamal	Daringbadi	Never	Never	No	1
Dandrabahal MIP, Bolangir	Patnagarh	Kharif	Never	No	No
Jamunasagar MIP, Kalahandi	Bhawanipatna	Kharif	Kharif	Yes	No

Source: Field study conducted by CTRAN Consulting

6.3.3 Agro-Chemical Use

Crops grown under various agro-climatic situation are affected by a large number of pests and diseases. Most often chemical control is being resorted to protect the crops to avoid crop losses. Besides adopting

situation specific need based Chemical control measures, Government is also providing IPM techniques, Seed Treatment campaigns, e-pest surveillance, etc.

6.3.3.1 Crop Disease and Pesticide Use

With changing climatic conditions, different type of pest attack is increasing[1] year by year. Pest attack has also increased and changing in these changing climatic conditions. To combat pest attack on standing crop, treatment of matured crop, fungicide and etc. and to increase productivity, pesticide use rate for different crops is increasing year on year basis.

Total pesticide consumption of whole state is increasing gradually year on year basis. Total fertilizer consumption for the state has increased almost by 1.5 times from 1.0 thousand MT in the year 2000-01 to 1.44 thousand MT in the year 2013-14. However, per hectare consumption rate ranges between 157- 169 Gms./Hect. during this long 14 years' time period. Consumption rate has jumped almost at 7% increase rate during 2011-12 to 2013-14 period[2].

Table 3: Year wise pesticide consumption in Odisha

Year	Total Consumption (in thousand MT)	Consumption (Gms./Hect.)
2000-01	1.00	157.00
2001-02	1.02	159.00
2002-03	1.03	139.00
2003-04	1.03	138.00
2004-05	0.99	148.68
2005-06	1.04	138.53
2006-07	1.10	148.94
2007-08	1.09	143.28
2008-09	1.16	149.10
2009-10	1.22	141.00
2010-11	1.18	159.00
2011-12	1.16	148.00
2012-13	1.21	158.00
2013-14	1.44	169.00

Source: Economic Survey 2014-15
<*http://www.indiaenvironmentportal.org.in/files/file/Odisha%20Economic_Survey_2014-15.pdf*>

Crops grown under various agro-climatic situation are affected by a large number of pests and diseases. Most often chemical control is being resorted to protect the crops to avoid crop losses. The details of pesticides consumption during 2013-14 for whole Odisha are as follows

Table 4: Pesticide consumption in Odisha during 2013-14

Sl. No.	Type of Pesticides	Consumption in MT		
		Kharif' 2013	Rabi' 2013-14	Total
1	Insecticides	470	213	683
2	Fungicides	120	67	187
3	Weedicides	57	49	106
4	Rodenticides	5	2	7
5	Plant growth regulators	6	7	13

[1]Source: <https://www.downtoearth.org.in/news/agriculture/pest-attacks-on-rise-across-india-yet-no-discussion-on-spurious-pesticides-59043><http://www.orissapost.com/farmers-face-double-whammy-after-dry-spell-pest-attack/
[2]Source: Source: Economic Survey 2014-15

Sl. No.	Type of Pesticides	Consumption in MT		
		Kharif' 2013	Rabi' 2013-14	Total
6	Neem based pesticides and bio-pesticides	130	93	223
	Total	788	431	1219
	Consumption (Gms./Hect.)	134	148	141

Source: Odisha Agriculture Statistics (2013-14)
<*http://agriodisha.nic.in/content/pdf/Agriculture%20Statistics_2013-14.pdf*>

Field Findings:

Sample MI tank wise crop diseases and used pesticides are listed down in below table. Use of bio-pesticides like Mangla Gold (Humic Substances Granules), GIM plus, Bio-20, Activzyme, Neem Oil and Biozyme are observed at Bolangir, Kalahandi and Bolangir districts. 7 out of 9 interviewed pesticide distributor/ retailer are familiar with India Govt. banned pesticides list and they have gained knowledge about banned pesticides from training programme organised by Dept. of Agriculture or newspaper or newsletter by pesticide company.

Table 5: Crop deseses and used synthetic pesticed at sample MI location

Name of MIP	Block	Disease	Synthetic Pesticide
Dhandamunda MIP, Nabarangpur	Chandahandi	Swarming caterpillar in paddy, BPH and BLB in paddy, Aphid and pod borer in arhar, downy mildew in blackgram, leaf curl virus in vegetables, root knot nematode of brinjal, fruit & shoot borer of brinjal, termite in mango	Monophosphate, Coelophysis, Buprofezin, Malathion, Monocrotophos (Ib)
Jallibandha MIP, Ganjam	Ganjam	Blast and brown spot diseases in paddy, sheathrot and sheath blight diseases in paddy, cercospora blight diseases in blackgram, swamping caterpillar attack on paddy, leaf spot diseases in green/ blackgram	Phaspa, Cypermethrin (II), Propanet, Quizolfop, Thiophanate-methyl, Mycozal, Tricyclazole (II), Mancozeb, Chloropyrophos, Imidachloropid
Bisipur MIP, Mayurbhanj	Karanjia	Leaf folder in paddy, blast and bacterial leaf bligh (BLB) of rice, rice caseworm and leaf folder attack, swarming caterpillar in paddy, brown plant hopper (BPH) in paddy, bacterial leaf streak and blight in rice, cercosporella blight disease in greengram/ arhar, black aphid in greengram/ arhar, stem borer in mango	Monocrotophos (Ib), Triacontanol, Chlorpyrifos (II), Dimethoate (II), Streptomycin, Endosulfan (II), Streptocycline, Mancozeb
Khaibandha MIP, Balasore	Nilagiri	Brown plant hopper (BPH) in paddy, flea beetle in black/Greengram, yellow mosaic virus (YMV) attack on blackgram/ greengram, leaf eating caterpillars on bitter gourd/ leafy vegetables, phomopsis blight of brinjal, black aphid of mango and brinjal	Copper oxychloride (II), Flonicamid, Chlorpyrifos (II), Mancozeb, Phaspa
Dandrabahal MIP, Bolangir	Patnagarh	Gundhy bug in paddy, blast and brown spot diseases in paddy, brown plant hoppers in paddy, pod borer in arhar, flea beetle in black/greengram, blister beetles in arhar, leaf eating caterpillars, Red pumpkin beetle in bitter gourd, leaf spot & blight of bitter gourd/ brinjal	Quizalofop (II), Nuvan, Ekalux, Metalaxyl (II), Streptocycline, Monophosphate, Imidacloprid (II), Cypermethrin (II), Monophosphate,
Jamunasagar MIP, Kalahandi	Bhawanipatna	Swarming caterpillar in paddy, stem borer in paddy, sheath blight/rot of paddy, flea beetle of black/ Greengram, leaf eating caterpillars in bitter gourd/ brinjal	Monocrotophos (Ib), Imidacloprid (II), Dichlorovinyl Dimethyl Phosphate (DDVP),

Name of MIP	Block	Disease	Synthetic Pesticide
			Buprofezin, Chlorpyrifos (II), Hexaconazole, Ekalux, Streptocycline, Jaggery
Kalimati MIP, Keonjhar	Harichandan pur	Blast, Bacterial leaf blight, brown spot, stealth blight, foot rot in paddy, wilting in sunflower, YMV and powdery mildew in green gram, YMV in black gram, Leaf blight and other fungal disease in Brinjal	Tricyclazole, Plantomycin, streptocycline, Carbendazim, mancozeb, chloropyrifosImidacloprid, Chloroquine Phosphate

Source: Survey conducted by CTRAN consulting during December, 2018.

Light trapping process of pest control has totally vanished in all sampled project area. However, few farmers are still practicing pheromone trapping process for selected Rabi crop. Almost 70 % respondents are practicing biological treatment of seed as pest control measures.

Table 6: Pest control measures

Sample MIP	Block	Pheromone trapping	Light trapping	Biological Treatment
Dhandamunda MIP, Nabarangpur	Chandahandi	Not Applied	Not Applied	For selected crop
Jallibandha MIP, Ganjam	Ganjam	For selected crop	Not Applied	For selected crop
Talakholaghai, Mohanpur MIP, Ganjam	Khallikote	Not Applied	Not Applied	Not Applied
Bisipur MIP, Mayurbhanj	Karanjia	Not Applied	Not Applied	Not Applied
Cradigappa MIP, Kandhamal	Daringbadi	Not Applied	Not Applied	Not Applied
Dandrabahal MIP, Bolangir	Patnagarh	Not Applied	Not Applied	For all crop
Jamunasagar MIP, Kalahandi	Bhawanipatna	Not Applied	Not Applied	For all crop
Kalimati MIP, Keonjhar	Harichandanpur	Not Applied	Not Applied	Not Applied

Source: Field study conducted by CTRAN Consulting

Issues:

- Pest attack is very common phenomenon in all sample project blocks.
- Pesticide consumption rate is increasing year on year basis in all project districts. Most of the farmers are well familiar with pesticide company's brand name but not aware of pesticide's generic name or constituent main chemical and recommended doge. They apply it as per recommendation of local distributor/ dealer/ retailer. However, few marginal farmers have obtained training or undergone awareness programme organised by Block level office of Agriculture Department.
- Most of the farmers are not aware about pheromone or light trapping process. Use of these old processes are diluting heavily because of easy availability of chemical pesticides which gives immediate solution.
- Use of bio-pesticides by farmers is very low in all sampled area. Farmers have not adopted use of bio-pesticides mainly because of slow effect wrt. chemical pesticides.
- Awareness level on WHO classified Ib and II pesticides is almost NIL among pesticides retailer as well as farmers.
- Use of WHO classified Ib and II pesticides is reported in all sampled project area.
- Farmers are moderately aware about detrimental effect of chemical fertilizer on soil fertility and health but now aware of other environmental consequence.

6.3.3.2 Fertilizer Use

The use of chemical fertilizers substantially improves the productivity and production of crops. Due importance is being given on balanced use of fertilizers in line with the Integrated Nutrient Management (INM) principles, which not only enhances production but also maintains the fertility of the soil. Fertilizer consumption for whole Odisha state in the year of 2013-14 during Kharif was 375.46 thousand MT and 111.68 thousand MT during Rabi season. While there was an increase in Kharif fertiliser consumption (12.3%) the Rabi consumption declined by 28.4% due to less supply of canal water and also the Phailin and Flash flood that inhibited farmers to go for intensive cropping[3]. The details of fertilizer consumption made by different project Districts are tabulated below.

Table 7: Project District wise fertilizer consumption

Project District	20006- 07				2013- 14				2016- 17				Consumption (Kg./ Hect.) - 2016-17
	(N)	(P)	(K)	Total	(N)	(P)	(K)	Total	(N)	(P)	(K)	Total	
Nawarangpur	12.3	2.7	2.4	17.3	26.8	8.2	6.5	41.6	23.3	8.4	4.0	35.7	152.2
Ganjam	22.5	4.8	4.3	31.7	29.7	5.9	2.5	38.0	26.3	4.2	3.0	33.6	56.9
Keonjhar	6.5	4.2	0.8	11.5	8.0	4.2	0.9	13.1	7.7	3.3	1.1	12.1	32.3
Mayurbhanj	11.4	4.7	1.9	18.0	14.2	5.3	1.7	21.2	15.0	5.0	2.0	22.0	42.3
Balasore	20.9	8.9	4.5	34.3	19.6	8.4	3.6	31.6	15.0	9.5	5.6	30.2	95.9
Bhadrak	14.2	7.2	2.8	24.2	11.6	6.7	2.0	20.4	13.0	7.7	3.6	24.3	121.4
Jajpur	9.8	3.6	1.9	15.3	9.4	3.7	1.8	14.9	9.6	3.9	2.5	16.0	65.0
Gajapati	3.1	0.8	0.2	4.1	3.3	1.3	0.5	5.1	3.3	0.8	0.3	4.4	34.9
Kandhamal	0.4	0.2	0.1	0.7	0.8	0.4	0.5	1.6	1.7	1.1	0.4	3.1	18.7
Bolangir	11.8	4.9	3.5	20.2	14.4	4.1	3.2	21.6	12.7	5.0	2.5	20.2	44.4
Bargarh	30.0	12.7	8.1	50.8	30.7	13.8	6.7	51.2	26.2	14.4	7.3	47.9	101.8
Boudh	5.5	2.4	1.0	8.9	4.6	1.5	0.4	6.6	4.1	1.6	0.7	6.4	48.9
Sonepur	5.1	2.0	1.0	8.1	7.1	2.8	1.2	11.1	6.1	2.4	1.6	10.1	48.5
Kalahandi	19.2	7.1	3.7	30.0	21.8	8.1	3.6	33.5	18.9	7.3	3.5	29.7	46.5
Nuapara	1.0	0.3	0.2	1.5	6.3	2.8	1.0	10.1	5.8	2.2	0.8	8.8	34.2
Total	173.6	66.6	36.5	276.7	208.2	77.3	36.1	321.7	188.8	76.9	38.8	304.5	

Source: Odisha Agriculture Statics (2013-14) <http://agriodisha.nic.in/content/pdf/Agriculture%20Statistics_2013-14.pdf
Note: N= Nitrogen, P= Phospetic and K= Potassium

- All units are in Thousand MT

Total fertilizer consumption in 15 project districts has decreased from 321.7 thousand MT in the year 2013-14 to 304.5 thousand MT in the year 2016-17. However, per hectare fertilizer consumption in 5 project districts (Nawarangpur- 152.2, Bhadrak- 121.4, Bargarh- 101.8, Balasore- 95.9 and Jajpur- 65.0) in the year of 2016-17 is more than state average consumption rate of 57.11 kg./hect. for the year 2013-14. Per hectare fertilizer consumption is almost three times at Nawarangpur and two times at Bhadrak district than state average consumption rate of 57.11 kg. / hect. in the year of 2013-14. Fertilizer

[3]Odisha Agriculture Statistics 2013-14

consumption rate is almost inline with state average in Gajam district where almost 46% of MIP are located.

Fertilizer consumption rate is relatively low in scheduled project districts – Gajpati, Kandhamal, Keonjhar, Mayurbhanj and Kalahandi except in Nawarargpur and Jajpur. Lowest consumption rate is reported at scheduled district Kandhamal (18.7 kg./hect.) followed by Keonjhar (32.3 kg./ hect.), Nuapara (34.2 kg./ hect.) and Gajapati (34.9 kg./ hect.).

NPK use ration in project districts in the year 2013-14 was 5.8: 2.1: 1 against state ratio of 5.5: 2.08: 1 in the same year. However, NPK use ration in the project districts for the year of 2016:17 was 4.9: 2: 1; indicates increase in use of Potassium based fertilizer.
Per hectare

Field Findings

Farmers of the project area mostly use Urea, NPK, DAP and MOP fertilizers. Consumption of urea is more than other fertilizers. Use of organic manure (farmyard manure, compost, green manure) is the oldest practiced means of nutrient replenishment. But due to increasing trend of using cow dung as fuel and using crop residue as animal feed, use of organic manure is reduced. People in command area of the project also used animal waste as organic manure for their crops. However, the use of organic manure is less than that of Mineral fertilizers. Use of bio-fertilizer is gaining popularity at snail pace mainly because of high input cost. Presence of vermi composting unit in surrounding villages is reported in 8 cases out of 11 sampled MI tank. Sampled MI tank wise fertilizer usages details are tabulated in table below:

Table 8: Sampled MI wise fertilizer use practice

MIP	Block	Used Fertilizer	Bio-Fertilizer Use	Presence of Vermin composting
Dhandamunda MIP, Nabarangpur	Chandahandi	Urea, Potash, DAP, Ammonia, Sulphate		Yes
Jallibandha, Ganjam	Ganjam	DAP, Urea, Potash, Anusar, Gromor, NPK	MicoLife, Fatra, Cow dung	No
Talakholaghai, Mohanpur, Ganjam	Khallikote	Urea, Potash, Gromor		Yes
Bisipur MIP, Mayurbhanj	Karanjia	DAP, Potash, Urea		Yes
Khaibandha MIP, Balasore	Nilagiri	DAP, Gromor, Super Potash, Urea	Annapurna, Godavari Gold, Mahashakti	Yes
Cradigappa, Kandhamal	Daringbadi	Urea, Potash, DAP, Super Potash, Gromor	Own Compost	Yes
Dandrabahal MIP, Bolangir	Patnagarh	Gromor, Urea, Potash, DAP, NPK, 20.20.0.13, 10.26.26, IPL Super, Ammonia Sulphate	Mangala Gold	No
Jamunasagar MIP, Kalahandi	Bhawanipatna	Urea 40 %, Potash 60 %, DAP (10.46), Gromor, 20.20.0.13 (NPK)	Seed Bed	Yes
Kalimati MIP, Keonjhar	Harichandanpur	DAP, Potash, Urea		Yes

Source: Survey conducted by CTRAN consulting during December, 2018.

Application of azolla /blue green algae as fertilizer is not reported in all sampled project districts. Other organic managing practices like green manuring and cultivation of N-fixing crops are practiced by almost 50% of respondents. However, bacterial culture treatment practice is significantly low among all respondents.

Table 9: Organic manuring practice

MIP	Block	Green manuring	Azolla /Blue Green Algae	Bacterial culture treatment	Cultivation of N fixing crops
Dhandamunda MIP, Nabarangpur	Chandahandi	Never	Not Applied	Selected Pulses	Occasionally
Jallibandha MIP, Ganjam	Ganjam	Annually	Not Applied	Not Applied	Regularly
Talakholaghai, Mohanpur MIP, Ganjam	Khallikote	Annually	Not Applied		Never
Bisipur MIP, Mayurbhanj	Karanjia	Never	Not Applied	Not Applied	Occasionally
Khaibandha MIP, Balasore	Nilagiri	Annually	Not Applied	Not Applied	Never
Cradigappa MIP, Kandhamal	Daringbadi	Annually	Not Applied	Not Applied	Never
Dandrabahal MIP, Bolangir	Patnagarh	Never	Not Applied	Not Applied	Regularly
Jamunasagar MIP, Kalahandi	Bhawanipatna	Never	Not Applied	All	Regularly
Kalimati MIP, Keonjhar	Harichandanpur	Never	Not Applied	Not Applied	Never

Key issues:

1. Unscientific application of fertilizer (higher doses). Fertilizer consumption in 5 project districts (Nawarangpur- 152.2, Bhadrak- 121.4, Bargarh- 101.8, Balasore- 95.9 and Jajpur- 65.0) in the year of 2016-17 is more than state average consumption rate of 57.11 kg./hect. for the year 2013-14.
2. Per hectare fertilizer consumption is almost three times more at Nawarangpur and two times more at Bhadrak district than state average consumption rate of 57.11 kg./hect. in the year of 2013-14.
3. Recommendation of Dept. of Agriculture on fertilizer use as per soil health card are not followed by most of the farmers;
4. Poor adoption of Integrated Plant Nutrient Management;
5. Input supplier to farmer extension which is more commercial and less technical;
6. Less use of organic manure in comparison to synthetic fertilizers
7. Less fertilizer efficiency and less adoption of fertigation method of application

6.4 Salient Features of the Project Approach

1. Popularizing IPNM approach among the farming community through awareness, training and exposure;
2. To play a catalytic role in transfer of innovative IPNM skills/methods/techniques to farmers through extension services;
3. Human Resource Development in IPNM by imparting training on IPNM to training of individual service providers, irrigation operators and farmers.

6.5 Major Activities under IPNM Promotion

Table 10: IPNM Strategy and Key Activities

Key Activities	Execution Strategy	Responsibility
Training of individual service providers and irrigation operators on IPNM.	Orientation training by crop type	Department of Agriculture & Farmers' Empowerment
Training of Farmers on IPNM through trained individual service providers and irrigation operators	Crop specific orientation on IPM in phased manner	
Developing IEC materials	IEC materials on crop specific IPNM in local language with visual display	

6.6 Capacity Building on IPNM

The project will adopt a cascading approach for the capacity building of farmers where resource persons will be developed through Training of Trainers (TOT) programme. The ground force available for irrigation management, specifically the individual service providers and the irrigation operator staff, will be trained on IPNM initiatives. They will provide support to farmers on IPNM in consultation with the local agriculture officer.

For capacity building, a need assessment related to IPNM will be done with the stakeholders, including mapping of current practices. Based on the findings of Training Need Assessment (TNA), relevant training modules and IEC materials will be developed covering crop specific IPNM practices (crops grown in different agricultural seasons). Trainings will be organized before the on-set of agricultural seasons, i.e., at least 30-45 days before sowing / planting. It will help the farmers to get acquainted with the IPNM and its adoption during actual cropping period. Hand holding support will be rendered to the farmers through the individual service providers and irrigation operators during different stages of crop growth. The capacity building activities plan is presented in thetable below.

Table 11:Capacity Building Activates & Follow Up

Capacity Building	**Project Villages**				
	Preparatory Stage	**Pre-Kharif**	**Kharif**	**Pre-Rabi**	**Rabi**
A. Preparatory Phase					
Assessment of Training Needs					
Preparation of Training Content					
Designing Training Modules / IEC Materials					
Piloting of the Training Materials					
Finalising Training Window / Session Plan					
Coordinate with Irrigation Operators and Individual service Providers					
B. Organisation Phase					
Training of Irrigation Operators and Individual service Providers					
Training of farmers					
C. Follow Up Phase					
Monitoring					
Field Guidance					

6.7 Monitoring of IPNM

Key monitoring indicators covering the capacity building efforts on IPNM will be assessed periodically as part of internal monitoring and periodic monitoring by third party.

Table 12:Monitoring of IPNM Promotion

Sl. No.	Activity	Monitoring Areas	Monitoring Indicators	Responsibility	Time Frame
1	Development of IPNM learning materials and its distribution to farmers / farmer's organisations	Learning materials cover crop specific IPNM practices	No. and type of learning materials developed	Department of Agriculture & Farmers' Empowerment	6 months from project inception
		Distribution of learning materials to individual service providers, irrigation operators and farmers	No. of farmers provided with IPNM related learning materials	Department of Agriculture & Farmers' Empowerment	1 month from printing of documents
2	Training and awareness creation	Training of individual service providers, irrigation operators and farmers on IPNM	No. of farmers of different holding categories trained on IPNM No. of individual service providers trained on IPNM No. of women farmers / tenants trained on IPNM	Department of Agriculture & Farmers' Empowerment	Annually throughout project duration

6.8 Details on Integrated Pest Management Practices

The Integrated Pest Management (IPM) Practices that will feed into the capacity building program on IPNM are detailed in this section.

6.8.1 Selection of IPM Methods Based on Assessment of Economic Threshold Level

The ETL differs by pest and also by crop types. Pest population is expected to be maintained at levels below those causing economic loss. It is generally assumed that pest tolerant capacity of different crops is limited and when it exceeds or approaching the ETL, chemical control methods can be used. Different pest / disease control methods of IPM will be applied based on the determination of ETL and pest density.

A priority list of different control methods of IPM is presented below.

Table 13:Adoption of IPM Methods & its Priority

IPM Procedures	Methods of Executing	Priority in Application
Cultural	Avoidance of monoculture Improved disease resistant varieties. Summer ploughing. Optimum plant densities. Avoiding excessive irrigation. Avoiding high nitrogenous fertilization.	To be given preference as preventive mechanism

IPM Procedures	Methods of Executing	Priority in Application
	Trap crops	
Biological	Conservation / promotion of bio agents like birds, parasites & pathogens for biological control of pests.	Second Priority
Mechanical	Damage/Destroying all the eggs of the insect; Destroy any material infested by insect, pest and diseases.	Third Priority
Chemical	Chemical Control when the loss is beyond ETL Use of recommended chemicals only	Last Priority when crop loss is beyond ETL

6.8.2 Criteria for Pesticide Selection and Use

The criteria to be followed for the selection and use of pesticides are (1) they must have negligible adverse human health effects, (2) they must be shown to be effective against the target species and (3) they must have minimal effect on non-target species and the natural environment. Secondly, the pesticides banned by Govt. of India should be avoided in the selection and use along with pesticides listed by WHO under Ia, Ib and II.

6.8.3 Pesticide Storage, Handling and Disposal

Precautionary Measures

When administering the pesticides, general precautions to be taken are as follows. Farmers will be educated / aware of taking required protective measures during administering pesticides.

Using Personal Protective Equipment: Personal protective equipment will prevent pesticides from coming in contact with the body or clothing. These also protect the eyes and prevent the inhalation of toxic chemicals. Personal safety gear includes clothing that covers the arms, legs, nose, and head. Farmers will be educated to wear gloves and boots to protect the hand and feet, and hats, helmets, goggles, and face masks to protect the hair, eyes, and nose. Respirators are used to avoid breathing dust, mist or vapour.

Body Wear: Body wear made of cotton are the best but should not be worn without additional protective clothing. When there is a chance of contacting wet spray, large sleeves with cuff-buttons, and pants with buttons at the bottom offer good protection. Aprons: Waterproof rubber or plastic aprons are effective. They should be long enough to protect the general clothing.

Head protection: Dust and mist settle easily on hair. Hats that are water resistant, wide brimmed with sweatbands are effective in protecting it. Many helmets provide attachments for face shields and goggles.

Eye Galss / Goggles: Farmers will be educated / oriented to protect their eyes from splashes, spills, mist, and droplets by using glasses / goggles. Goggles with plain lenses and full side shields are preferable. The lenses may become coated with pesticide droplets during spraying; hence cleaning tissues or an extra pair of goggles are a must.

Face shield: A face shield is a transparent acetate or acrylic sheet which covers the face and prevents it from splashes or dust. Face shields allow better air circulation and provide a greater range of vision than goggles

Hand and feet protection Gloves: Dermal exposure occurs the most in the hand region. The use of gloves reduces this risk. Gloves should be up to 2 to 3" long below the elbow i.e., they should extend to

the mid forearm. Waterproof gloves, such as those made of rubber, latex or PVC are preferable. After use, they should be discarded away from ponds, wells, and animals or even incinerated.

Footwear: Shoes made of rubber or synthetic materials like PVC and nitrite can be used to prevent dermal exposure of feet. Protective footwear should be calf-high and worn with the legs of the protective pants on the outside to prevent spray from getting in. Leather or fabric shoes should never be worn as they absorb pesticides. Shoes should be checked for any leakage or damage before use.

Respiratory equipment: A respirator is a device that offers protection to the lungs and respiratory tract. Different kinds of respiratory equipment are used based on the type and toxicity of pesticides. They include nose filters/disposable masks, cartridge respirators, canister-type respirators/gas masks, positive pressure breathing apparatus, self-contained breathing apparatus, and powered air cartridge respirator.

Safety in Application of Pesticides: Misuse of pesticides can be extremely dangerous. Apart from polluting the environment, they may prove fatal to human beings, animals, birds, and fish. Phytotoxicity often results when used in excess in plants. Judicious use, and careful and safe handling may prevent hazards. Safe handling of pesticides involves their proper selection and careful handling during mixing and application.

Safety during Application:

This reduces risk and prevents pollution. It also ensures safety to animals, which may be nearby. The following precautions may be taken while applying pesticides.

1. Wearing protective body cover / personal protective equipment (PPE) by the operator (hand gloves, mask like air purifying / air supplied etc.);
2. Spraying should be done in the windward direction, taking care to see that there are no animals, people, or animal feed nearby;
3. Applying correct dosage and avoiding use of higher dosages than recommended;
4. Checking the sprayer and spraying equipment for leaks before use, using properly maintained and functioning equipment.
5. While applying pesticide, restraining from taking food items, drink or smoke;
6. Do not blow, suck or apply the mouth to any sprayer nozzle or other spraying equipment.
7. Washing hands, face and other body parts with soap after spraying;
8. 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.
9. In case if any part of the body is exposed and come in contact with the pesticide, it should be washed-off immediately;
10. Change clothes immediately after spray and cleaning body properly.
11. Visit to doctor in case of feeling unwell.

Storage

Precautions to be taken in storing the pesticides are (1) keeping the place of storing of pesticides away from human and animals, (2) keeping away from water sources, (3) keeping at a height which should be out of reach of children, (4) keeping away from exposure to sunlight and moisture, (5) well ventilated place of storing, (6) well stacking to avoid of spillage, (7) away from food / consumable items / must not be stored with food items, and (8) the place of storage should be out of reach of children.

Transportation

Pesticides should be transported (1) in well-sealed and labelled containers, (2) should be transported separately, i.e. not with any other consumable items, cloths, drugs etc., (3) proper stacking to prevent leakage, (4) display of warning notice on the vehicle transporting pesticides, if transported in bulk with regular checking during transportation.

Disposal System

1. At the end of the day's work, the inside of the spray pump should be washed and any residual pesticides should be flushed out;
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 at disposal sites like pits or digs;
3. Pouring the remaining pesticides into surface water sources like stream, nala, rivers, wells or any drinking-water sources is strictly prohibited;
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 kept away from common approach space and should be returned to the designated organisation / individual for safe disposal. Re-use of empty insecticide containers will be prohibited. The used packages shall not be left outside to prevent their re-use. Used packages shall be broken and buried away from habitation.
6. While purchasing, date of manufacture and date of expiry will be reviewed, as per the print;
7. In case the stock remained unutilised and crossed the date of expiry, it should be returned to the supplier.

Table 14: Safety Precautions in different stages of application of pesticides

SN	Particulars	Safety Measures
1	Purchase	1. Always purchase only required quantity of pesticides and avoid bulk purchase; 2. Purchase as per the prescription of experts from Ag. Dept. / KVKs etc.; 3. Never purchase loose or unsealed containers. Purchase pesticides before the expiry date ends; 4. Don't purchase pesticides without proper label.
2	Storage	1. Avoid storage of pesticides in house premises or near grain storage; 2. Never keep any pesticide near food; 3. Keep all pesticides away from reach of children and livestock; 4. Don't expose them to sunlight for longer period; 5. Keep all pesticides in original container in intact seal;
3	Handling	Never transport any pesticides along with food material.
4	While preparing solution	1. Always use clean water; 2. Always protect your nose, eyes, mouth, ears and hands with clothes; 3. Use hand gloves; 4. Don't eat, drink, smoke or chew while filling the spray tank; 5. Don't smell pesticides; 6. Never mix granules with water except those wettable granules; 7. Avoid spilling of pesticides solution while filling the spray tank.
5	Equipment	1. Select right kind of equipment and nozzle; 2. Don't blow nozzle with mouth; 3. Don't use unwashed sprayer for weedicide or insecticide.

SN	Particulars	Safety Measures
6	While applying pesticides	1. Apply only recommended dose and spray solution; 2. Apply insecticides preferably in the evening. Avoid rainy or hot sunny or windy days; 3. Don't apply pesticides against the wind direction; 4. Thoroughly wash the sprayers & buckets with soap water after spraying; 5. Buckets used for spraying should not be used for domestic purpose; 6. Avoid entry of animals & workers in the field immediately after spraying.
7	Disposal	1. Left over spray solution should not be drained in to ponds / tanks / water bodies; 2. Should not be disposed off near open well / shallow wells or drinking water source; 3. Used empty containers should be crushed and buried deep in soil; 4. Never re-use empty pesticide container for any other purpose.

6.9 Major Insect Pests by Cultivated Crops and IPM Strategy

Table 15:IPM Strategy by Crop Type

Major insect/ pest	Diseases	IPM strategy
Paddy		
Stem borer Leaf folder Gall midge Green leaf hopper Hispa Mites Thrips Gundy bug	Bacterial leaf blight Leaf spot Leaf Blast Neck blast Stem rot Sheet rot Sheet blight False smut Dirty panicle	**Nursery:** 1. Raise pre-crop kharif grow Sesbania or sunhemp and incorporate 45 days old crop in soil during land preparation wherever possible. 2. Select suitable resistant or moderately resistant variety. 3. Use disease and insect free pure seed. 4. Seed treatment (for diseases) with carbendazim 50% WP @ 2 g/kg seed or Trichoderma/Pseudomonas @ 5-10 g/ha of seed for seed or soil borne diseases and carbosulfan 2 g/kg of seed for root nematodes or as per local recommendations. In termites, endemic areas, seed treatment with chlorpyriphos 20% EC @ 10000 ml/ha along with 10% solution of gum arabica @ 0.25 litre/100 kg seed along with 10% solution of gum Arabica in 3.75 litre of water just before sowing. 5. Timely planting/sowing. 6. Pre-sowing irrigation: Many weeds can be controlled by applying pre-sowing irrigation to area where nursery or seedlings are to be transplanted. The emerged weeds can be ploughed under. 7. Raising of healthy nursery. 8. As far as possible rice seedling should be free from weed seedlings at the time of transplanting. 9. Destruction of left over nursery, removal of weeds from field and cleaning of bunds. 10. Normal spacing with 30-36 hills/ m2 depending on the duration of the variety. 11. 30 cm alley formations at every 2.5 to 3 m distance in plant hopper and sheath blight endemic areas. 12. Balanced use of fertilizers and micro-nutrients as per local recommendations. Proper water management (alternate wetting and drying to avoid water stagnation) in plant hopper, bacterial blight and stem rot endemic areas. Maintain a thin layer of water on soil surface to minimize weed growth. 13. In direct sown rice, the crop should be sown in lines at

Major insect/ pest	Diseases	IPM strategy
		recommended spacing to facilitate inter-weeding operations. Mechanical methods of weed should be practiced after 2-3 weeks and second time if necessary after 4-6 weeks of sowing. 14. In nursery, spray Chlorantraniliprole (18.5SC) @200ml/Ha in 150-200ltl of water (Or) In the main field, between 15-20 DAT, as a prophylactic measure, apply granules of Chlorantraniliprole (0.4GR) @ 10kg/Ha. (Or) if the pest still persists, at ETL level repeat the spray Chlorantraniliprole (18.5 SC) @200ml/Ha in 150-200l of water. (Or) At both nursery stage and main field, at ETL spray Flubendiamide (40 SC) @125ml/Ha in 150-200lts of water. **Main Crop:** 1. Collection of egg masses and larvae of pest to be placed in bamboo cages for conservation of biocontrol agents. 2. Removal and destruction (burn) of diseased/pest infested plant parts. 3. Clipping of rice seedlings tips at the time of transplanting to minimize carryover of rice hispa, case worm and stem borer infestation from seed bed to the transplanted fields. 4. Use of coir rope in rice crop for dislodging case worm, cut worm and swarming caterpillar and leaf folder larvae etc. on to kerosinized water (1 L of kerosene mixed on 25 kg soil and broadcast in 1ha). 5. Trichogramma japonicum and T chilonis may be released @ 1 lakh/ha on appearance of egg masses / moth of yellow stem borer and leaf folder in the field. 6. Natural biocontrol agents such as spiders, drynids, water bugs, mirid bugs, damsel flies, dragonflies, meadow grasshoppers, staphylinid beetles, carabids, coccinellids, Apanteles, Tetrastichus, Telenomus, Trichogramma, Bracon, Platygaster etc. should be conserved. 7. Collection of egg masses of borers and putting them in a bamboo cage-cum-percher till flowering which will permit the escape of egg parasites and trap and kill the hatching larvae. Besides, these would allow perching of predatory birds. 8. Habitat management: Protection of natural habitats within the farm boundary may help in conserving natural enemies of pests. Management of farmland and rice bunds with planting of flowering weeds like marigold, sun hemp increases beneficial natural enemy population and also reduce the incidence of root knot nematodes. Provide refuge like straw bundles having charged with spiders to help in build up spider population and to provide perch for birds. 9. Spray Dinetofuran (20SG) @200ml/Ha in 150-200 lt of water. (Or) -Spray Pymetrozine (50WG) @300ml/Ha. (Or) Spray Buprofezin (25SC) @750ml/Ha in 150-200lt of water (for green leaf hopper); 10. Spray Spiromesifen (240SC) @500ml/Ha. (Or) Spray Spirotetramet (150 OD) @600ml/Ha in 150-200lt of water (for Mits). 11. Spray Spinosad (45SC) @ 187.5ml/Ha. (for Thrips) 12. Spray Streptocyclin @25gr/Ha. (Or) -Spray Propineb (70WP) @750gr/Ha. (Or) -Spray Mancozeb (75%WG) @1250gr/Ha. (Or) Spray Azoxystrobin (23SC) @750ml/Ha. (Or) -Spray Picoxystrobin (250EC) @320ml/Ha. (Or) -Spray Pyraclostrobin (250EC) @300ml/Ha. (Or) -Spray Kresoximmethyl (50WG) @312.5gr/Ha. (for diseases like bacterial leaf blight, leaf spot, leaf blast); 13. Spray Pencycuron (250SC) @ 187.5ml/Ha. (Or) Spray Thifluzamide (240SC) @375ml/Ha. (Or) Spray Validamycin (3L) @1000ml/Ha. (for sheet blight);

Major insect/ pest	Diseases	IPM strategy
		14. Spray Azoxystrobin (23SC) @750ml/Ha. (Or) Spray Picoxystrobin (250EC) @320ml/Ha. (Or) Spray Pyraclostrobin (250EC)@300ml/Ha. (Or) Spray Kresoximmethyl (50WG) @312.5gr/Ha. (for false smut); 15. Spray Azoxystrobin (23SC) @750ml/Ha. (Or) Spray Picoxystrobin (250EC) @320ml/Ha. (Or) Spray Pyraclostrobin (250EC) @300ml/Ha. (Or) Spray Kresoximmethyl (50WG) @312.5gr/Ha. (for Dirty Panicle)
Groundnut		
Aphids Jassids Thrips Leaf Miner Gram pod borer Tobacco caterpillar Groundnut white grub Termite Groundnut Bruchid	Collar rot Stem rot Dry root rot Yellomold	**Monitoring for Pest & Disease** Community level monitoring to know change in destruction and abundance of pest Organise regular pest monitoring and assess bio control potential at every 5 to 10 km distanc randomly. Use pheromone traps for monitoring Spodoptera/Helicoverpa and leaf miner. **Pre-Sowing stage** Deep ploughing in summer. Partial or complete lopping of host plants and retaining of preferred host trees in area of white gr Crop rotation with sorghum/pearl millet or maize. Early sowing. Collection and destruction of white grub adults. Installation of 12 light traps/ha or bonfire against Red Hairy Caterpillar **Sowing stage** Two hand hoeing at 20 days and 35-45 days after sowing for effective weed control. Stray planting of cowpea or soybean (for leaf miner) castor and sunflower for S. /itura as trap cr Soil application of castor cake @ 1000 kg/ha or neem cake against stem rot. Continue with light trap or bonfire against RHC. Collection and destruction of egg masses of RHC in the fields around light-trap areas. Seed treatment with Carbendazim @ 4g/kg OR Trichoderma viride, T. harzianum @ 4 g/kg seed **Vegetative stage** Rouge out bud necrosis affected and chump infected plants. Irrigate once. Continue with light trap or bonfire and mechanical collection of RHC egg masses/caterpillars. Install one pheromone trap per ha. for monitoring or 5 trap/ha for mass trapping of Spodoptera. Collection and destruction of- early stage larvae of Bihar hairy cater pillar. Collection and destruction of white grub adults from jujube or neem trees around the field. Install per ha.10-12 bird perches. Two hand or mechanical weeding at 15-20 days after sowing. Release egg parasite, *Telenomusremus* @ 50000/ha, 4 times (7-10 days interval) against Tobacc Spray SNPV @ 250LE or B.t @ 1 kg/ha for controlling defoliators. Spray Carbendazim @ 375 g a.i./ha or 2 gm of Chlorothalanil/lit for control of leaf spots and rus Spray Quinalphos @ 1250 ml/ha to control hairy caterpillar. **Flowering stage** Collect and destroy egg masses and early instar larvae of S. litura. Continue Pheromone trap @ 1/ha for monitoring or 5/ha for mass trapping of S. litura Spray neem based formulation @ 2%. Release *Trichogrammachilonsis* (50000/ha) twice and *Cheilomenussexmaculata* (1250/ha twice) **Fruiting stage** Collect egg masses and early instar larvae of S. litura. Spray neem based formulation @ 2%.

Major insect/ pest	Diseases	IPM strategy
		Spray SNPV @ 250 LE/ha or B.t. 1 kg/ha on need basis. No chemical control applied at the maturity stage. **Storage** Store the pods in polythene lined gunny bags and fill the top of the bags with sand. Mouth of bags not be closed to avoid germination loss. Harvest at optimum maturity stage to avoid pod infection.
Greengram/ Blackgram		
Pod borer Spotted pod borer Spiny pod borer Blue butterfly	Bacterial leaf blight Powedry mildew Rust Yellow mosaic	**Mechanical control methods** Remove and destroy stem fly damaged seedlings Pest and Disease Management: Organic Ecosystem Pull out plants manifesting symptoms of sterility mosaic, yellow mosaic, leaf curl and leaf crinkle virus disease since they will serve as a source of inoculum spread by sucking pests Collect eggs, larvae, pupae and adults of the insects to the extent possible to reduce their population (leaf feeding caterpillars, beetles, weevils, grasshoppers etc.) Burn the crop residues after harvest. **Cultural control methods** Sow good and healthy seeds In stem fly endemic areas use a higher seed rate to the extent of 25 - 30% to compensate the loss of seedlings Maintain the fields and bunds free from weeds Avoid crops susceptible to some pests either as mixed crops or in crop rotation Provide T shaped bird perches Grow castor along the borders to trap S.litura, marigold to trap H.armigera and cowpea to trap stem fly. The plant density should not exceed 30 - 35 / sq.m. If it exceeds it creates favourable microclimate suitable for the multiplication of pests and diseases. **Botanical control methods** Spray NSKE (5%) or neem oil (3%) alternatively (aphid, mite, whitefly) **Biological control methods** Spray specific NPV suspensions of H. armigera and S. litura in the evening hours **Behavioural control methods** Set up sex pheromone traps to attract and kill male moths of Helicoverpaarmigera and Spodopteralitura. Set up five traps per acre from floral bud formation and change the septa once in 3 weeks Use of light trap to monitor and kill the attracted adult moths of tobacco cut worm.
Cabbage / Cauliflower		
Diamond back moth; Tobacco caterpillar; Stem borer; Cabbage aphid	Damping-off and wire stem; Downy mildew; Alternaria leaf spot; Bacterial black rot	**Nursery Stage**: 1. Prepare raised nursey beds about 10 cm above ground level for good drainage to avoid damping off etc.; 2. Follow soil solarisation for 2-3 weeks using 0.45 mm thick polythene sheet. Sufficient moisture should be present in the soil for solarization; 3. Treat the soil with neem cake at 50 g / m2 impregnated with 10-15 g effective strain of Trichoderma; 4. Seed treatment with effective strain of Trichoderma @ 4 g / kg seed to manage rots. Seedling dip for 30 min with Trichoderma viride 1 % WP @

Major insect/ pest	Diseases	IPM strategy
		10 g / lit water to manage collar rot in cabbage can also be followed; 5. Need based soil drenching with captan 75 WP @ 0.25 % or captan 75 WS @ 0.3 % to manage damping off; 6. Spray NSKE 5% for management of H. undallis which appears in rainy season nursery sometimes. **Main Crop**: 1. Adopt wide spacing of 60 x 50 cm to reduce the spread of diseases; 2. Growing of Indian mustard as trap crop after every 25 rows of cabbage. (One row of mustard is sown 15 days before cabbage planting and second 25 days after planting of cabbage). First and last row should be of mustard; 3. Mustard traps 80-90% of diamond back moth (DBM) population and other pests like aphids. Spray fenvalerate 5 % EC @ 300 ml / ha in 600 lit water to manage DBM in trap crop mustard. 4. Spraying of B. thuringiensis var.kurstaki 5 WP @ 50 g a.i./ ha or 3 gm / litre at 10 DAP for DBM; 5. Installation of light traps / bulb @ 3 / acre for DBM. Adults are attracted to light trap and fall in water bucket. Within 3-4 days most of the adults get killed; 6. Release egg parasitoid Trichogrammatoideabactrae at 1.0 lakh / ha 3-4 times at weekly interval (optional) 7. Spray mancozeb 75 WP or zineb 75 WP @ 1.5-2 kg / ha in 750-1000 lit water to manage leaf spot; 8. Removal of basal and infected leaves to reduce Alternaria leaf spot and bacterial black rot of early stage; 9. Spray Neem Seed Kernal Extract (NSKE) 5% or malathion 50 EC @ 1500 ml / ha in 1000 lit water for stem / head borer. Spray NSKE 5% at primordia formation (18-25 DAP-head initiation stage - most critical stage) for DBM control. Repeat, if DBM is >1 / plant at 10-15 days interval. Maximum of 3-4 NSKE sprays in one crop season are required. When NSKE are sprayed, thorough coverage of the entire plant surface is must. Use sticker with spray. This will control aphids as well as tobacco caterpillar. 40 kg / ha of NSKE powder is required; 10. Need based spray of spinosad 2.5 SC @ 600 ml or novaluron 10 EC @ 750 ml / ha in 500-1000 lit water for DBM control; 11. Spray acetamiprid 20 SP @ 75 g ha in 500-600 lit water for aphids in late cauliflower; 12. Installation of yellow sticky traps for trapping winged aphids; 13. Collection of egg masses and larvae of tobacco caterpillar as they are gregarious in nature. Scout for papery patches & apply baits; 14. Set up sex pheromone traps @ 5 / ha for mass trapping and to monitor the activity of adult moths; 15. Spray SlNPV @ 250 LE / ha (2x109 POB) 2-3 times in evening with jiggery 2% when larvae are young; 16. Need-based spray of cyantraniliprole 10.26 OD @ 600 g / ha in appr. 500 lit water for tobacco caterpillar;
Brinjal		
Hadda beetle; Aphids; Leaf roller; Leaf hopper; Shoot and fruit borer; Mites (Red spider	Damping off; Phomopsis blight and fruit rot; Little leaf; Root-knot nematode	**Nursery Stage**: 1. Green manuring with sunhemp / Dhaincha in July-August; 2. Raised seed bed about 10 cm above ground level for good drainage to avoid damping off etc.; 3. Cover the nursery beds with polythene sheet of 45 gauge (0.45 mm) thicknesses for three weeks during June for soil solarisation which will help in reducing the soil borne insects, diseases like bacterial wilt and

Major insect/ pest	Diseases	IPM strategy
mite); Nematodes		nematodes. However, care should be taken that sufficient moisture is present in the soil for its solarization; 4. Seed (5 g / kg seed), nursery (250 g in 50 lit water drenched over 400 sq. mt area) and seedling root dip (1% for 15 min) treatment with Trichoderma viride 1 % to manage damping off or root rot etc. and need based soil drenching with captan 75 WP @ 0.25 %; 5. Selection of fruit borer resistant varieties / hybrids. **Main Crop**: 1. Setting up of yellow sticky / Delta traps @ 2-3 / acre for white fly; 2. Give 2-3 sprays of NSKE 5% at weekly interval for the control of sucking pests and leaf folder; 3. If incidence of white fly and other sucking insect pests is still above ETL, apply diafenthiuron 50 WP @ 600 g / ha in 500-750 litres water or spiromesifen 22.9 SC @ 400 ml / ha (mites) in 500 lit water; 4. Pheromone traps @ 100 / ha should be installed for monitoring and mass trapping of shoot & fruit borer moths. Replace the lures with fresh lures after every 15-20 days interval; 5. Clipping of damaged shoots from time to time in initial stages; 6. Bird perches @ 10 / acre should be erected; 7. Sprays of NSKE also brings down the borer incidence significantly. Neem oil (Azadirachtin based 1%) application is also helpful in reducing borer infestation, though marginally; 8. Release egg parasitoid T. brasiliensis @ 1-1.5 lakh / ha for shoot & fruit borer, 4-5 times at weekly interval; 9. Apply neem cake @ 250 kg / ha (in two splits) in soil along the plant rows at 25 and 60 DAT for reducing nematodes and borer damage. Don't apply neem cake when there is heavy wind velocity or temperature is above 30^0 C.; 10. Need-based alternate sprays of chlorantraniliprole 18.5 SC @ 200 ml / ha in 500-750 lit water or emmamectin benzoate 5 SG @ 200 g / ha in 600 lit water at 15 days interval effectively controls shoot & fruit borer; 11. Collection & destruction of little leaf affected plants, phomopsis blight affected fruits & field sanitation; 12. Spray zineb 75 WP @ 1.5-2 kg / ha in 750-1000 lit water or carbendazim 50 WP @ 300 g / ha in 600 lit water to manage Phomopsis blight and leaf spot diseases; 13. Continuous cropping of brinjal leads to more borer and bacterial wilt infestation. Therefore, crop rotation with non-solanaceous crops may be followed. 14. The commonly seen natural enemies of pests in brinjal cropping system should be protected from unwanted and excessive sprays of chemical pesticides.
Bitter gourd		
Mites, Aphid, Bettle Fruit fly Catterpillar	Powdery Mildew, Downy mildew	**Cultural control:** Deep ploughing of fields during summer. Soil solarization: Cover the beds with polythene sheet of 45 gauge (0.45 mm) thickness for three weeks before sowing for soil solarization which will help in reducing the soil borne pests. **Biological control:** Apply neem cake/pongamia cake @ 100 kg/acre in soil at the time of last

Major insect/ pest	Diseases	IPM strategy
		plouging or reducing nematodes, and soil dwelling pests. • Apply Trichoderma spp. @ 2.5 kg/acre along with FYM Conserve predators such as Pennsylvania leather wing beetle (Chauliognathuspensylvanicus); larvae of which feed on pumpkin beetle larva. • Conserve parasitoids such as Celatoriasetosa (grub) • Spray NSKE 5% **Chemical control:** Apply trichlorfon 5% GR @ 200 g/acre or trichlorfon 5% DUST @ 200 g/acre Generally cucurbit crops require 40: 32: 24 kg N: P: K/acre Apply N in two splits first one (50%) at 25 days after sowing. Apply entire P and K at the time of sowing. Micro nutrient deficiency should be corrected by foliar spray of particular nutrient. To maintain the sex ratio (more number of female flowers), spray borax @ 1 g/l at 2-4 leaf stage
Mango		
		Physical Method 1. Removal and destruction of affected and fallen fruits due to fruit fly and fruit borer infestation 2. Destruction of affected shoots due to shoot borer infestation along with larvae in young orchards. 3. Remove the dead and weak branches in order to reduce the inoculum of various pathogens. 4. Keep the stalks of the fruit clear by removing dried rachis, small leaves which harbor the disease and pests inoculums. Remove the unfruited panicles to avoid scratching injury to fruits, put dried leaves in between adjacent fruits. 5. Ploughing/weeding or digging of the soil under tree canopy. This will expose the hibernating pupae of gall midge and other pests like fruit borer, fruit fly etc. 6. Avoiding overcrowding of the laterals and foliage as it develops the favourable microclimate for pest and disease build up. 7. It also prevents the penetration of the pesticide sprays which invites the pest resurgence due to residual population. Therefore, proper thinning/centre opening should be done and trees be kept open and well aerated. **Cultural Method** • The neem products particularly Nimbicidine @ 2 ml/lit can control 50 to 60% hopper population and hence it can be used during lean periods of outbreak right from the bud burst stage and thereafter in 10 to 15 days interval, so that hopper build up will be checked without disturbing natural enemies like red ants, spiders and lace wing bugs and coccinellids which

Major insect/ pest	Diseases	IPM strategy
		are common predators in mango garden. **Chemical Method** • For blossom protection, use 5ml Fenvalerate 20 EC or 9ml Decamethrin 2.8 EC or 20ml Quinalphos 25 EC or 1.2 g Clothianidine 50 WDG or 1.0 g Thiomethoxam 25 WDG or 20 ml Phenthoate 50 EC per 10 lit of water. • Midge : Fenitrothion (0.05%) • Thirps :Phosalone (0.05%) if intensity is more apply Thiomethoxam 25% 2gm or Spinosad 45% 2.5 ml/10 lit. • Mealy bugs : DDVP (0.05%) during advance stage of fruit development • Shoot borer: Quinalphos • The trees and branches when cut, invites the stem borer problem. Therefore, cut portions should be treated with pesticide and applied with Bordeaux mixture **Biological Method** • Glyricidia is a major host of mealy bugs, *Ferissiavirgata* which is predominant species of mealy bugs in Konkan region. The incidence was noticed in the month of March. Therefore, the population of mealy bugs on glyricidia should be monitored form March onwards and if noticed, glyricidia stumps should be chopped off and destroyed. • Explore the possibility of releasing, *Cryptolemusmontrizerae*, a potential predator of mealy bugs during second fortnight of March as spray schedule will already be exhausted by this time and hence, there is no hurdle in establishment of predator population.
Marigold		
Aphids Bettle& Weevils Leaf Hopper Red spider mites	Wilt & stem rot Collar rot Leaf spot & blight Powdery mildew	Spraying of Phosphamidon 0.02% at 10-15 days interval helps to check the population of the aphids. Spraying of systemic insecticides like Roger @ 2 ml/ litre of water on the under surface of the leaves effectively controls the insects. Sprayings of Quinalphos (0.05%) as soon as the pest infestation is observed. Spraying of miticides like Kelthane (2 ml/litre of water) or Dicofol (0.1%) is effective against the mites. Soil treatment with captan, mancozeb and Fosetyl-Al Spraying Sulfex(3g/Litre of water) and Mancozeb(2g/ litter of water) Soil sterilization by Formalin @ 2% before sowing and spraying of Dithane Z-78 @ 2g/liter of water

***Note**: In the changing scenario, consultations will be made with local SAUs, KVKs, Agriculture Dept. on recommended package of practices for IPM in crops that are specific to a particular geographical area / project location.*

6.10 Details on Integrated Nutrient Management Practices

The Integrated Nutrient Management (INM) Practices that will feed into the capacity building program on IPNM are detailed in this section.

INM embraces soil, nutrient, water, crop, and vegetation management practices, tailored to a particular cropping and farming system. The INM aims at improving and sustaining soil fertility and land productivity and reducing environmental degradation. It optimizes the condition of the soil, with regard to its physical, chemical, biological and hydrological properties, for the purpose of enhancing farm productivity, while minimizing land degradation. It not only provides tangible benefits in terms of higher yields, but also conserve the soil resource.

INM also contributes to pest management. Stressed crops are more susceptible to disease and to the effects of pest attacks. Crops growing in poorly structured soil, under low or unbalanced nutrient conditions or with inadequate water supply will be stressed. Responding to disease or pest attacks by applying pesticides is a costly symptomatic approach to a syndrome which is better addressed by improving the ecological conditions and systems within which the crops are cultivated.

INM practices combine use of inorganic, organic and biological resources in a reasonable way to balance efficient use of limited resources and ensure ecosystem sustainability.

At the farm level, integrated and synergistic approach will be adopted under INM, 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 favourable 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, rhizobial N-fixation, Phosphorous and other nutrient uptake;
7. Efficient fertiliser use with application of appropriate quantities and method of application to minimizes losses (for example, rather than broadcasting, project will educate farmers to apply fertilizer into the soil directly).
8. 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;

9. Crop rotation, agro-forestry and soil restorative practices that maintain and enhance the soils physical properties thereby encouraging root development and rainfall infiltration;
10. Promotion of crop-livestock system in project clusters as a part of integrated nutrient management strategy;
11. Nutrient monitoring during growing stage by using colour chart and application of nutrients accordingly.