Agro-ecology specific interventions/technologies recommended for doubling agricultural income in Champawat

Agro-ecological region: Region A (up to 1000 m)

A.General information about Agroeco-region
District: Champawat
Agro-ecological region: Region A (up to 1000 m) (Babhar)
Main Blocks in Region: Champawat
Main village cluster in blocks: Bastia, aam bag, chandani, phagpur, garikot, Chalthi, Belkhat
Irrigated Clusters: Chandani, Phagpur, Bastia
Rainfed Clusters: Belkhat,Deori, Jhalakudi
Existing rain water management facilities: Tube well, Canal irrigation

B. Productivity Enhancement

1. Specific Action / Interventions recommended for harvesting and management of rain water in specific agro-ecological region

1. Roof water harvesting system & Poly tank for water storage for rainfed area Check dams and irrigation channels for irrigation,
2. Tube wells, Drip/sprinkler irrigation system
3. Seed Replacement and improved package and practices.

2. Existing practices for soil health improvement

1. Inadequate quantity of fertilizer
2. Shortage of compost

3. Specific Action / Interventions recommended to improve soil health in specific agro-ecological region

1. Bio-fertiliser/soluble fertiliser based farming
2. Soil test based fertilizer application
3. Promotion of pulse based crop rotation
4. Integrated nutrient management
5. Maximum use of value added compost/FYM
6. Green manuring

4. Existing crop cultivation strategy being adopted under changing climatic condition: No contingencies plan is used by farmers

5. Specific strategy to be adopted for doubling productivity under changing climatic conditions in the agro-ecological region

1. Use fodder crop i.e Lobia, Barseem, Fodder maize, sorgam as supplementary crop
2. Sowing of radish /leafy vegetables as cash crop
3. Plantation of citrus / pome granate/Mango/litchi
4. High yielding and hybrid varieties of wheat and paddy
5. Cultivation of vegetable

6 A. Name of Field Crop: Wheat

i. Existing varieties being used: PBW-343, PBW-373 PBW-502, Mixed, Local,UP-2572

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: PBW-550, DBW-17,UP-2628, UP2585, HD-2967, UP-2572, VL Gehun 829, VL Gehun 892, VL Gehun 907, VL Gehun 953 and UP 2572

iii. Existing package of practices being used:

1. Preperation of land- 1 or 2 ploughing with local plough no definit depth
2. Seed rate and seed sowing -100-120 kg/ha, Broad casting
3. Manure and fertilizer- use of un decomposed FYM and un decomposed FYM with

improper doses of chemical fertiliser as per availability

4. Irrigation- 3 or 4 irrigation

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Preparation of land-** 2 ploughing + 1 harrowing with mould bold plough upto 10-15 cm
2. **Seed rate and seed sowing** -100-125kg/ha, line sowing 18-21 apart
3. **Manure and fertilizer-** 10-15 tonne FYM, NPK 100-120:60:40, 50-60:30:20 with micronutrients.
4. **Irrigation**-As per irrigation facility 1irrigation at CRI, late jointing stage and 1 at flowering stage.

v. Major insect pests associated with crop: Armyworm,Termites, Aphids

vi. IPM Module for management of insect pests(except organic areas):

Army Worm, *Mythimna separata*

1. Avoid late sowing of crop to save crop from armyworm.
2. Spray in afternoon any of the following insecticides after diluting in 500 litre of water/ha when 4-5 larvae are recorded per meter row:
3. Monocrotophos 36WSC 1500ml/ha
4. DDVP 76EC 500ml/ha
5. Quinalphos 25 EC 1000ml/ha

Aphids (*Macrosiphum (Sitobion) avenae* or *Macrosiphum miscanthi*)

1. Avoid late sowing of crop to save crop from aphid.
2. Conservation and enhancement of biocontrol agents like coccinellid beetles, Chrysopa, syrphid, Apanteles etc. protects the crop against aphid attack.
3. Spray any of the following insecticides after diluting in 500 litre water/ha when more than 5 aphids are recorded per ear head:

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Thiamethoxam 25% WSG	50	21
Quinalphos 25 %EC	1000	

Termites: *Microtermes obesi* and *Odontotermes obesus*)

Name of the Insecticides	**(gm/ml) /ha**
Thiamethoxam 30% FS (Seed Treatment/Kg)	3.3 per Kg

vii. Major disease associated with crop:

Brown spot Loose smut, Yellow rust

viii. IPM Module for management of disease:

Loose smut: *Ustilago nuda* f.sp. *tritici*

Sticker @ 1 ml per liter of water must be applied along with chemical pesticides to improve the effectiveness of chemical. For control of loose smut seed treatment with fungicide.

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Carbendazim 50% WP (Seed Treatment/Kg)	1.0	2.0
Carboxin 75% WP (Seed Treatment/Kg)	1.5-1.9	2-2.5
Tebuconazole 2% DAS	0.02	1.00
Difenoconazole 3% WS	0.06	2.0

Biofungicides

Name of the Herbicides	**g/Kg seed or g/lit. water**	**Treatment**

Pseudomonas fluorescens 1.75% WP (In house isolated Strain Accession no. MTCC 5176)	5 g/Kg seed 5 g/lit. water	**Seed Treatment:** Mix the required quantity of seeds with the required quantity of *Pseudomonas fluorescens* 1.75% WP formulations and ensure uniform coating. Shade dry and sow the seeds. **Foliar spray:** Dissolve 5 Kg of *Pseudomonas fluorescens* 1.75% WP in 1000 litres of water and spray.

Yellow rust=stripe rust: *Puccinia striiformis=Puccinia glumarum*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Propiconazole 25% EC	500	30

ix. Major weeds associated with crop: *Phalaris minor*, grassy and non grassy weeds, broad leaf weeds

x. IPM Module for management of weeds:

Dwarf canary grass: *Phalaris minor* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Clodinafop Propargyl 15% WP	400	110
Diclofop methyl 28% EC	2500-3500	90
Fenoxaprop-p-ethyl 10% EC	1000-1200	110
Isoproturon 50% WP	2000	
Isoproturon 75% WPs	1330	60
Methabenzthiazuron 70 %WP (PE: 2DAS)	1500-2000	100
Methabenzthiazuron 70 %WP (POE: 16-18DAS)	1000-1250	100
Metribuzin 70% WP (Medium soil)	250	120
Metribuzin 70% WP (Heavy soil)	300	120
Pendimethalin 30% EC(Light soil)	3300	
Pendimethalin 30% EC (Medium soil)	4200	
Pendimethalin 30% EC (Heavy soil)	5000	
Pinoxaden 5.1 %EC (POE: 30-35DAS)	800+900	90
Sulfosulfuran 75%WG	33.3	110
Clodinafop Propargyl 15%+ Metsulfuron methyl 1% WP	400	100
Fenoxaprop-p-ethyl 7.77%+Metribuzin 13.6%EC	1250	110
Mesoulfuron methyl 3%+ Iodosulfuron methyl 0.6 %WG	400	96
Sulfosulfuran 75%+Metsulfuron methyl 5%WG	40	110

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Wheat-Rice
2. Timely Sowing, Seed treatment, Use of HYV
3. Maximum use of value added compost/FYM/neem coated urea and NPK
4. INM and soluble fertiliser
5. Integrated weed management

6. IPM
7. Good storages conditions
8. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM,
2. climate changing,
3. Wild animal damages
4. Inadequate Irrigation facilities

6B. Name of Field Crop: Rice

i. Existing varieties being used: Govind, HRK-47, PR-113. PR-114, NDR-359

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:
Pant Shankar dhan -1, Pant Basmati-1 &2, Hybrid rice, PR-113. PR-114, NDR-359 VL Dhan 65, VL Dhan 85 and Vivek Dhan 154, Pant Dhan-19, HKR-127, PB-1509, PA 6444, VNR 2355, Pusa Basmati 1509 & PRH 10

iii. Existing package of practices being used:

1. Preparation of land- 1 - 2 ploughing with local plough, no definit depth, Manual puddling
2. Transplanting 60-70 kg/ha
3. More than 45 days seeding used
4. Manure and fertilizer- use of un decomposed FYM (, undecomposed FYM 1.5-2.0qt./nail) with inadiquate doses of chemical fertiliser

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preperation of land- 1 or 2 ploughing with local plough , puddling
2. Transplanting rice 40-50 kg/ha, basmati20kg/ha,hy 20kg/ha 25-30days seeding used
3. Manure and fertilizer- -15 tonne FYM , NPK 100-120:60:40,
4. Use of pre and post emergence tp herbicide, rainfed- pre emergence,Use of IPM practcices

v. Major insect pests associated with crop: Stem borer, Rice leaf folder, Rice bug**,** Rice Hispa

vi. IPM Module for management of insect pests(except organic areas):

Stem borer:

1. In the stem borer endemic area raise the nursery away from light source.
2. Raise nursery in narrow strip and mechanically destroy egg masses and moths
3. Remove seedling with Stem borer eggs before transplanting.
4. Use nitrogenous fertilizer moderately and split the application of it over three growth stages to reduce the damage.
5. For the monitoring install the pheromone traps in the field at the rate of 3 trap per acre at a distance of 60 m in a triangular pattern and record the males trapped daily to access the peak population.
6. For the management of yellow stem borer through pheromone mediated mass trapping of male install the pheromone trap in field at the rate of 20 traps/ha in rows maintaining a distance of 20 and 25 meters between traps and rows, respectively. The traps in the first rows are installed 10 m inside from the boundary of the field. The traps are tied on 1.25-1.5m long straight bamboo sticks or poles with the help of jute or plastic strings.The lures containing 3 and 5 mg pheromone are changed after 3 and 4 week, respectively, whereas 10 mg lure work for whole season. Adjust the trap height at 0.5 m and 1.0 m in the early vegetative and reproductive stage of crop, respectively, or 30 cm above crop canopy in all the stages of the crop.To check the escape of trapped males put a tea spoonful insecticidal dust in the polythene sleeve of dry sleeve trap. Dust is not required in funnel type trap. To Ascertain the quality use lures supplied by 2-3 manufacturers in alternate traps initially and

after recording their performance replace the ineffective lures by highly effective lure. Relocate the traps displaced in bad weather and replace the polythene sleeve damaged by weather or animals.

7. Mass rearing and release of some parasitoids such as different species of *Trichogramma* have not been found useful in the rice ecosystems in so many countries including India which are inhabited by *Telenomus* and *Tetrastichus* species. Use of trichocard, therefore, increases the cost of cultivation without any gain. The conservation of *Telenomus* and *Tetrastichus* species is self sufficient to naturally reduce the stem borer population.
8. To increase the effectiveness of parasitoides and predators in the rice field
9. Conserve and enhance the natural enemies which are already present in the field.
10. Create favourable condition for natural enemies.
11. Always leave a pest residue in the field at non-economic level, for natural enemy.
12. Reduce the harmful effect of pesticides on natural enemy by:
    I. Apply insecticide only when necessary, not regularly.
    II. Apply insecticide only when the pest population reaches Economic Threshold Level.
    III. Applying a selective insecticide which is less toxic to natural enemy.
    IV. Apply the minimum doses of insecticide toxic to pest and least toxic to natural enemy.
    V. Use selective formulation and application method.
    VI. Application of granular formulation is less harmful to natural enemy
13. Following insecticides may be used to control stem borers of rice when the population or damage of pest is recorded to 1 moth or 1 egg mass/ m^2 or 5% dead heart :

50 Days within transplating (2 inch water in field)

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 0.4 %GR	10000	53
Fipronil 0.3% GR	16670-25000	32
Cartap 4% Gr	18750	
Carbofuron 3% CG	33300	
Carbosulfon 6% G	16700	37

50 Days after tranplanting

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5 %SC	150	47
Fipronil 5% SC	1000-1500	32
Fipronil 80 %WG	50-62.5	19
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75 %SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20% WG	125	30
Thiacloprid 21.7 %SC	500	30
Acephate 75% SP	666-1000	15
Acephate 95 %SG	592	30
Chromafenozide 80% WP	94-125	32
Monocrotophos 36% SL	1400	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Carbosulfon 25 %EC	800-1000	14
Chlorpyriphos 20% + Acetamiprid 0.4%	2500	10

EC		
Phosphamidon 40% + Imidachlorpid 2 %SP	600-700	22
Flubendamide 4%+ Buprofezin 20% SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Bio-Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	

Leaf folder:

Following insecticides may be used to control leaf folders of rice

50 Days within transplating (2 inch water in field)

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 0.4% GR	10000	53
Cartap 4% Gr	18750	
Carbosulfon 6% G	16700	37

50 Days after transplating

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC	150	47
Indoxacarb 15.8 %EC	200	14
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75% SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20 %WG	125	30
Chromafenozide 80% WP	94-125	32
Fipronil 80%WG	50-62.5	30
Acephate 75 %SP	666-1000	15
Acephate 95 %SG	592	30
Monocrotophos 36 %SL	1400	
Dichlorovos 76% EC	627	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Quinalphos 25 %EC	1000	40
Flubendamide 4%+ Buprofezin 20 %SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Bio-insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5

Azadirachtin 5% (Neem extract concentrate containing)	375	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	
Beauveria bassiana 1.15%WP Strain BB-ICAR-RJP	2500	
Beauveria bassiana 1.15%WP Strain ICAR	2500	

Rice hispa: *Dicladispa armigera*

Name of the insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Triazophos 20% EC	1250-2500	40
Chlorpyriphos 20 %EC	1250	30
Quinalphos 25 %EC	2000	40

Rice bug: *Leptocorysa acuta*

Name of the insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Methyl parathion 2% DP	500	25000

vii. Major disease associated with crop: Khaira, rice blast , brown spot , bacterial leaf blight, sheath blight

viii. IPM Module for management of disease:

During Nursery Sowing

Deep summer ploughing or soil solarisation

Seed bio priming with bio-control agent (PS @10g/kg seed) or fungicide (Carbendazime 1g/kg seed)

Fertilizers

Basal: Nitrogen= 30 Kg/ha

P2O5= 60 kg/ha

K2O = 40 kg/ha

Zinc sulphate 25kg/ha

After 30 days crop stage Nitrogen= 50 kg/ha

At Panicle initiation = 40 kg/ha

Khaira disease: Due to Zinc deficiency)

Name of the Fungicides	**(gm/ml) /ha**
Zinc sulphate (Apply in soil at the time of plot preparation)	25000
Zinc sulphate spray (2.5 Kg Quick lime & 20 Kg Urea in 1000 lit. water	5000

Sheath blight: *Rhizoctonia solani*

1. Drain of water to check spread of sheath blight.

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Carbendazim 50 %WP (Seed Treatment)	2	
Carbendazim 50 %WP	250-500	
Propiconazole 25% EC	500	30
Hexaconazole 5% EC	1000	40
Hexaconazole 5% SC	1000	40
Difenoconazole 25% EC	0.05%	25
Flusilazole 40% EC	300	24
Tebuconazole 250% EC (25.9%)	750	10
Validamycin 3% L	2000	14
Iprodione 50% WP	2250	35

Pencycuron 22.9% SC	150-188	600-750
Thifluzamide 24% SC	375	28
Cresoczim-methyl 44.3 %SC	500	30
Tebuconazole 50% +Trifloxystrobin 25% WG	200	21
Carbendazim 12%+Flusilazole 12.5 %SE	800-960	54
Iprodione 25% + Carbendazim 25% WP	500	
Propiconazole 13.9%+ Difenoconazole 13.9% EC	0.07-0.1%	46
Tebuconazole 50% +Trifloxystrobin 25% WGs	200	31

Biofungicides:

Name of the Bio-fungicides	**(gm/lit) /ha**	**Treatment**
Trichoderma viride 1% WP (Strain T-14 in house isolate of M/s Indore Biotech Inputs and Research (P) Ltd., Indore)	5 -10 gm/lit water	Foliar spray: Mix 2.5 Kg of *Trichoderma viride* 1% WP in 500 lit. of water. Spray three times at 15 days interval uniformly over one hectare land 30 days after planting.

Rice blast: *Magnaporthe grisea*

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Picoxystobin 22.52% SC	600	12
Isoprothiolan 40 %EC	750	60
Tricyclazole 75% WP	300-400	30
Tebuconazole 25% WG	750	10
Idifenphos 50% EC	500-600	21
Carpropamid 27.8 %SC	500	
Cresoczim-methyl 44.3 SC	500	30
Hexaconazole 5% EC	1000	40
Casugamycin 3 %SL	1000-1500	30
Carbendazim 50 %WP	250-500	
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Tebuconazole 50% +Trifloxystrobin 25% WG	200	31
Carbendazim 12%+Mancozeb 63% WP	750	57
Azoxystrobin 18.2% + Difenoconazole 11.4%SC	0.1%	5

Bacterial leaf blight: *Xanthomonas oryzae*

1. Do not planting under full or partial shade to avoide bacterial blight (BLB) infection.
2. After bacterial blight infection of drain the water from field and stop the application nitrogenous fertilizer.
3. Drain of water to check spread of bacterial blight

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Streptocyclin (Seed Treatment)	40ppm	

Streptocyclin (Nursary Treatment)	40-100ppm	
Streptocyclin (Spray)	15	Local recommendation
Copper hydroxide 53.8% DF	1500	10
Copper hydroxide 50 %WP	500	Local recommendation

Biofungicides

Name of the Bio-Fungicides	**gm/Kg seed**	**Treatment**
Pseudomonas fluorescens 1.5% WP (BIL-331 Accession No. MTCC 5866)	5 gm/Kg seed	**Seed Treatment:** Make a thin paste of required quantity of *Pseudomonas fluorescens* 1.5% WP with minimum volume of water and coat the seed uniformly, shades dry the seeds just before showing.

Brown leaf spot: *Cochiobolus miyabianus*

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Propineb 70 %WP	1500-2000	
Idifenphos 50% EC	500-600	21
Captan 75% WP	1000	

Biofungicides

Name of the Bio-fungicides	**Kg /ha**	**Treatment**
Pseudomonas fluorescens 1.5% WP (BIL-331 Accession No. MTCC 5866)	2.5 Kg/ha	**Seed Treatment:** Make a thin paste of required quantity of *Pseudomonas fluorescens* 1.5% WP with minimum volume of water and coat the seed uniformly, shade dry the seeds just before sowing.

ix. Major weeds associated with crop: *Echinochloa* sp.*, Ageratum conyzoids, Chenopodium album*

x. IPM Module for management of weeds:

Jungle rice: *Echinochloa colonum, E. crusgali* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Anilofos 30% EC (Transplanted rice)	1000-1500	30
Anilofos 18% EC (Transplanted rice)	1660-2500	
Anilofos 2% G (Transplanted rice)	20000-25000	30
Bispyribac Sodium 10% SC (Nursary)	200	
Butachlor 50% EC (Transplanted rice)	2500-4000	90&120
Butachlor 50% EW (Transplanted rice)	2500-3000	
Butachlor 5% G	25000-40000	90&120
Chlorimuron ethyl 25% WP (Transplanted rice)	24	60
Clomazone 50% EC (Transplanted rice)	8000-10000	90
Cyhalofop butyl 10% EC	750-800	90
2,4-D Ethyl Ester 38% EC	2500	

2,4-D Ethyl Ester 4.5% GR (Transplanted rice)	25000	
Fenoxaprop-p-ehtyl 9% EC (Transplanted rice)	625	70 Post
Fenoxaprop-p-ehtyl 6.9% EC	812-875	61
Flufenacet 60% DF (Transplanted rice)	200	90-110
Orthosulfamuron 50% WG (Transplanted rice)	150	65 Pre
Oxadiargyl 80% WP (Transplanted rice)	125	97
Oxadiargyl 6% EC (Transplanted rice)	1066	97
Oxadiazon 25% EC (Transplanted rice)	2000	
Oxyflourfen 0.35.5% GR (Transplanted & Direct sown)	30000-40000	
Oxyflourfen 23.5% EC (Transplanted & Direct sown)	650-1000	
Pendimethalin 30% EC (Transplanted & Direct sown)	3300-5000	
Pendimethalin 5% G (Transplanted & Direct sown)	20000-30000	
Pretilachlor 37% EW (Transplanted rice)	1500-1875	90
Pretilachlor 30.7% EC (Wet Direct Seeding)	1500-2000	110
Pretilachlor 50% EC (Transplanted rice)	1000-1500	75-90
Anilofos 24%+ 2,4-D ethyl ester 32% EC	1000&1500	90 (Transplanted rice)
Bensulfuron methyl 0.6% + Pretilachlor 6 G	10000	88(Transplanted rice)
Clomazone 20%+ 2,4- D ethyl ester 30% EC	1250	110 (Transplanted rice)
Cinmethylin 10% EC (Transplanted rice)	750-1000	60
Paraquat dichloride 24% SL (Before sowing)	1250-3500	

Goat weed : *Ageratum conyzoides* (annual, dicot, broad leaves,leafy)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Paraquat dichloride 24% SL (Before sowing)	300-800	125-350

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorimuron Ethyl 25% WP (Transplanted rice)	24	60

xi.Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Timely Sowing/Trans planting, Seed treatment,
2. Use of HYV, Hybrid (120-125days), Basmati (120-125days)

3. Maximum use of value added compost/FYM
4. INM and soluble fertiliser
5. Integrated weed management
6. IPM
7. Good storage condition
8. Sale of value added products
9. Avoid early Nursery raising practice and use of 21-30 days old seedling

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages,
5. Poor Irrigation facilities

6C. Name of Field Crop: Finger millet

i. Existing varieties being used: Band mutthi(Garhwali mandua), Khuli muthi(Kumaon mandua)

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL Mandua 324, and VL Mandua 352, PRM1

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. undecomposed FYM 1.0-2.0qt./nali,
3. 1-2 weeding

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preperation of land- 2 or 3ploughing ,
2. Seed rate and seed sowing -14-16kg/ha, Gapfilling/Transplating
3. Manure and fertilizer- -10 tonne FYM , NPK 20:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide (As per moisture availability), rainfed- pre emergence,Use of IPM practices

v. Major insect pests associated with crop: Stem borer

vi. IPM Module for management of insect pests: Spray of Fipronil 5 SC @1lt./ha or Chloropyriphos 20 EC @ 2.5 lt./ha

vii. Major disease associated with crop: Blast

viii. IPM Module for management of disease:

1. Grow resistant variety such as VL 149
2. Seed treatment with carbendazim @ 1g/kg seed followed by 2 sprays of carbendazim @ 0.1% (first when 50 per cent ear heads are formed and second 10 days later)
3. For organic farming seed treatment with Bioagents like T. harzianum @ 10g/kg seed followed by 2 sprays of same @ 10g/litre of water (first when 50 per cent ear heads are formed and second 10 days later).

ix. Major weeds associated with crop: *Oxalis latifolia, Phyllanthus niruri, Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp, *Cyperus* sp

x. IPM Module for management of weeds:

1. First hand weeding after 10 to 20 days of germination
2. Broadcast of Isoproturan @0.75 kg/ha

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,

2. Adoption of low-cost based cultivation practices,
3. Fingermillet- Wheat/Lentil/Barley/oat (fodder) (rainfed), Fingermillet+Horsegram/Soybean-Wheat/Lentil/Barley/ oat (fodder) (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV, Gapfilling/Transplating
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing, wild animal damages
4. Migration, poor Irrigation facilities

7A. Name of the Pulse crop: Lentil

i. Existing varieties being used: Chota masur, Lal masur

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Pant Lentil-4 & 5, PL-7, PL-8, VL Masoor 125, VL Masoor 126, VL Masoor 507, VL Masoor 514

iii. Existing package of practices being used:

1. Traditional seed variety, Un decomposed FYM 1.5-2.0qt./nali,
2. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing– 20-25kg/ha, spacing 30*10cm
3. Manure and fertilizer- 10 tonne FYM , NPK20:40 :20,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence
6. Use of IPM practices

v. Major insect pests associated with crop: - Gram Pod-borer

vi. IPM Module for management of insect pests:

Gram Pod-borer, *Helicoverpa (=Heliothis) armigera* (Hubner)

Apply any of the following insecticides in 500 litre in gram and 600-800 litre water in red gram per ha:

Name of the Insecticides	**(gm/ml) /ha**
Chlorantraniliprole 18.5% SC	125
Indoxacarb 15.8 %EC	500
Emamectin benzoate 5 SG	220
Monocrotophos 36 WSC	1000
Quinalphos 25 EC	1250
Deltamethrin 2.8 EC ml	400-500

Donot repeat the same active ingredient to check the development of resistance

vii. Major disease associated with crop: wilt

viii. IPM Module for management of disease: Seed Treatment with

Trichoderma,Fortification of FYM with *Trichoderma*

ix. Major weeds associated with crop: Grassy and non grassy weeds, broad leaf weeds

x. IPM Module for management of weeds: Weeding within 40-50 DAS. Foliar spray of Pendimithaline after sowing

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Horse gram/Soybean- Lentil (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV,
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs
2. Use of imbalance and un decomposed FYM
3. Climate changing
4. Wild animal damages
5. Migration
6. Poor Irrigation facilities
7. Water scarcity
8. Wild animals
9. Lack of mechanization
10. Lack of rain water harvesting structures

7B. Name of Pulse/oilseed Crop: Soyabean

i. Existing varieties being used: Kala bhatt(Oval), Pahari soybean, VLS 47, PS-1092

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VLS 47, VL Soya 59, VL Soya 63, VL Soya 65 and PS-1092

iii. Existing package of practices being used:

1. Traditional seed variety,
2. Undecomposed FYM 1.0-2.0qt./nali.
3. No use of chemical fertilizer
4. 1-2 manual weeding.
5. No use plant protection measures

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Preparation of land-** 2-3 ploughing followed by planking ,
2. **Sowing time-** Ist fortnight of June
3. **Seed rate and seed sowing** – 75-80 kg/ha, line to line spacing- 45 cm
4. **Manure and fertilizer-** -Well decomposed FYM @5-10 tonnes/ha , NPK 20:60:40 and seed treatment with bio fertiliser
5. **Irrigation**-usually maximum area is rain fed
6. **Weed control –** Two manual weeding at 20-25 and 40-45 DAS is quite effective for weed control. Herbicides i.e. Alachlor 50 Ec 4 lt/ha at 0-3 DAS, Imazethapyr 10SL @100 gm

a.i./ha At 15-20DAS.

7. Use of IPM practcices

v. Major insect pests associated with crop: Semi looper, Defoliators, Leaf miner, Girdle beetle, Bihar hairy catter piller,White fly

vi. IPM Module for management of insect pests:

Cultural practices: The cultural practices make the environment less favorable for the pests and more favorable for its natural enemies. The following are cultural practices recommended for the management of soybean insect pests.

1. Removal and destruction of infected stubbles followed by deep summer ploughing destroys the pupae of stem fly, girdle beetle, pod borer and tobacco caterpillar present in the soil.
2. Optimal fertilizer dose of NPK and S @ 20:60-80: 30-40:20 kg/ ha should be applied.
3. Application of excessive dose of nitrogen fertilizer causes the infestation of all insect pests on soybean.
4. Crop rotation with non-leguminous plants is recommended for the management of leaf miner.
5. Inter-cropping of soybean with either asafetida (*Ferula assafoetida* L.) or maize or sorghum in the sequence of 4 rows of soybean with 2 rows of intercrop should be practiced. These intercrops help in conservation of bio–control agents, like coccinellid beetles, Chrysoperla etc. In girdle beetle and semilooper endemic areas, intercropping with maize or sorghum should be avoided.
6. Planting of trap crops like castor for tobacco caterpillar, ground–nut for leaf miner, marigold for pod borer and Dhaincha (*Sesbania sesban*) for girdle beetle.
7. Selection of insect resistant or tolerant varieties for cultivation.

Table1: Resistant or tolerant varieties for insect pests of soybean.

Insect pest	Resistant or tolerant variety
Stem fly	Dsb 25, Himso 1685, JS 20-89, MACS 1370, MACS 1410, NRC 97, JS 20-53,PS 1543, SL 983, Dsb 23-2
Girdle beetle	MACS 1410, Dsb 23-2, Himso 1685, JS 20-89, KDS 726
Defoliators	Dsb 23-2, KDS 726, PS 1543, PS 1569
Pod borer	Dsb 25, SL 683, NRC 97, MACS 1370, JS 20-89
Leaf miner	MACS 1370, Himso 1685, MACS 1370, MACS 1410
Pest complex	DS 2708, Dsb 23-2, Dsb 25, Himso 1685, JS 20-53, JS 20-79, JS 20-89, KDS 726, MACS 1370, MACS 1410, NRC 97, SL 983, PS 1543

Mechanical Control: Reduction of insect pest population by means of manual devices or labour is called mechanical control. The following measures are recommended for mechanical practices for soybean insect pests.

1. Collection and destruction of girdle beetle infested plant parts, egg masses and gregariously feeding larvae of Bihar hairy caterpillar and tobacco caterpillar.
2. Hand picking and mechanical destruction of matured pod borer larvae.
3. Erection of bird perches @ 10-12/ha to attract predatory birds for preying on defoliator larvae.

Physical control: Reduction of pest population by using device which affect them physically or alter their physical environment. Manipulation of temperature, humidity, light is used for this purpose. This includes the following:

1. Light traps should be placed at ground level early in the season for collection and destruction of the leaf-miner moths.
2. Installation of light traps in the field for monitoring and collection of adult moths.

Biological Control: The successful management of a pest by means of another living

organism (parasitoids, predators and pathogens) is called biological control. The following biological control agents are used in IPM of soybean.

1. Release of *Tricogramma chilonis* @ 50,000/ ha four times at weekly interval against *S. litura*.
2. Spraying of *Bacillus thuringiensis* var. kurstaki @ 0.75 to 1.0 kg/ha for the management of defoliators.
3. Foliar application of HaNPV (*Helicoverpa armigera* Nuclear Polyhedrosis Virus) for *H. armigera* @ 250 LE/ha.
4. The major predators of soybean insect pests are given in the table 2.

Table 2: Major predators of insect pests of soybean

Insect pests attacked	Predator
Whiteflies	Lady bird beetles: *Coccinella septumpunctata* *Coccinella transversalis*
Lepidopterous caterpillars	Pentatomid bug *Eocanthecona furcellata*
Lepidopterous caterpillars and Whiteflies	Spiders: *Lynx* spider and Orb weaver spider

Chemical Control: The control of insects with pesticides/insecticides is known is chemical control. The insecticides are applied only when the population of insect pests crossed the Economic Threshold Level (ETL) (Table 3). The list of insecticides recommended for soybean insect pests are given in table 4.

Table 3: Economic Threshold Level (ETL) of soybean insect pests

Insect Pest	Crop stage	Population/ meter
Green semilooper	Flowering	2 larvae
Tobacco caterpillar	Flowering	4 larvae
Girdle beetle	Flowering	10 % infestation
Pod borer	Podding	3 larvae

Table 4: List of insecticides recommended for soybean insect pests

Insect pest	Insecticide	Dosage
Sucking pests, stem fly	Thiamethoxam 30 FS (Seed treatment)	10ml/kg seed
Sucking pests	Acetamiprid 20 SP	100 ml/ha
Sucking pests	Spiromesifen 22.9 SC	600ml/ha
Sucking pests	Imidacloprid 17.8 SL	500 ml//ha
Sucking pests and girdle beetle	Triazophos 40 EC	800ml/ha
Defoliators	Dichlorovos 76EC	500 ml/ha
Defoliators and pod borer	Quinalphos 25 EC	1500 ml/ha
Sucking pests and defoliators	Monocrotophos 36 SL	800 ml/ha
Pod borer	Indoxacarb 15.8EC	333 ml/ha
Defoliators, stem fly and girdle beetle	Chlorantraniliprole 18.5 SC	150 ml/ha
Leaf miner	Carbaryl 50WP	2.0 kg/ha
Leaf miner and sucking pests	Oxydemeton methyl 25EC	350 ml/ha
Girdle beetle	Phorate 10 G	10 kg/ha
Stemfly and girdle beetle	Carbofuran 3 G	30 kg/ha

Bio-insecticides

Tobacco caterpillar (*Spodoptera litura*)

Name of the Bio-Insecticides	(gm/ml)/ha
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

***Hairy caterpillar* (*Spilosoma obliqua*)**

Name of the Bio-Insecticides	(gm/ml)/ha
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

Semilooper (*Chrysodeixis acuta*)

Name of the Bio-Insecticides	(gm/ml)/ha
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

Soyabean leaf miner (*Odontota horni*)

Name of the Bio-Insecticides	(gm/ml)/ha
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

vii. Major disease associated with crop: YMV, leaf spot, blight, Collar rot, rust

viii. IPM Module for management of disease:

Maintain proper drainage condition in field.

Deep summer ploughing

Rust: *Phakopsora pachyrhizi*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Hexaconazole 5% SC	500	30
Propiconazole 25% EC	500	26

Collar rot: *Sclerotium rolfsii*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Carboxin 37.5%+ Thiram 37.5% DAS	3.0/Kg	Seed Treatment

ix. Major weeds associated with crop : *Oxalis latifolia, Phyllanthus niruri ,Amaranthus viridis, Euphorbia hirata, Solanum* sp.

x. Production constraints in agro-ecological region:

1. Apply Trifluralin 48%EC @ 1.0 kg a.i/ha as pre plant incorporation.
2. Apply Alachlor 50%EC @ 2-2.5 kg a.i/ha or Pendimethalin 30%EC @ 0.75-1.0 kg a.i/ha or Pendimethalin 30% EC + Imazethapyr 2% EC @ 0.75+0.05 kg a.i/ha or Metribuzin 70%WP @ 0.35-0.525 kg a.i/ha or Diclosulam 84% WDG @ 22-26 g a.i/ha within 3 days after sowing.
3. Apply Quizalofop- ethyl 5%EC @ 0.0375-0.05 kg a.i/ha or Fenoxaprop-p-ethy l 9.3% EC 0.1 kg a.i/ha or Haloxyfop 10.5% EC 108-135 g a.i/ha at 20-25 days after sowing to control grassy weeds.
4. Apply Imazethapyr 10%SL @ 0.1 kg a.i/ha or Imazamox 35%+ Imazethapyr 35% @ 0.07 kg a.i/ha at 20-25 days after sowing to control grassy and non grassy weeds.
5. Apply any pre emergence herbicide followed by one hand weeding at 30-35 days after sowing.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV,
6. Care soil & water conservation measures

7. INM (Maximum use of value added compost/FYM and soluble fertiliser)
8. Integrated weed management
9. IPM
10. Good storage condition
11. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages
5. Migration,
6. Poor Irrigation facilities
7. Water scarcity
8. Wild animals
9. Lack of mechanization
10. Lack of ICT tools due to poor awareness and inter net connectivity

7C. Name of oilseed crop: Toria/sarson

i. Existing varieties being used: Rara,Gharia, Daind

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: PT-303,507,Uttara, PPS-1

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. un decomposed FYM 1.0-2.0qt./nali,
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 4-5kg/ha, spacing 30*10cm
3. Manure and fertilizer- 10 tonne FYM, NPK50:20 :20,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide (Asper moisture availability), rainfed- pre emergence,
6. Use of IPM practices

v. Major insect pests associated with crop: Aphid, Mustard saw fly

vi. IPM Module for management of insect pests(except organic areas):

Mustard aphid: *Lipaphis erysimi*

1. Timely sowing of crop
2. Removal & destruction of Aphid infested twigs at flowering and siliquae formation stages.
3. Release of larvae/adult of lady bird beetle (***Coccinella septempunctata***) @ 50,000/ha

Name of the Insecticdes	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 25% WSG	50-100	21
Oxydemeton-methyl 25% EC	1000	
Dimethoate 30% EC	660	
Chlorpyriphos 20% EC	500	

Mustard saw fly : *Athalia lugens proxima*

Name of the Insecticides	(gm/ml) /ha
Imidacloprid 70% WS (Seed treatment/Kg)	7.0
Dimethoate 30% EC	660

Quinalphos 25% EC	1200

vii. Major disease associated with crop : Blight, Rust, Mildew

viii. IPM Module for management of disease (except organic areas):

1. Field sanitation *i.e.* collect and burn the diseased plants debris to minimize the primary source of inoculum.
2. Timely sowing of crop
3. Crop rotation with non host crops (like rice or maize) for at least 5 years in case of severe disease problems

Alternaria blight or Leaf spot: *Alternaria brassicae*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Iprodione 50% WP	2250-3000	50

White rust : *Albugo candida*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Metalaxyl 35% WS (Seed treatment/Kg)	6-0	
Metalaxyl 8%+ Mancozeb 64% WP	2500	56
Metalaxyl 4%+ Mancozeb 64% WP	2500	60

Downy mildew: *Peronospora parasitica*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Metalaxyl 4%+ Mancozeb 64% WP	2500	60

ix. Major weeds associated with crop: *Cyperus* spp,

x. IPM Module for management of weeds:

Umbrella plant: *Cyperus rotundus* (annual, monocot, narrow leaves, sedge)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Chlorimuron ethyl 25% WP	24	60
2,4-D Ethyl Ester 4.5% GR	25000	
MCPA, Amine salt 40% WSC	2000-5000	
Metsulfuron methyl 20 %WP	20	60

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Sowing as sole cropping ,
2. Timely Sowing,
3. Seed treatment,
4. HYV and IPM

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing, Wild animal damages
4. Migration specially from border area,
5. Poor Irrigation facilities

8A. Name of the vegetable crop: Mango

i. Existing varieties being used: Local, Dashari, Banarasi, Chausa

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Dashari.Banarsi, Amrapali,Pant sinduri, Pant Chandra Dashehari, Langra, Chausa, Bombay Green, Amrapalli, Mallika, Pusa Arunima, Ramkela (for pickles)

iii. Existing package of practices being used:

1. Manuring of FYM during winter
2. Pruning

iv. Specific package of practices to be suggested for increasing yield in specific agro-

ecological region:

1. Use of quality planting materials.
2. Adoption of improved promising varieties.
3. Plantation of fruits with proper pit (pit size: 1x1x1m) preparation and addition of soil mixture.
4. Planting should be done at proper spacing. The medium vigour varieties (Dashehari, Bombay Green, Mallika, Ramkela) shall be planted at the distance of 10 x10 meters, while the vigorous one (Chausa and Langra) at the distance of 12x12 meters. **In the hilly region, having the gravels/stones in soil the planting distance is reduced by 30 to 40 per cent as per the extent of fertility and stones in soil.**
5. The high density planting in mango cv. Amrapali (2.5 x 2.5 meter), medium high density planting in Dashehari (5.0 x 5.0 meter) and "Double Hedge Row" system of planting (in any variety with reference to spacing for individual variety) can be adopted to increase the productivity at a greater extent.
6. Proper placement of pollinizers and pollinators in the existing orchard and new plantation.
7. Adoption of micro-irrigation system especially drips.
8. Use of mulching especially in hilly region.
9. Adoption of proper training/pruning and canopy management practices.

(a).Training for canopy development by beheading of one year old plant at height of about 75.0 cm in the field.

(b). Pruning of criss-crossed, intermingling, diseased branches and in addition to pruning of 10 cm shoot just after harvesting.

(c). For HDP, pruning of 10 cm branches just after fruit harvest with application of paclobutrazol @ 1.0 g a.i. per meter of canopy spread in month of September can be adopted.

The proper nutrition should be given to plants as follows

For 1 year old mango plant: 10 kg of FYM, 100 g N, 75 g P and 100 g K

For 10 year and above old mango plant:

1. Fifty (50) kg of FYM, 1000 g N, 750 g P and 1000 g K per year per tree.
2. The phosphatic and potasic fertilizers must be added during November and December.
3. The urea should be applied in two split doses (first half dose just after fruit set and second half dose at one month interval). After harvesting the crop in "ON" year apply additional dose of urea @ 1.0 kg per tree.
4. The micronutrients namely copper sulphate, zinc sulphate and boric acid @ 250 g each should be added along with phosphatic and potasic fertilizers in November and December.
5. The micronutrients like copper sulphate (0.1%), zinc sulphate (0.2%) and borax/boric acid (0.1%) may be used as foliar spray, two times (just before flowering and marble stage) to increase the productivity and quality of mango fruits. The drip irrigation along with fertigation must be adopted for efficient use of fertilizerz and to increase the productivity. Moreover, the N.P.K. and micro-nutrients must be recommended on the basis of soil test.
6. Pre-harvest spray of $CaCl_2$ @ 2 % (20 g/ l) and borax @ 1 % (10 g/ l) for increasing shelf life and quality of fruits. Application should be done 30 days before anticipated harvest of fruits.
7. Sustainable intensification/intercropping must be adopted. In the initial age of the orchard (upto 10 years) the filler crops like papaya, guava, strawberry and low chill peach may be planted. The inter crops like potato, peas, mustard, soyabean, urd, mung may be also grown.

Rejuvenation of old and senile orchards (Thinning up to crowded branches and centre open (in month of January) with application of paclobutrazol @ 30 ml per plant).

v. Major insect pests associated with crop: Mango Hopper, Mango mealy bug, Mango

shoot gall, Mango fruit fly, Mango stem borer

vi. IPM Module for management of insect pests:

Mango Hopper:

1. Pruning of dense orchards in the month of December and orchard sanitation.
2. Removal of weeds and alternate host plants like hibiscus, custard apple, guava etc.
3. Avoid dense plantings, maintained open canopy; prune overcrowded, overlapping branches after rainy season with proper drainage.
4. Avoid excess use of nitrogenous fertilizers
5. Smoking of orchards by burning of crop residues/cow dung cake during evening hours.
6. Application of bio-agents, *Metarhizium anisopliae* @ 1x 108 cfu/ml or *Beauveria bassiana* @ 108 cfu/ml on tree trunk once during off season for second generation of mango hopper in the months of July-August.

Name of the Insecticdes	**(gm/ml) /ha**	**Waiting period (days)**
Thiamethoxam 25% WSG	100	30
Imidacloprid 17.8 SL (per tree)	2-4	45
Deltamethrin 2.8% EC	0-33-0-5/lit.	1
Lambda cyhalothrin 5% EC	0-5-1-0/lit.	7
Monocrotophos 36% SL	1500-2000	
Oxydemetonmethyl 25% EC	1500-2000	
Dimethoate 30% EC	2475-3300	

Mango mealy bug:

1. Ploughing of orchard in November.
2. Raking of soil around tree trunk to expose the eggs to natural enemies and sun, removal of weeds.
3. Tree banding with 25 cm wide polythene/alkathene sheet (400 gauges) alongwith grease plastering during the first fortnight of December.
4. Releasing 10-15 grubs of coccinellid predator, *Cryptolaemus montrozieri per* tree.
5. Apply insecticides as recommended for mango hopper, if required.

Name of the Insecticdes	**(gm/ml) /ha**
Monocrotophos 36% SL	1500-2000
Dimethoate 30% EC	2475-3300

Mango shoot gall:

1. Pruning of infested gall bearing branches in the months of October.
2. Application of following three sprays at 15 days interval during the months of August and September.
3. Monocrotophos 36%SL @ 2ml/l or Quinolphos 25EC @2ml/l or Dimethoate 30EC @ 2ml/l of water.

Name of the Insecticdes	**(gm/ml) /ha**
Monocrotophos 36% SL	1500-2000

Mango fruit fly:

1. Ploughing of orchard during November-December to expose pupae to sun's heat which kills them.
2. Premature harvesting at firm stage.
3. Collect and dispose off infested and fallen fruits to prevent further infestation.
4. Use methyl eugenol bottle trap: Take wooden block of 5x5x1cm^3 and dipped this block should be in the mixure of Alcohol + Methyl eugenol+ DDVP (6:4:1) for 24 hrs and then hang in plastic bottle.
5. Use bottle trap @ 10 bottles per ha (Replace the wooden block at 2 month interval)

Name of the Insecticdes	(gm/ml) /ha
Malathion 50%EC + gur	1+10

Mango stem borer:

1. Pruning of old infested branches.
2. Scraping the loose bark to prevent oviposition by adult beetles.

Insert cotton plug soaked in kerosene or petrol or DDVP into the holes and paste them with mud.

vii. Major disease associated with crop: Mango malformation, powdery mildew, gummosis

viii. IPM Module for management of disease:

Powdery mildew: *Oidium mangiferae*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Azoxystrobin 23% SC	0.1%	5
Carbendazim 50% WP	0.1%	15
Penconazole 10% EC	0.05%	30
Hexaconazole 5% EC	0.1%	30
Hexaconazole 5% SC	0.2%	27
Sulphur 80% WDG	1875-2500	
Sulphur 80% WP	3130	
Dinocap 48% EC (per tree)	5	

ix. Major weeds associated with crop: *Cyperus rotundus*

x. IPM Module for management of weeds:

1. Pruning of dense orchards in the month of December and orchard sanitation.
2. Removal of weeds and alternate host plants like hibiscus, custard apple, guava etc.
3. Ploughing of orchard during November-December to expose pupae to sun's heat which kills them.

Umbrella plant: *Cyperus rotundus* (annual, monocot, narrow leaves, sedge)

Name of the Herbicides	(gm/ml) /ha
Chlorimuron ethyl 25% WP	24
2,4-D Ethyl Ester 4.5% GR	25000
MCPA, Amine salt 40% WSC	2000-5000
Metsulfuron methyl 20 %WP	20
Orthosulfamuron 50% WG	150
Bensulfuron methyl 0.6% + Pretilachlor 6% G	10000

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Intensive orchard plantation,
2. Regimentation of old orchards
3. Inter cultural operation time to time

xii. Production constraints in agro-ecological region:

Poor management practices

8B. Name of the vegetable crop: Litchi

i. Existing varieties being used: Rose scented

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Rose scented, Sahi, Culcuttia, Swarn Rupa

iii. Existing package of practices being used: Manuring of FYM during winter, pruning

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region: Proper plantation as per specific norms and management practices

v. Major insect pests associated with crop: Litchi mite, Litchi fruit borer, Litchi leaf roller

vi. IPM Module for management of insect pests:

Litchi mite:

1. Pruning of all the affected twigs / leaves during June just after harvest & destruction.
2. Application of Dicofol @ 0.05% (3ml/liter of water) or dimethoate @ 2ml/l twice at flush emergence in Sept-Oct at 7days interval.

Litchi fruit borer:

1. Collection and destruction of fallen infested fruits.
2. Use *Trichogramma chilonis* and Bt formulations.
3. At early stage of fruiting which coincides with egg laying, spray carberyl 50WP or Monocrotophos (0.04%) or Phosalone (0.05%)? Repeat twice at 10-12 days interval.
4. Application of Flubendiamide 39.35 SC (0.008%)@ 1.5ml/5l, Spinosad 45 SC (0.014%)@ 1.5ml/l or Novaluron 10 EC (0.015%)@1ml/l twice at colour brick stage at 7 days interval.

Litchi leaf roller:

Low infestation can be reduced by destruction of infested rolled leaves.

Application of Monocrotophos or Quinolphos @ 2ml/l of water at new flush

vii. Major disease associated with crop: Cracking of fruits, dropping of fruits, fruit rot

viii. IPM Module for management of disease:

1. Foliar spray of water during morning hours and evening hours.
2. Timely irrigation.
3. Foliar spray of copper oxycloride @ 0.3%

ix. Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Pruning of dense orchards in the month of December and orchard sanitation.
2. Removal of weeds and alternate host plants like hibiscus, custard apple, guava etc.
3. Ploughing of orchard during November-December to expose pupae to sun's heat which kills them.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Intensive orchard plantation,
2. Regimentation of old orchards,
3. Inter cultural operation time to time
4. Proper marketing of fruits

xii. Production constraints in agro-ecological region: Poor management practices

8C. Name of the vegetable crop: Pear

i. Existing varieties being used: Gola, Victoria, China, Baggugosha, Kashmiri, Thumb pear etc

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Max Bartlette, Red Bartlette, Willium, Starkrimson, Hokoi, Sukoi (Low Hills)

iii. Existing package of practices being used:

1. Use of old and traditional varieties
2. Less or no use of mulch for water conservation
3. Canopy management is poor
4. Recommended Cultural practices are rarely applied
5. Maturity indices are rarely use
6. Surplus management of fruit are not done
7. Processing industries are not established for Gola nashpati

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of new strains or occidental pears are needed for high hills
2. Introduction of new strains with less gritcells in fruits
3. Need to develop Postharvest management system with minimum losses.
4. Processing facilities needs to be strengthened.

v. Major insect pests associated with crop:

San Jose Scale, Woolly Apple Aphid ,Tent Caterpillar, Codling Moth/ Fruit borer, Peach Leaf Curl Aphid, Peach Fruit Fly

vi. IPM Module for management of insect pests :

San Jose Scale:

1. Collection and destruction of infected pruned material.
2. Adult emergence monitoring with special sex pheromone
3. TrapsParasite, *Encarsia perniciasi* with *Aphytis diaspidis* may give upto 86.5 per cent parasitism.
4. Conserve Coccinellid predators,*Chilocorus bijugus* Mulsant,*Chilocorus rubidus* Hope *Pharoscymnus flexibilies* Mulsant

Name of the Insecticdes	(gm/ml) /ha	Waiting period (days)
Malathion 50% EC	0.05%	1500-2000
Oxydemetonmethyl 25% EC	0.07%	4200-5600

Tent Caterpillar:

1. Pruning and burning of twigs containing egg mass (Dec-Jan).
2. Mopping up the tent with pole and some rags dipped in kerosene tied on its end (at 12.00-3.00 pm).
3. Ues parasitoid Tachnid fly, virus also causes diseases to caterpillar.
4. Spraying with melathion @ 2ml/l or Carbaryl 50 WP @ 2 Kg per 500 lit of water per hac.
5. Spray 0.05% nimbecidine or *B.t.* based Halt 0.02%.

Codling Moth/ Fruit borer:

1. Thorough clean up of orchard.
2. Scrapping lose bark from old trees.
3. Collection and destruction of fallen fruits.
4. Mating disruption dispenser, moth pheromone trap can be used
5. Birds; *Parus major* and *Passer domesticus* prey upon overwintering larvae.
6. Predators, such as ground beetles (Carabidae), ants and crickets, and parasitic wasps, attack larvae as they leave fruit and crawl towards tree trunks
7. Spray of Carpovirusine (GV of moth) at fortnightly interval.
8. Release of *Trichogramma embryophagum* within the first appearance of moth and subsequent release at weekly interval.
9. Spraying (before caterpillar enter into fruit), monocrotophos @ 2ml/l or quinolphos @ 2ml/l or 2.0 kg carbaryl 50 WP in 500 l of water/ha.
10. In case of high abundance, tree should be banded with chemically treated bands.

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause succulent tissue that is very susceptible to infection.
3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion

Name of the Insecticdes	(gm/ml) /ha	Waiting period (days)
Carbosulfan 3% CG	1000	33300

Oxydemetonmethyl 25% EC	0.025%	1500-2000

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Bury the infested fruits at 60 cm deep in the soil.
4. Use Methyl eugenol trap
5. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting.

vii. Major disease associated with crop: Collar rot, Die back, Powdery mildew

viii. IPM Module for management of disease:

Powdery mildew of Peach

Name of the Fungicides	(gm/ml) /ha
Lime sulphur 22% SC	1%

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds: -

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: Introduction of New Strain *viz*. Anjou, Starkrimson in high hills.

xii. Production constraints in agro-ecological region: Availability of quality planting material

9A. Name of the vegetable crop: Cabbage

i. Existing varieties being used: Pride of India, Golden acre as open pollinated varieties and Varun, Pragati as hybrid varieties

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: All hybrid varieties. Seeds are available in Multinational companies. T 621,Varun, Pragati, Indica,, Pusa Mukta , Sri Ganesh Gole

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
7. Cultivars-In cabbage, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be head formation.
8. Transplanting- Farmers practices improper planting distance.
9. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
10. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
12. Harvesting- The harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should test their soils before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to go for deep ploughing before sowing the crop particularly during the hot season or before the snowfall
3. Seed- Farmers should adopt improved varieties/ hybrids

4. Soil solarisation practice should follow in nursery beds .
5. Seed Treatment- To combat the different seed borne diseases to treat the seed by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or Trichoderma viride 4g/kg before sowing
6. Seed Rate- It is recommended to use the seed quantity for different as follows-
   a. (Early)-600-700g/ ha open pollinated
   b. (Mid and Late)- 500-550g/ha open pollinated
   c. (Hybrid)-350-400g/ha
7. Optimum sowing time :Mid Sept- Oct
8. Transplanting- Farmers should transplant seedlings properly as for early (40x45cm), medium (40x45cm),
9. Manures and fertilizers- Farmers should incorporate well rotten cow dung (20-25tonnes/ha) and NPK (120:60:60) in irrigated, half dose of NPK in unirrigated condition.
10. Irrigation- As per requirements. At critical stages such as head initiation and head development
11. Weed control- Farmers must know about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically.
12. Harvesting- The farmer must aware about the maturity stage of a particular crop variety so he can harvest the crop as per their object. In general the heads should be harvested when they attempt the size in between 500-750 gms.

v. Major insect pests associated with crop: Butterflies , Aphids, *Plutell*a and bugs in seeds

vi. IPM Module for management of insect pests :

1. Diamond black moth- plantation of mustard crop as trap crop at margins of cabbage field to attract the adults for egg laying,spray of *Bacillus thurengnsis* @ 1.0 kg /ha or
2. Cabbage butterfly - mechanically destroy the cluster of eggs,*Helicoverpa* - release of *Tricogramma* spp insect eggs @ 50000 / ha at the time of initation of flowering to 7- 10 days,

Before Planting

1. Deep ploughing in the month of summer to expose immature stages of insect pest.
2. Hand picking and destruction of cabbage butterfly eggs and larvae in nursery as well as main crop to reduce the pest multiplication .
3. Growing of African bold seeded mustard as trap crop at 22:2 ratio (Cabbage: Mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop may reduce the infestation.

After Planting

1. Regular Monitoring of the plants randomly for the presence of pests on both the leaf surface as well as between the leaves.
2. Hand picking and destruction of leaf webber and egg masses and early instar larvae to reduce further multiplication of pests in the field.
3. Hook out the head borer and destroy mechanically. Spray Neem seed powder extract 4% @ every 10 days interval starting from 30 days after planting (DAT) and alternate spray with Neem cake (5%) to keep the pest in check.
4. Spray Neem soap 1% to manage the sucking pests at 10 days interval from 30 to 90 DAT.

Dimond back moth: *Plutella Xyllostella*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC	50	3
Cyantraniliprole 10.26% OD	600	5
Indoxacarb 14.5% SC	200-266	7
Indoxacarb 15.8% EC	266	5

Spinosad 2.5% SC	600-700	3
Chhlorfenapyr 10% SC	750-1000	7
Emamectin benzoate 5% SG	150-200	3
Flubendamide 480% SC	45-60	7
Flubendamide 20% WG	90-120	7
Chlofluazuron 5.4% EC	1500	7
Diafenthiuron 50% WP	600	7
Lufenuron 5.4% EC	600	14
Novaluron 10% EC	750	5
Metaflumizone 22% SC	750-1000	3
Tolefenpyrad 15% EC	1000	5
Thiodicarb 75% WP	1000-1330	7
Fipronil 5% SC	800-1000	7
Cypermethrin 10% EC	650-760	7

Bioinsecticides

Name of the Bio-insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7
Bacillus thuringiensis var. galleriae 1593 M sero type H 59 5b, 1.3% FC	600-1000	
Bacillus thuringiensis serovar kurstaki (3a,3b,3c) 5% WP	500-1000	
Bacillus thuringiensis serovar kurstaki serotype 3a,3b, SA II WG	500	

Cabbage/cauliflower Aphid

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7
Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Bio-insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

Painted bug

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Dimethoate 30% EC	200	660

vii.Major disease associated with crop: Black rot, Damping off, Collar rot, Leaf spot

viii.IPM Module for management of disease:

Root rot/Collar rot (*Rhizoctonia solani*)

Name of the Fungicides	**(gm/ml) /ha**
Mancozeb 75% WP (Drenching/ lit. water)	3

Biofungicides

Name of the Bio-fungicides	**(g/lit.) /water**	**Treatment**

Trichoderma viride 1% WP	10 g/lit. water 2.5 Kg/ha	**Seedling Root dip Treatment:** Mix 10 g of Trichoderma viride1% WP in one litre of water and dip the cabbage seedling root for 30 minutes. **Soil Treatment:** Mix 2.5 Kg of Trichoderma viride 1% WP with 62.5 Kg FYM and broadcast uniformly over a hectare of land and irrigate the field immediately.

ix.Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Use of plastic mulch
2. Timely manual weeding

xi.Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

Use of hybrid varieties suitable for year round production system for mid or high hills.

xii.Production constraints in agro-ecological region:

1. Less heading in open pollinated cabbage
2. Boron deficiency is becoming serious.
3. Less availability of high quality seeds
4. High prices of hybrid seeds
5. Post-harvest losses are more due to non availabilityof storage facility
6. High prices of fertilizers
7. Low prices of farm produce
8. Lack of knowledge about the cultivation practices
9. Lack of processing facilities
10. So far no minimum support price is fixed for the crop.

8B. Name of the vegetable crop: Cauliflower

i. **Existing varieties being used:** Pusa Snowball 16, PSB-35 as open pollinated. Snow Queen and Snow King, Sweta and late group hybrids

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** A large number of hybrids are used in the distt. There is no specific hybrid available for farmers in the state.

Region A- Early- Early Kunwari, Pusa Kartiki, Pusa Early Synthetic
Mid- Pusa Shubhra, Pant Shubhra, Hisar No.1, Snow crown
Late- Pusa Snowball-16, PSBK-1, PSBK-25, Pusa Hybrid

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil.
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ unamounted seed quantity.
7. Optimum sowing time
   Early: May- June

Mid: July – Aug
Late: Oct

8. Cultivars-In cauliflower, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be curd formation.
9. Transplanting- Farmers practices improper planting distance.
10. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
11. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
12. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
13. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Seed- Farmers should use improved varieties/ hybrids. Soil solarisation practice in nursery must be followed by the farmers because it is easy method of sterilization at low cast.
4. Seed Treatment- For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or *Trichoderma Viride* 4g/kg before sowing.
5. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Cauliflower (Early)-500-750g/ ha open pollinated.
   Cauliflower (Mid and Late)- 300-350g/ha open pollinated.
   Cauliflower (Hybrid)-250-300g/ha.
6. Varieties- Farmers should select proper variety for suitable sowing time as per maturity group.
7. For early crop- Early Kunwari, Pusa Kartiki, Pusa Early Synthetic; Mid- Pusa Synthetic, Pusa Shubhra, Pant Shubhra, Hisar No.1 and Late- Pusa Snowball-16, Pusa Snowball Kt-1, Pusa Hybrid-2.
8. Transplanting- Farmers should transplant seedlings properly as for early (30x30cm), medium (45x30cm), and late (60 x 45 cm).
9. Manures and fertilizers- Farmers should incorporate well rotten cow dung (15-20tonnes/ha) and NPK (150:80:60) in irrigated, half dose of NPK in un irrigated condition.
10. Irrigation- Farmers should apply water in the field at proper stage of the crop. As critical growing stage such as proper growing stage, curd formation and maturity stages.
11. Weed control- Farmers must know about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically.
12. Harvesting- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. Major insect pests associated with crop: Aphids are serious problem

vi. IPM Module for management of insect pests :

Cabbage/cauliflower Aphid

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7

Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

vii. Major disease associated with crop: Black rot and stalk rot are serious problem

viii. IPM Module for management of disease:

***Sclerotenia* stem rot:**

1. Summer deep ploughing,
2. Burn the infected crop debris,
3. Two spray at 10-12 days interval of carbendazim @ 1.0 gm / litre

***Xanthomonas* Black rot:**

Seed treatment with Streptocyclin @ 100 mg/kg seed and two spray of Streptocyclin 1.0 gm / 10 litre of water after 10-12 days interval.

ix.Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Use of plastic mulch
2. Timely manual weeding

xi.Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yieldind and disease tolarent varieties,
2. Use of well decomposed FYM,
3. Use of black polythine mulch
4. Drip irrigation system,

xii.Production constraints in agro-ecological region:

1. Non availability of suitable varieties as per agro-ecological situation.
2. Buttoning and leafiness are common problem
3. Lack of technical knowledge
4. Less availability of high quality seeds
5. High prices of hybrid seeds
6. Post-harvest losses are more due to non availability of storage facility
7. High prices of fertilizers
8. Low prices of farm produce
9. Lack of knowledge about the cultivation practices
10. Lack of processing facilities
11. So far no minimum support price is fixed for the crop.

9C. Name of the vegetable crop: Radish

i. **Existing varieties being used:** Dunagiri, Chinese Pink and Pusa Himani

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** Early Mino, Japanese White, Pusa Himani, Pusa Chetki, Pusa Reshmi, Arka Nishant, Punjab Pasand

iii. **Existing package of practices being used:**

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
4. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
5. Sowing time: Sept- Dec
6. Planting distance- Farmers practices improper planting distance and sown through broadcast.
7. Manures- Farmers incorporated cow dung in undecomposed stages in the field.

8. Fertilizers: Farmer use imbalance fertilizer
9. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method..
10. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
11. Harvesting- The root harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Soil Testing-** Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. **Land Preparation-** The farmers are recommended to open the land before sowing the crop for sterilization.
3. **Seed Treatment-** For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or T*richoderma viride* 4g/kg before sowing
4. **Seed Rate**- The recommended seed rate of Asiatic type radish 10 Kg/ha and European type 12-14 Kg/ha
5. **Planting distance**- Farmers should be sown the seed Asiatic type line to line 45 cm and plant to plant 8cm and European type line to line 30 cm and plant to plant 8 cm
6. **Manures and fertilizers**- should be used as per soil testing , General recommendation are **FYM**-250q/ha **Nitrogen**: 60 kg/ha **Phosphorus**: 100 kg/ha and **Potassium:** 50kg/ha **Micronutrient:** should be used as per soil testing,
7. **Irrigation**- Farmers should apply water in the field at proper stage of the crop. Irrigate the crop in winte**r** at 7-8 days interval and in summer 3-4 days interval
8. **Harvesting**- Depending upon the cultivars, the roots become ready for harvesting in about 25-35 days after sowing. Early and rapid maturing European cultivars reach harvest maturity in 25-30 days after sowing. They become bitter and pithy if the harvesting is delayed. In India, harvesting is done manually. A light irrigation may be given before harvesting to facilitate lifting of roots. In advanced f countries, commercial radish growers use a single row harvester that pulls the plants from the soil, cuts the roots from the tops, and then places them in bags for transportation to a picking shed.

v. Major insect pests associated with crop: Aphids

vi. IPM Module for management of insect pests:

Aphid; *Aphis gossypii* Glover and *Myzus persicae* (Sulzer)

1. Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.
2. Yellow sticky trap is effective for controlling aphid population.
   Imidacloprid 17.8 SL @ 0.25ml/l or Acetamiprid 20%SP @100g/ha or Thiamethoxam 25%WG@ 100g/ha if needed.

vii. Major disease associated with crop: White rust, Nematodes

viii. IPM Module for management of disease:

1. Crop rotation,
2. Use of FYM treated with *Trichoderma* @500 gm per 100 kg

ix. Major weeds associated with crop: Not serious

x. IPM Module for management of weeds: Not applied

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of short duration, non pithy, coloured varieties for year round production.
2. Farmers should be adopted intensification of the crop such as he should grow at least 3-4

crops in a year such as Cauliflower early- Radish- Bottlegourd
Brinjal-Radish –Chilli
Bottle bourd-radish-French bean

xii. Production constraints in agro-ecological region:

1. Pithyness problem in low hills
2. Less availability of high quality seeds
3. High prices of hybrid seeds
4. Post-harvest losses are more due to non availability of storage facility
5. High prices of fertilizers
6. Low prices of farm produce
7. Lack of knowledge about the cultivation practices
8. Lack of processing facilities
9. So far no minimum support price is fixed for the crop.

9D. Name of the vegetable crop: Tomato

i. Existing varieties being used: Pant T3, Non descriptive varieties as open pollinated, Naveen 2000, Manisha, etc. Private company varieties like Himsona, Rakshhak etc.in all zones.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL Tamatar 4

iii. Existing package of practices being used:

1. Preparation of field.
2. Plantation of under filed condition on ridges as well as poly houses.
3. Management of wooden stick for stacking.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use Inderminate tomato varieties like Naveen 2000+ under protected cultivation to promote vertical cultivation of tomato in marginal holdings under polyhouse condition. Use Zn in deficient soil.
2. Use micronutrient including Ca, B and Mo
3. Crop rotation Tomato-cowpea-Early cauliflower.

v. Major insect pests associated with crop: Fruit borer and white flies

vi. IPM Module for management of insect pests:

Tomato fruit borer *Helicoverpa armigera* (Noctuidae: Lepidoptera)

1. Growing trap crop of African tall marigold as border row before 15 days of transplanting is beneficial in reducing egg laying in main crop.
2. Field sanitation and clean cultivation is effective tool to suppress the pest population.
3. Setting of sex pheromone traps @ 5 trap/acre for monitoring is effective.
4. Spray of Ha NPV @ 500 LE/ha mixed with 0.1 per cent UV retardant (Tinopol) and 0.5 per cent jiggery is effective.
5. Use of Bt @ 0.50kg/acre and NSKE 5 per cent to kill early stage larvae. Release of the egg parasitoid, *Trichogramma chilonis* or *T. brasiliensis* @ 1Lakh/ha coinciding with flower initiation at 15 days interval may reduce the pest population.
6. Development of pyridalyl nanocapsule suspension for efficient management of tomato fruit and shoot borer (*Helicoverpa armigera*) is an efficient approach for frequent delivery and effective management.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Indoxacarb 14.5% SC	400-500	5
Chlorantraniliprole 18.5% SC	150	3
Cyantraniliprole 10.26% OD	900	3
Flubendamide 480% SC	120	5

Flubendamide 20% WG	240	5
Novaluron 10% EC	750	1-3
Novaluron 5.25%+ Indoxacarb 4.5% SC	1700	5
Methomil 40% SP	750-1125	5-6
Lambda cyhalothrin 5% CS	300	5

Management strategies(white fly and other sucking pests)

A. Crop Hygiene

Field hygiene should be a high priority and should be included as an integral part of the overall strategy for managing whitefly populations, Tomato yellow leaf curl virus(TYLCV) incidence, and insecticide resistance. These practices will help reduce the onset of the initial infestation of whitefly, regardless of biotype, and lower the initial infestation level during the cropping period.

B. Other Cultural Control Practices

1. Use proper pre-planting practices.
2. Vegetative propagated ornamental plants (i.e. *Hibiscus, Poinsettia*, etc.) should not be grown at the same location, especially if bringing in plant materials from other areas.
3. Avoid yellow clothing or utensils as these attract whitefly adults.
4. Delay planting new fall crops as long as possible.
5. Do not plant new crops near or adjacent to old, infested crops.
6. Use proper post-planting practices.
7. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc. Rogue tomato plants with symptoms of TYLCV.
8. Plants should be treated for whitefly adults prior to rouging and, if nymphs are present, should be removed from the field, preferably in plastic bags, and disposed of as far from production fields as possible.
9. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
10. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

C. Insecticidal Control Practices.

1. Restricted the use of neonicotinoids (imidacloprid or acetamiprid) in the field only during the first six weeks of the crop thus leaving a neonicotinoid-free period at the end of the crops.
2. Use selective rather than broad-spectrum control products where possible to conserve natural enemies and enhance biological control.
3. Do not apply insecticides on weeds on field perameters. These could kill whitefly natural enemies and, thus, interfere with biological control.
4. Crop rotation is effective tool to prevent pest population.
5. Avoiding of same group of crop in same field for a long time is beneficial.
6. Sticky trap is effective to control whitefly population.

White fly

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	900	3
Spiromesifen 240% SC	625	3
Thiamethoxam 25% WSG	200	5
Imidacloprid 17.8% SL	150-175	3

vii. Major disease associated with crop: Buckeye fruit rot, late blight, Blossom end rot, Saptoria leaf spot

viii. IPM Module for management of disease:

Late blight :

1. Burn the infected crop debris,

2. Avoid excess moisture.

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Famoxadone 16.6%+ Cymoxanil 22.1% SC	500	3
Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Ametoctradin + Dimethomorph 20.27% SC	800-1000	32
Azoxystrobin 23% SC	500	3
Cyazafamid 34.5% SC	200	3-5
Mandipropamid 23.4% SC	0.08%	5
Captan 50% WP	2500	
Copperoxychloride 50% WP	1250	
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Azoxystrobin 18.2%+ Difenoconazole 18.2% SC	0.1%	5

Early Blight :

1. Use of resistant varieties,
2. Burn the weeds & infected crop debris.

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Azoxystrobin 23% SC	500	3
Pyraclostrobin 20% WG	375-500	3
Iprodione 50% WP	1500	15
Kitazin 48% EC	1000	5
Mancozeb 75% WP	1000	5-6
Mancozeb 35% SC	0.5%	10
Metiram 70% WG	2500	6
Metiram 55% + Pyraclostrobin 5% WG	1500-1750	5
Famoxadone 16.6%+ Cymoxanil 22.1% SC	500	3
Zineb 75% WP	1500-2000	
Ziram 80% WP	1500-2000	3
Captan 50% WP	2500	
Copperoxychloride 50% WP	1250	
Azoxystrobin 18.2%+ Difenoconazole 18.2% SC	0.1%	5

Buck eye rot:

1. Burn the infected fruit, leaves etc. and staking of plants,
2. Remove the leaves upto 9 inches from ground.

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Mancozeb 75% WP	1500-2000	
Propeneb 70% WP	1500	10

ix. Major weeds associated with crop: Various weeds

x. IPM Module for management of weeds: Use of poly mulch, Timely manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yielding varieties grown under ventillated polyhouse using standardized technology with fertigation technology in tomato can enhance the productivity of tomato manifold. Polyhouse technology is a boon for small and marginal farmers with fragmented holdings.
2. Reduce number of spray of pesticides.

3. Raise nursery on treated soil.
4. Treat seed with fungicide before sowing.
5. Manage fog during fruiting period.

xii. Production constraints in agro-ecological region:

1. Non-availability of reliable hybrid cultivars for continuous cultivation.
2. Poor nursery management in the crop
3. Poor staking and pruning techniques.
4. Poor technical know how Imbalance use of fertilizes.
5. More numbers of pesticides' spay
6. Increase incidences of Bacterial wilt

9E. Name of the vegetable crop: Potato

i. Existing varieties being used: Up-to-date, Kufri Jyoti, Kufri chandramukhi K. Bahar, K Badshah and Kufri Jyoti

ii.High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Kufri Girriraj, Kufri Chipsona- 1, Kufri chipsona- 3, K. Khyati, K. Pukhraj, K. Ashok, K. Sadabahar, K. Anand, etc

iii.Existing package of practices being used:

1. Use of big sized tuber or divion of tuber (50-60 g)
2. No Tuber treatment
3. Use of organic maures, sowing in flat bed.
4. Sowing time is March-April.
5. Limited or no IPM practices
6. Spacing: 50-60 x 15-20 cm
7. Seed rate: 25-30 qtl/ha
8. Farmers are only using FYM along with urea at hills but the farmers in plains are using FYM + 160:100:120kg/ha NPK

iv.Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of HYV variety with proper seed size (with 3 sprouted eyes, sown in line with application of organic manures.
2. Late blight resistant variety such as K Girdhari, K.Himalini and K. Shailja should be selected for planting. Fertilizer should be used on soil test basis. Dehaulming practise should be adopted for long duration storage of tubers.
3. Suitable fungicides should be used for control of Late blight disease e.g. mancozeb, cardendazim alone and in combination.

v. Major insect pests associated with crop: White grub, cut worm, aphid, potato tuber moth, epilachina beetle

vi. IPM Module for management of insect pests:

Potato tuber moth: *Phthorimaea operculella*

1. Heaps of green grasses may be kept at suitable interval in infested field during evening and next day early in the morning along with caterpillars to destroy.
2. Clean cultivation and mechanical destruction of caterpillars also help in reducing pest infestation.
3. Irrigation also brings them on the surface and birds shall predate them.
4. Apply chlorpyriphos 20EC at the rate of 2.5ml/l in the soil before seed sowing.

Epilachna beetle: *Epilachna viginatioctopunctata*

1. Hand packing of grubs and collection of beetles by hand nets during early stages of attack, helps in reducing the intensity of infestation.
2. Conservation and augmentation of natural parasitoids viz.*Pediobius foveolatus, Pleunotrogrus faveolatus* and *Tetrastichus* sp.

3. Application of Neem, Mahua, ground nut cakes are efficient in suppressing the pest population.
4. Spray of Malathion 50 EC in 200 liters of water per acre provides effective control of this pest

Aphids: ***Myzus persicae***

Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.

Yellow sticky trap is effective for controlling aphid population.

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 25% WSG (Spray)	100	77
Thiamethoxam 25% WSG (Drenching)	200	77
Dimethoate 30% EC	660	
Oxydemeton-metyl 25% EC	1000	
Carbofuran 3% CG	16600	
Phorate 10% CG	10000	

Jassids:

Fenvalerate 20% EC	300-375	7

White grub:

1. Use of VL Kurmula trap,
2. Use of WGPSB2 Bio-Formulation @ 10 gm/kg vermicompost or FYM,
3. Drenching of Chlorpyriphos @ 2ml/L

vii. Major disease associated with crop: Late blight, Early blight, Black scorf and Bacterial wilt

viii. IPM Module for management of disease:

1. Crop rotation,
2. Use of only diseases free seed tuber for raising the crops,
3. Use of balance dose of common of fertilizer.

Early blight of potato: ***Alternaria solani***

1. Use of resistant varieties,burn the weeds & infected crop debris,

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Chlorothaonil 75% WP (per lit. water)	0.875-1.250	14
Kitazin 48% EC	0.20%	48
Hexaconazole 2% SC	3000	21
Mancozeb 75% WP	1500-2000	
Propineb 70% WP	0.30%	15
Zineb 75% WP	1500-2000	
Captan 50% WP	2500	
Ziram 80% WP	1500-2000	3
Copperoxychloride 50% WP	1250	
Captan 70%+Hexaconazole 5% WP	500-1000	21

Late blight of potato: ***Phytophthora infestans***

1. Use resistant verities.
2. Burn the infected crop debris, avoid excess moisture,

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Cyazafamid 34.5% SC	200	27
Chlorothaonil 75% WP (per lit. water)	0.875-1.250	14
Azoxystrobin 23% SC	500	12

Mandipropamid 23.4% SC (per lit. water)	0.8	40
Propineb 70% WP	0.30%	15
Captan 50% WG	1500	21
Captan 75% WP	1667	8
Copperoxychloride 50% WP	1250	
Copperhydroxide 53.8% DF	1500	22
Dimethomorph 50% WP	1000	16
Hexaconazole 2% SC	3000	21
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Metalaxyl 8%+ Mancozeb 64%WP	2500	49
Metalaxyl 4%+ Mancozeb 64%WP	2500	24
Capatan70%+ Hexaconazole 5% WP	500-1000	21
Carbendazim 25%+ Mancozeb 50%WS	0.6-0.7/Kg	Seed Treatment
Cymoxanil 8%8% +Mancozeb 64%WP	1500	10
Famoxadone 16.6%+Cymoxamil 22.1% SC	500	40
Fenamidone 10%+ Mancozeb 50% WG	1250-1500	30
Metiram 55%+ Pyraclostrobin 5% WG	1500-1750	15
Metalaxyl 3.3%+ Chlorothanil 33.1% SC	0.02%	34

ix. Major weeds associated with crop: *Ranunculus*, *Cyperus* sp and *Chenopodium* etc.

x. IPM Module for management of weeds:

Mechanical and cultural method.

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	2000	3440
Oxyflourfen 23.5% EC	100-200	425-850

Rice flat sedge: *Cyperus iria* (annual-perennial, monocot, narrow leaves, sedge)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	2000	3440
Oxyflourfen 23.5% EC	100-200	425-850

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Early maturing varieties.
2. Use of Kufri Girriraj and Kufri Jyoti varieties supplementation with use of optimal tuber size,
3. Selection of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja.
4. Seed treatment should be followed.
5. Planting of pre-sprouted tubers should be done.
6. Proper crop rotation to should be followed.
7. Winter/ summer ploughing of fields.
8. Use of organic mulching material in appropriate thickness especially under rain fed mid hills agro climatic conditions.
9. Dehaulming practise should be adopted by the farmers for long duration storage of tubers.
10. Medium size whole tuber should be used as planting material.

xii. Production constraints in agro-ecological region:

1. Timely and adequate seed supply.
2. Facility of poor seed storage in the distt.
3. The seed of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja is not available in sufficient quantity.
4. Use of infected planting material by the farmers.
5. Use of un sprouted seed (newly dug tubers)
6. Proper crop rotation is not followed.
7. Cultivation on sloppy land.
8. In situ moisture conservation techniques such as mulching technology are not followed.
9. Dehaulming technique is not followed.
10. Imbalance use of fertilizers.
11. Use of unrecompensed FYM.
12. Lack of storage facilities.
13. Seed production is not done by the farmers.

9F. Name of the vegetable crop: Brinjal

i. Existing varieties being used: Non descriptive or non identified varieties, PPL 74

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Navkiran, Brinjal 704 (SunGro Seed), Navina, VNR212 (VNR Seed), IndameSupriya (Indo-American), Pant Rituraj, Pant Samrat (Pantnagar), Kashi Taru, Kashi Sandesh (IIVR)

iii. Existing package of practices being used:

1. Poorly managed nurseries infected with damping off.
2. Over aged or less vital seedling utilization
3. Transplanting is done on or before monsoon shower
4. Round and long purple variety use
5. No control measure for shoot and fruit borers and phomopsis blight.
6. Soil Testing-Farmers do not test their soil
7. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
8. Nursery- Nursery soil generally not sterilize by the farmers.
9. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
10. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
11. Sowing time: Region A: Dec-Jan, June-July
12. Transplanting- Farmers practices improper planting distance.
13. Manures- Farmers incorporated cow dung in undecomposed stages in the field.
14. Fertilizers: Farmer use imbalance fertilizer
15. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method..
16. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
17. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Soil solarisation practice in nursery must be followed by the farmers because it is easy method of sterilization at low cast.

4. **Seed Treatment-** For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed orCarbandazim @2g/kg of seed or*Trichoderma viride* 4g/kg before sowing
5. **Seed Rate**- The recommended seed rate of brinjal: Hybrid-250g/ha, Open pollinated-500-600g/ha
   Planting
6. **Transplanting**- Farmers should transplant seedlings properly as for non spreading type varieties- 60cm x 60cm, spreading type varieties - 75cm x 60cm.
7. **Manures and fertilizers**- should be used as per soil testing General recommendation are **FYM**-250q/ha **Nitrogen**: (Hybrid-200kg/ha, Open pollinated-100-120kg/ha) **Phosphorus**: (Hybrid-100kg/ha, Open pollinated-80kg/ha **Potassium:** (Hybrid-80/ha, Open pollinated-60kg/h), **Micronutrient:** should be used as per soil testing,
8. **Irrigation**- Farmers should apply water in the field at proper stage of the crop. Irrigate the crop in winte**r at**7-8days interval and in summer3-4 days interval
9. **Weed control**- Farmers must know the about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically. Farmer can control the weeds by hand weeding along with pre-planting surface application @ of 1.0-1.5 kg/ha Alachlor.
10. **Growth substances:** Use 2,4-D @ 2ppm at flowering stage
11. **Harvesting**- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. Major insect pests associated with crop: Shoot and fruit borers

vi. IPM Module for management of insect pests:

Brinjal fruit & shoot borer: *Leucinodes orbonalis*

1. The damaged portions of the plants and fruits should be removed and destroyed.
2. Early removal of drooping shoots will reduce the fruit infestation.
3. Proper collection of all the infested flower buds, fruits during harvest.
4. Continuous cultivation of brinjal also favors the pest infestation.
5. Varieties like Punjab Barsati, (moderate resistant cultivar) Pusa purple round, Punjab Neelam found to be resistant to brinjal fruit borer.
6. Biological method recommended by IIHR, Bengaluru involving release of *Trichogramma chilonis* @10 to 15 lakh parasites/ha/season along with 2 sprays of *Bt* formulation found to be economically effective.
7. Installation of BSFB (brinjal shoot and fruit borer) pheromone traps Lucinure @3/ha to monitor and mass trap the male moths is effective.
8. Neem Seed Kernal Extract(NSKE)5 % per cent at the time of flowering is effective.
9. Prevent continuous growing of same group of crop at same field.
10. Rotate brinjal with cabbage or other crops

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC -	200	22
Emamectin Benzoate 5% SG	200	3
Thiacloprid 21.7% SC	750	5
Thiodicarb 75% WP	625-1000	6
Lambda cyhalothrin 5% CS	300	5
Cypermethrin 25% EC	150-200	1
Betacyfluthrin 8.49%+ Imidacloprid 19.81% OD	200	7
Triazophos 35% + Deltamethrin 1% EC	1250	3
Pyriproxyfen 5%+ Fenpropathrin15% EC	750	7

vii. Major disease associated with crop: Phomopsis blight is a serious problem in the hills.

viii. IPM Module for management of disease:

1. Upright nursery beds for seedling production above 10-15 cm above ground to ward off damping off etc.
2. Cover the beds with polythene sheet of 45 gauge (0.45 mm) thickness for three weeks before sowing for soil solarisation which will help in reducing the soil borne pests. Sufficient moisture should be present in the soil for solarisation.
3. Mix 150 gm of fungal antagonist *T. harzianum* in 3 kg of FYM and leave for about seven days for enrichment. After 7 days mix in the soil in a bed of 3 sq. m.
4. Treat the seeds of popular hybrids with *T. viride* @ 4 gm/ kg.
5. Use nylon net of 40 gauge mesh for leaf curl management.

Blight

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: *Euphobia hirta, Cynadon dactylon , Cyperus* and *Oxalis*, *Cyperus rotundus, Panicum repens, Cynodon dactylon, Amaranthus virdis, Parthenium hysterophorus*

x. IPM Module for management of weeds:

1. Hand weeding only
2. The field should be kept weed-free, especially in the initial stage of plant growth, as weeds compete with the crop and reduce the yield drastically.
3. Frequent shallow cultivation should be done at regular interval so as to keep the field free from weeds and to facilitate soil aeration and proper root development.
4. Deep cultivation is injurious because of the damage of roots and exposure of moist soil to the surface.
5. Two-three hoeing and the earthing up are required to keep the crop free of weeds.
6. Preemergence application of Fluchloralin (1.5 kg a.i./ha) coupled with one hand weeding 30 days after transplanting is effective for control of weeds.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of hybrids can increase productivity 2 to 3 times higher.
2. Use of mulch in rainy season.
3. Farmers should be adopted intensification of the crop such as he should grow at least 3-4 crops in a year such as Brinjal- Radish-Bottle gourd, Brinjal- spinach-cowpea, Brinjal-Turnip-Amaranthus, Brinjal- Spinach-Bitter gourd etc.

xii. Production constraints in agro-ecological region:

1. Non-availability of suitable hybrids
2. Wild animals problems
3. Poor technical knowhow
4. Marketing problem in rainy season
5. Less availability of high quality seeds
6. High prices of hybrid seeds
7. Post-harvest losses are more due to non availability of storage facility
8. High prices of fertilizers
9. Low prices of farm produce
10. Lack of knowledge about the cultivation practices
11. Lack of processing facilities
12. So far no minimum support price is fixed for the crop

9G. Name of the vegetable crop: Cucumber

i. **Existing varieties being used:** Local and traditional varieties Kalyanpur Green,

Japanese Long Green, Poona Khira, Pant Khira-1, Poinsette, Japanese Long Green, Straight Eight, Swarna Sheetal, Swarna Poorna, Swarna Ageti etc.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

For open field condition: Pusa Udhay, Pusa Barkha,Shubhangi, Himangi, Punjab Naveen, Tasty, Ruchi, Mandakini, Kumud, Noori, Alamgir, Rani, Don etc,

For protected condition: Pant Parthenocarpic Cucumber-2 & 3, Hilton, Kian, Isatis, Malini etc.

iii. Existing package of practices being used:

1. Use of traditional seeds,
2. Planting in rainy season,
3. Traditional stacking method,
4. Long harvest duration season,
5. Sale at local market
6. Absence of crop rotation.
7. Random selection of variety (May or may not be suited to Agroeco-region).
8. Untimely sowing / planting of crop.
9. Use of untreated seed.
10. Unbalanced use of fertilizers.
11. Use of plant protection chemicals having long wetting period.
12. Use of traditional irrigation system.
13. No soil solarisation/ treatment during lean period.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Glasshouse or polyhouse technology
2. Use of Hybrids or/and Pathenocarpic varieties
3. Management of crop geometry.
4. Use of organic manure or fertigation inside playhouse.
5. Management of fruit flies. Use of protected cultivation.
6. Adoption of crop/ soil health related crop rotations.
7. Recommended/suitable variety for Agroeco-region.
8. Use recommended spacing eg. 60-200 × 50-100 cm
9. Treating seed before sowing.
10. Balanced use of fertilizers (125: 155: 125 Kg N: P: K/ha, respectively) with water soluble fertilizers (fertigation).
11. Selection of eco-friendly plant protection chemicals having short wetting period, recommended for protected cultivation.
12. Selection of optimum planting period.
13. Region A: (Protected cultivation) : Sept
14. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
15. Adoption of micro irrigation technologies for efficient use of available water.
16. Adoption of fertigation system for efficient use of fertilizers.

v. Major insect pests associated with crop: Fruit flies

vi. IPM Module for management of insect pests:

Fruitflies, *Bactrocera cucurbitae* Coq. and *B. ciliatus* Loew (Tephritidae : Diptera)

1. To avoid infestation by fruit flies, growing of resistant or early maturing varieties has been recommended.
2. To check the damage by these flies, fruits should be harvested before they start ripening.
3. All the fallen and infested fruits should be collected and destroyed to prevent the

carryover of the pest.

4. Frequent raking of the soil under the vines or ploughing the infested fields after the crop is harvested can help in killing the pupae.
5. Baits prepared with 10% ripe banana, 10% jaggery mixed with 0.1% malathion or 1g carbofuran used in bait traps was found effective or this bait mixture is to be applied as 200 spot splashes per hectare on the undersurface of cucurbit leaves.
6. Use of 0.4 ml methyl engenol with 1ml of dichlorvos in bait traps was also found effective

Pumpkin beetle *Raphidopalpa foveicollis* (Lucas) (red beetle

Cultural practices like clean cultivation and early sowing will reduce pest damage. After harvesting deep ploughing of infested field to kill the grub in the soil. Use sevin/Carbaryl dust @2g/m2 area in the soil before plantation.

Red pumpkin beetle

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Dichlorovos 76% SC	500	627

vii. Major disease associated with crop: Powdery mildew and downy mildew, anthracnose

viii. IPM Module for management of disease:

Downy mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1500-2000	
Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Azoxystrobin 23% SC	500	7
Amectoctradin+ Dimethomorph 20.27% SC	800-1000	3

Powdery mildew

Name of the Fungicides	(gm/ml) ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300

Anthracnose

Name of the Fungicides	(gm/ml) ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: Various weeds

x. IPM Module for management of weeds:

1. Use of black Poly mulch,
2. Timely weeding and
3. Crop rotation.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Polyhouse technology and hybrid cultivars can increase productivity 3-4 times in mid and high hills.
2. Use of well designed and recommended protected technology suited to area i.e. poly houses, net house, insect proof net house, shed net house, poly tunnels with the use of mulches & micro irrigation structures.
3. Follow proper crop rotation.
4. Selection of varieties suited to Agroeco-region.
5. Use recommended spacing eg. 60-200 × 50-100 cm

6. To use sufficient quantity of fully decomposed Farm Yard Manure (two year old)/ vermi compost.
7. Balanced use of fertilizers through fertigation.
8. To use technology such as soil solarisation/ chemical treatments for effective control of pests.
9. Timely sowing/ transplanting of crop.
10. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
11. Use bio pesticides/ plant protection chemicals recommended for protected cultivation.
12. Timely harvesting of crop.
13. To save the precious natural resource water, follow micro irrigation technologies (drip irrigation).
14. Use genetically pure & treated seed.

xii. Production constraints in agro-ecological region:

1. Lack of plant growing structures.
2. Monkey, baboon, wild pigs are serious threats. Good quality seed is inaccessible.
3. High cost of seed & poor purchasing power of farmers.
4. Water scarcity.
5. Protected cultivation is cost involving technologies.
6. Repair of the poly houses/ micro irrigation structures is a tedious task.
7. Damage of crop / poly houses /micro irrigation structure by wild animals.
8. Unawareness about scientific technologies.
9. Involvement of middle men in marketing.
10. Availability of agriculture inputs is not easy.
11. Use of unsafe agro chemicals.
12. Difficult labour availability.
13. Different biotic and abiotic stresses.

9H. Name of the vegetable crop: Cucumber

i. Existing varieties being used: Kalyanpur Green, Japanese Long Green, Poona Khira, Pant Khira-1, Poinsette, Japanese Long Green, Straight Eight, Swarna Sheetal, Swarna Poorna, Swarna Ageti etc.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

For open field condition: Pusa Udhay, Pusa Barkha,Shubhangi, Himangi, Punjab Naveen, Tasty, Ruchi, Mandakini, Kumud, Noori, Alamgir, Rani, Don etc,

For protected condition: Pant Parthenocarpic Cucumber-2 & 3, Hilton, Kian, Isatis, Malini etc.

iii. Existing package of practices being used:

1. Use of traditional seeds,
2. Planting in rainy season,
3. Traditional stacking method,
4. Long harvest duration season,
5. Sale at local market
6. Absence of crop rotation.
7. Random selection of variety (May or may not be suited to Agroeco-region).
8. Untimely sowing / planting of crop.
9. Use of untreated seed.
10. Unbalanced use of fertilizers.
11. Use of plant protection chemicals having long wetting period.
12. Use of traditional irrigation system.

13. No soil solarisation/ treatment during lean period.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of protected cultivation.
2. Adoption of crop/ soil health related crop rotations.
3. Recommended/suitable variety for Agroeco-region.
4. Use recommended spacing eg. 60-200 × 50-100 cm
5. Treating seed before sowing.
6. Balanced use of fertilizers (125: 155: 125 Kg N: P: K/ha, respectively) with water soluble fertilizers (fertigation).
7. Selection of eco-friendly plant protection chemicals having short wetting period, recommended for protected cultivation.
8. Selection of optimum planting period.
9. Protected cultivation : Sept
10. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
11. Adoption of micro irrigation technologies for efficient use of available water.
12. Adoption of fertigation system for efficient use of fertilizers.

v. Major insect pests associated with crop:

Leaf miner , white fly, thrips, leaf eating caterpillar, fruit fly, cut worm, Red pumpkin beetle

vi. IPM Module for management of insect pests:

Use of recommended insecticides as per recommended doses during pre-sowing and post-sowing.

Red pumpkin beetle

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Dichlorovos 76% SC	500	627

vii. Major disease associated with crop: Wilt, Mildew, Mosaic

viii. IPM Module for management of disease:

1. Use of recommended insecticides as per recommended doses during pre-sowing and post-sowing.
2. Use of recommended insecticides as per recommended doses during pre-sowing and post-sowing.

Downy mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1500-2000	
Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Azoxystrobin 23% SC	500	7
Amectoctradin+ Dimethomorph 20.27% SC	800-1000	3

ix. Major weeds associated with crop:

Oxalis latifolia, Phyllanthus niruri ,Amaranthus viridis, Euphorbia hirata, Solanum sp.

x. IPM Module for management of weeds: Manual weeding in hills.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of well designed and recommended protected technology suited to area i. e poly houses, net house, insect proof net house, shed net house, poly tunnels with the use of mulches & micro irrigation structures.
2. To follow proper crop rotation.
3. Selection of varieties suited to Agroeco-region.
4. Use recommended spacing eg. 60-200 × 50-100 cm

5. To use sufficient quantity of fully decomposed Farm Yard Manure (two year old)/ vermi compost.
6. Balanced use of fertilizers through fertigation.
7. To use technology such as soil solarisation/ chemical treatments for effective control of pests.
8. Timely sowing/ transplanting of crop.
9. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
10. Use bio pesticides/ plant protection chemicals recommended for protected cultivation.
11. Timely harvesting of crop.
12. To save the precious natural resource water, follow micro irrigation technologies (drip irrigation).
13. Use genetically pure & treated seed.

xii. Production constraints in agro-ecological region:

1. Good quality seed is inaccessible.
2. High cost of seed & poor purchasing power of farmers.
3. Water scarcity.
4. Protected cultivation is cost involving technologies.
5. Repair of the poly houses/ micro irrigation structures is a tedious task.
6. Damage of crop / poly houses /micro irrigation structure by wild animals.
7. Unawareness about scientific technologies.
8. Involvement of middle men in marketing.
9. Availability of agriculture inputs is not easy.
10. Use of unsafe agro chemicals.
11. Difficult labour availability.
12. Different biotic and abiotic stresses.

9I. Name of the vegetable crop: Vegetable Pea

i. **Existing varieties being used:** Arkel, Azad Pea 1 or mixture of varieties

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** Pant Sabji Matar 3, Azad Pea 3, Pea 89, PSM-3

iii. **Existing package of practices being used:** Sowing by broadcasting method, no seed treatment, using own saved seeds to grow crop.

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Sowing early maturing varieties at closer spacing (30 cm plant to plant and about 5-10 cm between plants) and higher seed rate (120 kg/ha).
2. Sowing time: Oct & Mid Nov
3. Seed rate: 100 Kg/ ha
4. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time.
5. If available, at least one ton of farmyard manure per ha should be incorporated in the soil at the time of land preparation. Add fertilizers containing NPK as 30: 70: 50 kg/ha all apply as basal dose.
6. Water the crop as per need especially during flowering and pod setting.

v. **Major insect pests associated with crop:** Leaf miner, pea stem fly

vi. **IPM Module for management of insect pests:** Spray of Dimethoate 0.01% or Imidachloprid 1 ml/l

vii. **Major disease associated with crop:** Powdery mildew in all agroecological situations Fusarium wilt in autumn sown crop

viii. IPM Module for management of disease:

1. Seed treatment with bioagent -3 (4g) and carbendazim (1g) @ one Kg seed for the management of white rot and Fusarium wilt.
2. Foliar spray of tilt @ 0.1% for the management of powdery mildew.

ix. Major weeds associated with crop: All seasonal weeds

x. IPM Module for management of weeds:

Use pendimethaline @ 1kg ai/ha as pre-emergence and one hoeing 25-30 days after sowing.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Follow proper crop rotation.
2. Selection of varieties suited to Agroeco-region.
3. Use recommended spacing eg. 60-200 × 50-100 cm
4. To use sufficient quantity of fully decomposed Farm Yard Manure (two year old)/ vermi compost.
5. Balanced use of fertilizers through fertigation.
6. To use technology such as soil solarisation/ chemical treatments for effective control of pests.
7. Timely sowing/ transplanting of crop.
8. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
9. Use bio pesticides/ plant protection chemicals recommended for protected cultivation.
10. Timely harvesting of crop.
11. To save the precious natural resource water, follow micro irrigation technologies (drip irrigation).
12. Use genetically pure & treated seed.

xii. Production constraints in agro-ecological region: Non-availability of quality seeds and lack of irrigation facilities.

9 J. Name of the Vegetable crop: Leafy vegetables

i. Existing varieties being used: Locally available varieties of palak, methi and amaranthus

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

Palak- All Green, Pusa Harit
Methi- Pant Ragini, Pusa Early Bunching and Kasuri Selection
Amaranth- Chhoti Chaulai, Badi Chaulai, Pusa Kiriti,
Pusa Kiran and Pusa Lal Chaulai.

iii. Existing package of practices being used:

1. Varieties- – farmers are using the local varieties of leafy vegetable
2. Sowing methods: Broadcasting method of sowing is used by farmers.
3. seed Treatment- farmers of the state do not treat the seed materials
4. Manures and fertilizers- Farmers incorporated undecomposed cow dung in the field.
5. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
6. Cuttings- The leaves are not picked as per recommended practices as per variety.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Seed- Farmers should use improved varieties/ hybrids of leafy vegetables
2. Seed Treatment- to protect crops from different diseases, farmers must treat the seed by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or T*richoderma viride* 4g/kg before sowing of seeds.

3. Seed sowing: Seed is sown by line sowing method
4. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Palak- winter crop-10-15 kg seeds/ha
   Summer crop-25-30 kg/ha
   Methi- direct sowing -20-30 kg/ha
   Amaranthus-direct sowing-2kg/ha
5. Transplanting- 1kg/ha
6. Spacing: sowing of seed should be done at proper spacing
   Palak: Row to Row- 20cm and plant to plant -5cm
   Methi: Row to Row-20-30 cm and plant to plant 10-15cm
   Amaranth: Row to Row-20-30 cm and plant to plant-10 cm
7. Manures and fertilizers- Farmers should incorporate well rotten cow dung (10-15 tonnes/ha) and NPK (50: 50:20). On the basis of soil testing. Top dressing of nitrogen after each cutting.
8. Application of Vermicompost @ 5qt/ha in the field is beneficial for leafy vegetables.
9. Cutting: cutting should be done at proper stage at 25-30 days after sowing.

v. Major insect pests associated with crop: Aphid, white fly, grass hopper

vi. IPM Module for management of insect pests : Foliar spray of quinalphos 25EC @0.2%

vii. Major disease associated with crop: Powder mildew

viii. IPM Module for management of disease: Spray of wettable sulphur @0.2%

ix. Major weeds associated with crop:
Palak- jangli palak (Rumex acutus)
Methi- bathua, senji (*Melilotus alba)*
Amaranthus- Jungli Chauli (*A. viridis*) kataili chauli, Bathua

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1.Follow deep summer /winter ploughing
2.Line sowing should be prefer
3.Follow proper crop rotation
4.Use of improve varieties of leafy vegetable
5.Timely weeding and hoeing should be done and timely cuttings of leaves

xii. Production constraints in agro-ecological region:

1.Unavailability of quality seed
2. Farmers are not aware about improved varieties of leafy vegetables
3.seed treatment is not being followed
4. Proper method of sowing is not followed
5. Imbalance use of fertilizers.
6. Disease and insect pest problem. They do not know how protect leafy vegetable from biotic stress.

9A.Name of the fodder crop: Berseem

i. Existing varieties being used: Mescavi, Vardan

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: JB-1, BL-1,Hybrid multi cut, Pusa Gaint & Bundel Berseem 243

iii. Existing package of practices being used: Sowing after Puddiling

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil : loam to clay soil
2. Field preparation: 3-4 Harrowing + Leveling the field.

3. HYVS. – Mescavi, Vardan. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
4. Seed rate: 25-30 kg/ha
5. Sowing method:

a. Wet method-like rice in puddled field

b.Dry method: Without puddled.

6. Broad casting
7. Sowing time: First an week of October
8. Fertilizer: 30:60:70:: N:P2O5 K2O kg/ha
9. Irrigation: Field should remain at field capacity throughout the crop period after germination.
10. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
11. Cutting management: First cut -45-50 DAS
12. Other cutting at 25-30 days interval- total 5-6 cutting are taken
13. Yield: 800-1000g/ha. Green forage.

v. **Major insect pests associated with crop:** Not reported
vi. **IPM Module for management of insect pests:** Mechanical control
vii. **Major disease associated with crop:** Not reported
viii. **IPM Module for management of disease:** Seed treatment
ix. **Major weeds associated with crop:** Not reported
x. **IPM Module for management of weeds:** Not available
xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:** Use multicut Varieties
xii. **Production constraints in agro-ecological region:** Not sowing in hill areas

9B.Name of the fodder crop: Maize

i. **Existing varieties being used:** Ganga, Kanchan
ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:**
Early -Gourav, Vivak, Kanchan, Pant Sankar makka – 1, Vivak hybrid maize-25, 33 & 39
Mid mature – Tarun, Naveen, Sweta
iii. **Existing package of practices being used:** Line sowing
iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Soil: Well drained alluvial soil with soil PH 5.5-7.5.
2. Field preparation: 4-5 harrowing + leveling
3. HYVS: African Tall, J-1006. Pratap Makka Chari-b.
4. Seed rate: 50kg/ha
5. Spacing : 30-45 cm(row to row distanced)
   10-15 cm (plant to plant)
6. Sowing time
   Rainfed: Onset of monsoon
   Irrigated : Feb to July
7. Sowing method : Line sowing is proposed over broadcasting
8. Fertilizer : 100-120 : 60:40: 20::: P_2O_5 : K_2O: ZnSo4 kg/ha
9. Irrigation: Fodder maize grown under irrigated condition should be irrigated at 20 days interval. Spring/summer crop requires 5-6 irrigations.
10. Weed control: Pendimethalin @ 0.75 kg ai/ha (PE) application.
11. Harvesting: The crop should be harvested at tasseling /silling stage or 50-55 days after sowing.
12. Yield: Green fodder: 350-450q/ha.

v. Major insect pests associated with crop: -

vi. IPM Module for management of insect pests: -

vii. Major disease associated with crop: -

viii. IPM Module for management of disease:-

ix. Major weeds associated with crop: Local weeds

x. IPM Module for management of weeds: Hand weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yielding variety,
2. Production of sweet corn & baby corn, Maize with quality protein maize

xii. Production constraints in agro-ecological region: Local varieties, thining & Imbalance fertilizer

C1. Livestock: Buffalo

1.A Existing breeds available: Mostly non-descript, Neeli-Ravi cross, Murraha cross

1.B Specific breeds to be introduced: Murraha, Neeli-ravi

2.A Existing feeds being used:

Wild grasses, paddy straw, wheat straw, wild dried grasses, Leaves of trees such as silver oak, bhemal, khadeek, mulberry

2.B Specific feeds to be introduced / advised:

1. UMBB, Feed blocks, Fodder maize, multi cut chari, multi Barseem, Hybrid napier, tall fascue, Italian rai, cox foot, orchard grass fodder trees etc
2. Fortification of local Fodder, use of Chaff cutter and mangers etc

3.A Existing health services:

1. State animal husbandry department (Vet. Hospital, LEO Centers)
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Village level workers for first aid,
2. Vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder,
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction,
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds, shortage of feed and fodder,
2. Improper feeding,
3. Poor housing and management of animals,
4. Improper health services,
5. Mostly unproductive animals,

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed,

3. Low cost of milk

C2. Livestock: Cattle

1.A Existing breeds available: Mostly non-descript, Badri, Cross bred of Jursey, HF, Sahiwal

1.B Specific breeds to be introduced: Jersey, HF, Sahiwal

2.A Existing feeds being used:

1. Wild grasses, paddy straw, wheat straw, dry grasses
2. Leaves of trees as silver oak, bhemal, khadeek, mostly rearing on grazing

2.B Specific feeds to be introduced / advised:

1. Fodder maize, multi cut sorgam (chari), Barseem, Hybrid napier, fodder trees etc
2. Fodder treatment, Chaff cutter, mangers etc

3.A Existing health services:

1. State animal husbandry department
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Village level workers for first aid
2. Vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds,
2. Shortage of feed and fodder,
3. Improper feeding,
4. Poor housing and management of animals,
5. Improper health services,
6. Mostly unproductive animals

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed
3. Low cost of milk

C4. Livestock: Goatry

1.A Existing breeds available: Jamunapari/CB/ ND

1.B Specific breeds to be introduced:

Jamunapari/sirohi/ Barbari, Chaugarkha, 200 Flock farm to be established at Nariyal gaon, only land is available, produced animal will make available to farmers on demand on various scheme.

2.A Existing feeds being used:

Tree leaves, Grasses/ perennial herbs, Seasonal fodder crops, Crop byproducts (straws, stalks, stover),

Grasses (from forests, orchards, pastures, agricultural land, grazing lands, wastelands, alpine land)

Urea treated straw, UMMB, Complete feed blocks

2.B Specific feeds to be introduced / advised:

1. Plantation of more fodder trees, perinniel grasses,
2. Distribution of seasonal fodder seeds,
3. Need to devolap good quality pastures, grazing lands,
4. Motivate people to feed
5. Concentrate to goats

3.A Existing health services:

PPR Enterotoxemia/ppr contagious ecthima fmd, Viral Exanthema

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Vaccination against all related diseases,
2. 3 times scheduled deworming before and after rainy season and during winters,
3. Regular treatment camps to be organized,
4. Required Dipping tank in all area for ectoparasites

4.A Existing management practices:

1. No seperate barn(house)is there, kept along with large animal,
2. Stall-fed and intensive production system
3. Semi-intensive production system , both the system of rearing are practised

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Be protected from hot and cold wind, humidity, solar radiation and rain. The house should have east-west orientation.
2. Shed should be constructed on elevated land and free from water logging or marshy areas.
3. Adequate floor space (1.2 to 4.0 sq mt/ goat) may be provided to avoid overcrowding. Breed improvement should be adopted.
4. Castration at the right age i.e. 1 to 2 months for better meat quality, higher market price and unwanted breeding in the flock

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Local breed, Shortage of feed and fodder, Inbreeding

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing: Local breed, Shortage of feed and fodder, Inbreeding, Marketing of product

C3. Livestock: Sheep

1.A Existing breeds available: ND

1.B Specific breeds to be introduced: Not much scope (as the number is very less in district)

2.A Existing feeds being used:

1. Tree leaves, Grasses/ perennial herbs,
2. Seasonal fodder crops,
3. Crop byproducts (straws, stalks, stover),
4. Grasses (from forests, orchards, pastures, agricultural land, grazing lands, wastelands, alpine land)
5. Urea treated straw, UMMB,
6. Complete feed blocks

2.B Specific feeds to be introduced / advised:

1. Plantation of more fodder trees, perinniel grasses,
2. Distribution of seasonal fodder seeds,
3. Need to devolap good quality pastures, grazing lands,
4. Motivate people to feed
5. Concentrate to goats

3.A Existing health services:

1. PPR (though population in the district is negligible),
2. 3 times scheduled deworming before and after rainy season and during winters.

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Vaccination against all related diseases,
2. 3 times scheduled deworming before and after rainy season and during winters,
3. Dipping tank and shearing centers required

4.A Existing management practices:

1. No seperate barn(house)is there, kept along with large animal,
2. Stall-fed and intensive production system
3. Semi-intensive production system , both the system of rearing are practised

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. The goat house should always be protected from hot and cold wind, humidity, solar radiation and rain. The house should have east-west orientation.
2. Shed should be constructed on elevated land and free from water logging or marshy areas.
3. Adequate floor space (1.2 to 4.0 sq mt/ goat) may be provided to avoid overcrowding. Breed improvement should be adopted.
4. Castration at the right age i.e. 1 to 2 months for better meat quality, higher market price and unwanted breeding in the flock.

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Local breed, Shortage of feed and fodder, Inbreeding

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing: Local breed, Shortage of feed and fodder, Inbreeding, Marketing of product

C5. Livestock: Poultry

1.A Existing breeds available: Poultry: Local, Croiler, RIR, uttara fowl

1.B Specific breeds to be introduced: Poultry: Croiler, Kadaknath, Cob, Cari-davendra, cari-nirbheek

2.A Existing feeds being used: Kitchen waste

2.B Specific feeds to be introduced / advised: Starter, grower, finisher feed according to age

3.A Existing health services: State animal husbandry department, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region: Specific poultry management services

4.A Existing management practices: Mostly backyard

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district: High yielding breeds, proper feeding and management practices

Vet. Health services

Resouces		Manpower							Infrastructure		
		No.	V. O.	LEO	Pharmacist	Lab. Tech.	Livestock Assistant	Para vets	Buildings	Equipments	Others
Vety. Hospitals	Existing	13	13	-	15	-	31	1	12	Available	-
	Proposed	3	3	-	3	-	6	-	3	-	-
Mobile Vety. Unit	Existing	1	1	-	1	-	2	-	No	Not Available	-
	Proposed	1/block+1	05	-	05	05	05	-	-	Needs to be procured	
Vety. Dispen.	Existing	23	-	23(Vacant -09)	-	-	-	-	9	-	-

	Proposed	2	-	2	-	-	-	-	2	-	-
AI centres	Existing	28	13	15	-	-	-			Available	-
	Proposed	2	-	2	-	-	-	-	-	-	-
Disease Diag. Labs	Existing	Nil	1	-	-	Vaccant	1	-	1	Available	-
	Proposed	1	1	-	1	1	1	-	-	-	-
Polyclinic	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	1	-	-	-	-	-	-	Required	Required	-
Ambu. Clinics	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	-	-	-	-	-	-	-	-	-	-

Availability of Medicines/ Vaccines: Adequate

Specific health services to be required/ advised for doubling income in specific agro-ecological zone:

1. Nutritional gap needs to be filled.
2. Farmers should be provided feed &fodder supplements at subsidised rates,
3. Minimum support prize should be fixed for the farm products, improved market infastrustureand market scope.

Any other suggestions to improve the quality of Vety. Health services:

1. Need restructuring of the department especially for the hilly areas so as to fulfil the staff requirement.
2. Refresher course should be organised for the doctors.

Problems of Animal Husbandry

Specific problems due to which income is not increasing	Poor accessibility	Yes (some remote hilly area)
	Water scarcity	Almost in the whole district
	Natural disasters	Frequency is low
	Wild life conflicts	Yes, frequency is very high due to which farming intensity is decreased to a significant level in both the zones
	Marketing of animals	No availability of structured market
	Marketing of products	Due to Low cost of milk and milk product marketing is not upto the mark, transportation cost is also very high thus making is not feasible, need chilling plants at regular distance.
	Budget	Allocation is low
	Manpower shortage	Yes. Monopoly gender role in livestock activity
	Capacity building	Para veterinary staff and refreshal courses of vetenarians is required
	Equipment & Implements (old/ shortage, etc.)	Adequate
	Mobility	Huge Problem. Dependence on the public vehicle is very high. Difficult terrain. Difficult road

		connectivity.
	Risk cover (Insurance)	Is must, though inappropriate action by insuarance companies in settlement of claims discourage farmers
	Relook to policies	-

D. Integrating Farming system

1.A Existing farming system: Animal husbandry + Crop/Vegetable

1.B Specific farming system for doubling income in specific agro-ecological region: Animal husbandry+Horti +Crop/Vegetable

E. Reducing post harvest losses and value addition

1.A Existing grading facilities: Not available in area

1.B Grading facilities to be advised/ setup for doubling income in the agro-ecological region of district:

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.A Existing processing facilities:

1. Food processing units of Deptt of Horticulture.
2. Units of some NGOs

2.B Processing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular commodity
6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

3.A Existing packing facilities: Not available

3.B Packing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

A factory based on plastic cartoon, *Kilta*, *Dalia* of various grade and size based on weight of the fruit is needed at least at distt level to meet the requirement of mango, litchi and seasonal vegetables.

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)
4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxes for particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed

4. A Existing storage facilities: At present no storage facilities are available in the distt.

4.B Storage facilities to be advised/ setup for doubling income in the agro-ecological region of district:

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo
3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chambers
7. Jaggery storage bin

F. Waste land development and waste water

1.A Existing practices of soil water conservation:

1. Using indigenous technology use for water conservation includes formations of bund,
2. Growing of Napier and other perennial grasses, multiple forest species as per need are requirement.
3. Plantation on eroded/waste lands, and check dams for gully control.

1.B Package of practices to be advised/ developed for management of wasteland and wastewater in the agro-ecological region of district:

1. Construction of check dams and irrigation channels
2. In wasteland, a wide scope of fodder and fruit plantation.

2.A Existing plantation: Shirish, Kachnar, shisham , teak, popular, UK liptus, Khair etc

2.B Plantation suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of

district:

1. Shirish, Kachnar, Vilyati khair etc are useful as dual purpose species to meet fodder, fire wood and other requirement of the farmers. Sufficient plants are available at forest nurseries for plantations.
2. Rejuvenation/repair of faulty/abandoned terraces;
3. Stabilization of eroded land using biological/engineering measures;
4. Plantation of suitable trees/brushes in waterlogged and eroded areas;
5. All agricultural operations should be done on contours i.e. across the existing land slope.
6. Temporary gully control structures (brush-wood dam, loose-rock dam, plank/slab dam, log dam, gabion check dam etc.) should be constructed to stabilize gullies using locally available materials.
7. Permanent gully control structures (drop spillway, drop inlet spillway and chute spillway) should be constructed in badly eroded large gullies where temporary structures are inadequate or uneconomical.
8. Diversion of runoff through ditches from upper slopes to safer places.
9. Gabion structures can be made along the hill roads as retaining wall, and along the stream banks for protection.
10. Contour bunding up to 6% slope in areas with less than 800 mm mean annual rainfall and permeable soils; and graded bunding in areas with > 6% slope and > 800 mm mean annual rainfall.
11. Contour trenching (staggered/continuous).
12. Domestic wastewater may be reclaimed at house hold level for use in kitchen gardens.
13. Industrial wastewater must be purified by the concerned industries at their factory level, and should not be thrown into the streams/rivers.
14. The discharge from perennial/seasonal natural water springs must be stored in tanks to ensure continuous water supply for drinking and domestic uses.
15. Efforts must be made to rejuvenate the dying springs or enhance the discharge of flowing springs by way of plantation and trenching in their recharge zone.

3.A Existing fodder production: Forest leaves, bar seem, Napier, Maize, sorgam, etc.

3.B Fodder suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of district:

Napier grass, Multi cut bar seem, Multi cut Chari fodders are suggested

Package of practices to be advised/ developed

1. Rejuvenation/repair of faulty/abandoned terraces;measures;
2. Plantation of suitable trees/brushes in waterlogged and eroded areas;
3. All agricultural operations should be done on contours i.e. across the existing land slope.
4. Temporary gully control structures (brush-wood dam, loose-rock dam, plank/slab dam, log dam, gabion check dam etc.) should be constructed to stabilize gullies using locally available materials.
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13. Efforts must be made to rejuvenate the dying springs or enhance the discharge of flowing springs by way of plantation and trenching in their recharge zone.

4.A Type of waste water: Home and kitchen waste

4.B Existing treatment facilities: Not available

4.CTreatment facilities to be advised/ developed for waste water treatment and utilization in the agro-ecological region of district:

1. Multistage filtration unit should be established to recycle the waste water for multiple uses.
2. Domestic wastewater from kitchen and bathroom should be treated before being used for irrigation in vegetables and other crops.
3. Industrial wastewater should not be used for irrigation directly; and must be treated by the concerned industries at their factory level as per norms to make it suitable for irrigation or other uses.
4. Sewage water from cities should be treated by municipal corporations or other agencies.

G. Reduced cultivation cost

1.A Existing inputs being given:

Rice-wheat/Rice-Potato/Maize-Rajma/Mustard

1. Annexure–II is enclosed for N, P and K.
2. In Zn deficient soils, application of 25 (sandy loam)- 50 (Clay loam) kg $ZnSO_4$ (21% Zn)/ha or foliar spray of 0.5% $ZnSO_4$ + 0.25% lime in standing crop
3. In Cu deficient soils, application of 4-5 kg $CuSO_4$/ha or foliar spray of 0.25% $CuSO_4$ + 0.125% lime in standing crop
4. Soil application of 215 kg gypsum/ha
5. Foliar spray of 1% $FeSO_4$ in rice nursery

Tomato, Cabbage, Capsicum, French bean, Green pea, Radish

1. In Zn deficient soils, application of 10 kg $ZnSO_4$ (21% Zn)/ha or foliar spray of 0.5% $ZnSO_4$ + 0.25% lime in standing crop
2. Foliar spray of 0.2% Borax
3. Soil application of 215 kg gypsum/ha
4. Traditional and unprocessed inputs are used in agricultural practices.
5. Drudgery prone implements/tools are in practice for various operations.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district: Application of nutrients based on soil test basis as major and micro elements.

2.A Existing mechanization:

Limited use of power driven implements in land preparation. Small tools like sickle, hand hoe etc are being adopted by progressive farmers.

Wheat

1. Conventional tillage by offset disc harrow/ rotavator followed by Planker
2. Conventional seed-cum-fertilizer drill / manual broadcasting for sowing
3. Manually operated sprayers for plant protection / tractor operated high pressure sprayers.
4. Manual and chemical weed control
5. Combine harvester / manual harvesting
6. Multi-crop / wheat thresher
7. *Bhusa* combine / straw reaper in combine harvested field.

Paddy

1. Conventional method of nursery raising.

2. Conventional tillage using disc harrow.
3. Puddling by paddy disc harrow / rotavator/ cultivator/peg type puddler.
4. Manual transplanting.
5. Manual / chemical weed control.
6. Manual top dressing of urea and zinc.
7. Manual / combine harvesting.
8. Threshing by axial flow power thresher.

Soybean

1. Seedbed preparation using disc harrow followed by planker.
2. Manual sowing.
3. Manual interculture and earthing-up of plants.
4. Manually operated sprayers for weed control and plant protection.
5. Manual harvesting.
6. Manual threshing / multi-crop power threshers

Pea

1. Seedbed preparation using disc harrow followed by planker.
2. Sowing by conventional tractor drawn seed drill.
3. Chemical weed control and plant protection using high pressure tractor operated sprayers.
4. Manual picking of vegetable pea.
5. Manual harvesting for seed production.
6. Threshing by multi-crop thresher

Management of Orchards

1. Manual digging of holes for sapling planting.
2. Manual watering of plants.
3. Manual interculture operations.
4. Manual pruning of branches.
5. Manual plant protection.
6. Manual picking of fruits.
7. Manual grading.

2.B Mechanization required for reducing cost of cultivation in the specific agro-ecological region of district:

Tractor, Power tiller, power weeder, and shrub cutter, Multiple crops threshers are becoming popular and are available in pockets. Old wooden based impelents are being replaced with iron/alloy (Plough, danalla,) based tools are available.

Wheat

1. Seedbed preparation by rotary plough /rotavator
2. Sowing by zero-till drill / roto –till drill / happy seeder
3. Tractor operated high capacity power sprayers/ power operated ULV sprayers for plant protection.
4. Combine harvesting and *bhusa* making using *bhusa* combine.
5. Self-propelled reaper binder / tractor drawn vertical conveyor reaper windrower.
6. High capacity power wheat thresher.
7. To avoid wheat straw burning and its useful application recovery of wheat straw using tractor drawn baler.

Paddy

1. Transplanting by self-propelled transplanter and mat type nursery raising.
2. Seedbed preparation by rotavator/ conventional disc harrow.
3. Puddling by rotavator / peg type puddler.
4. Cono-weeder / powered paddy weeder for weed control.
5. *Promotion of Direct Seeded Rice using DSR Seed drill.*

6. *Promotio of rice drum seeder for sowing of pre-germinated rice.*
7. Chemical weed control using high capacity power sprayers in DSR / drum seeded rice.
8. Harvesting by self-propelled combine harvester.
9. Harvesting by tractor / power tiller operated vertical conveyer reaper windrower.
10. Threshing by axial flow thresher.
11. To avoid paddy straw burning and its useful application recovery of paddy straw using tractor drawn baler.

Soybean

1. Seedbed preparation using rotary plough/ rotavator/disc harrow followed by planker.
2. Sowing by FIRB planter.
3. Weed control by powered rotary weeder.
4. Harvesting and threshing by soybean combine.
5. Harvesting by tractor drawn soybean reaper.
6. Threshing by multi-crop thresher.

Pea

1. Seedbed preparation by rotary plough.
2. Sowing by tractor drawn inclined plate planter.
3. Plant protection using ULV sprayer.
4. Chemical weed control.
5. Manual picking for vegetable pea.
6. Harvesting by self-propelled combine harvester for seed production.

Management of Orchards

1. Digging of holes by light weight power tiller operated post hole digger.
2. Watering by fertigation using drip method.
3. Pruning by power chain saw / mechanical pruners.
4. Fruit picking by mechanical hand held pickers.
5. Plant protection by aero blast sprayer.
6. Grading by mechanical graders.

3.A Existing collective inputs:

Community pasture land, Service bulls, Irrigation channel and source, Irrigation tanks, Chemical Fertilizers, Insecticides, Pesticides, Farm Yard Manure, Seed, Water and Tillage Machinery

3.B Collective inputs suggested for reducing cost of cultivation in the specific agro-ecological region of district:

Custom hiring energy based implements viz. Small tractor, tiller, Power sprayers; Hydrum irrigation can reduce the cost of cultivation along with reduction of farm labour.

Lower Hills

1. Fertilizer application should be based on soil test value at right time, right place with right method.
2. Basal application (50%N+100% P&K) at the time of sowing and 02 foliar application of N, secondary and micronutrients on standing crop.
3. Apply well decomposed organic manures and composts such as vermicompost, biofertilizer to supplement costly fertilizers to reduce cost up to 25-30%.
4. Inclusion of pulses in crop rotation.
5. Need based and recommended concentration of plant protection chemicals using correct method of application.
6. Enhanced use of bio-agents to control disease and pests; avoid use of costly chemicals.
7. Farmer should use high yielding variety seed and multiply at his own site for next 02-03 seasons.
8. Use optimum and recommended seed rate at optimum spacing and depth.

9. Use good quality of water and avoid excess use of water for irrigation.
10. Sprinkler and drip methods for irrigation should be encouraged to improve water use efficiency.
11. Promote reduced tillage operations.

4. **Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district**

Irrigated valleys and lower hills (600-1200m area)

1. Labour cost
2. High hybrid seed cost
3. No storage facilities for perishable product
4. No chilling plant for milk

Situation-I

Represent subtropical climate with moderating high temperature (18-30 ^{0}C) medium rainfall, low humidity (40-50%) and experiences no snowfall. 80% of total precipitation is received during June to September. Sal in outer Himalayas and pine and oak in middle and inner Himalayas are the predominant vegetation. Soils are alluvial sandy loam to loam.

H. off-farm income

1.A Existing SHGS operative in specific agro-ecological region of district: ATMA, AAJIVIKA, GRASS, SAMBANDH, NIDHI, BAIF, KAGAS

1.B SHGS to be created/ encouraged in the specific agro-ecological region of district for doubling agricultural income:

1. Milk collection and chilling group
2. Honey collection and production group
3. Mango and Litchi collection centres
4. Crop collection centre
5. There is need to have regular monitoring and follow up of SHG's by the forming agencies and time to time evaluation of the group.
6. Regular monitoring by the concerned agency must be ensured like ensuring regular meeting of the SHG, checking their register, regular collection of the money, help during conflicts, solving problems occurring during banking etc. and submitting the monitoring report to their concerned officials so that steps can be taken by the high officials to ensure regular continuity of the SHG.
7. Imparting the information to the groups about various govt. schemes regarding loan, trainings and marketing of the product.
8. A large number of groups discontinued as they were not having knowledge regarding income generating activities that can be started (what activities can be taken up, how to operate it, where to market the produce etc.) So there is need of encouragement, motivation along with imparting knowledge, skills and linking them to market.
9. Trainings should be provided to the rural women on income generating activities as per the need of rural women, marketing potential and availability of locally available resources.
10. Loan procedure should be made more flexible with less interest rate.
11. As there were problems like non-cooperation among members, confusion regarding money matter, lack of confidence on office bearers with respect to group money etc., there is need of organizing training on good governance, democratic election and how to solve financial and administrative issues.
12. SHG's formed should be grouped into clusters, federations and registered cooperatives so as to converge with govt. schemes, facilitate collective purchase of input and marketing of products.
13. To encourage people to form and sustain SHG's so that new enterprise developed,

intensive work needs to be done with them in sustainable manner.

14. Enterprises need to be identified depending upon local resources- human and material.
15. Market linkages need to be developed so that people can sell their produce gainfully.
16. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
17. Target should not be only to form large number of SHGs but care should be taken that formed SHG may be in less number are functioning properly.

1.C Problems related with SHG:

1. Not interested in continuing the group
2. Non-cooperation among the members
3. Problem in getting loan
4. Lack of resources like money, space
5. Lack of knowledge regarding various income generating activities,
6. Lack of trainings
7. Lack of follow-up and monitoring from the forming agencies.
8. In hills farm holdings are very small and large part is rainfed depending upon rains with very low and uncertain productivity.
9. Young people do not stay in villages and move to other areas or take up other profession such as tourism, transport, hospitality etc.
10. People remaining in villages are not very enterprising.

2.A Existing Micro-entrepreneur employment:-

2.B Micro-entrepreneur employment to be generated in the specific agro-ecological region of district for doubling agricultural income:

1. Poultry growing group
2. Honey and honey products unit
3. Milk and milk products shops
4. Honey collection and production group

3.A Existing skill development facilities:

1. Extension training institute
2. Dairy
3. Handloom weaving, Office of Development commissioner (handicrafts), Handicraft marketing, service and extension centre, Almora

3.B Skill development facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units
5. Value addition and food chain centre
6. Storage, grading and Packaging centre
7. Bioagent and bio fertilizers production lab
8. Medicinal plant growing and processing units
9. Survey need to be conducted regarding locally available crops, fruits, vegetables and other things.
10. On the basis of these enterprise can be generated.
11. Handloom weaving can be promoted
12. Training centre, processing and packaging units as per the locally available resources

4.A Existing women skilling facilities: Not Available

4.B Women skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Khadi and Kargha training for women skill
2. Drudgery reduction practices for high efficiency
3. Herbal dye based skill training and skill for local textiles.
4. Value addition skill for women
5. Training centres processing units, packaging units and market outlet as per the locally available resources

5.A Existing youth skilling facilities: Extension training institute

5.B Youth skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units
5. Value addition and food chain centre
6. Storage, grading and Packaging centre Training centres processing, packaging units and market outlet as per the locally available resources

Beekeeping

Beekeeping is an environment friendly and agro-forestry based occupation. It provides enormous potential for income generation, poverty alleviation and sustainable use of forest resources. Beekeeping is one of the oldest traditions in India for collecting the honey. Honey bee farming is becoming popular due its demand in national and international markets as well. *Apis cerana indica* is the indigenous bee, is known to be the ideal pollinator for organically grown mountain crops due to its capacity to significantly enhance agricultural productivity. India has a potential to keep about 120 million bee colonies that can provide self-employment to over 6 million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tons of honey and about 15,000 tons of beeswax.

Less Investment: Bee Farming is not a manufacturing activity, as such costly machine and tools are not required. There is nothing like production capacity as well. Only small wooden frames with boxes are needed. Their sizes are also standardized. To begin with around 15 such sets/boxes can be purchased or assembled at rate of Rs.1500.00 per box that would cost Rs.22, 500/- for 15 Boxes. Honey extractors would cost to the tune of Rs.5, 000/- each with filtration facilities. For other miscellaneous expenditures including training and consultancy services a sum of Rs.5000.00 can be earmarked. That means total of Rs.32, 000.00 would be required to start Bee Farming with 15 Boxes which is equivalent or less than the cost of cultivation of one acre of paddy field.

More Returns: As per the established norms, each box comprises 7-8 hives which is able to harvest around 30-35 kg of honey in a year. The annual harvest of honey starting with 15 bee boxes could be 450-525 kg depending on the flowering season. Even after considering very conservative selling price of Rs. 150/- per kg; the annual realisation would be to the tune of Rs. 67,500/- to Rs.78,750/-. Therefore, Bee Farming can be considered as an excellent, profitable agro-based green enterprise for landless farmers and entrepreneurs.

Beekeeping in Uttarakhand: Beekeeping has been an integral part of human society since centuries in hill regions of Uttarakhand state. The state of Uttarakhand has a predominantly agrarian economy and large number of small and marginal farmers in the mountainous state call for augmenting agricultural production by organic means. The indigenous bee sub-species *Apis cerana indica* commonly is ideal pollinator for organically grown mountain crops, with the capacity to significantly enhance agricultural productivity with an indirect but vital role in combating soil degradation by pollinating wild plants thereby enabling improved regeneration of bio mass, to be returned to the soil. Beekeeping with *Apis cerana indica F*. is a common practice in hills of Garhwal and Kumoun Himalaya which is carried out mostly by

using traditional methods since long past and is stationary in nature. In these regions, beekeeping is also carried out with *Apis mellifera,* but in winter season, due to temperature lower than 20ºC, colonies are being migrated to plains. According to report given by KVK Jeolikot(2017), in Uttarakhand, there are about 4,790 beekeepers with 45,247 number of *A. cerana indica* colonies yielding 546.70 mt of honey production. Whereas, in Almora region of Uttarakhand, there are about 400 beekeepers with 1,165 number of *A. cerana indica* colonies yielding 16.4 mt of honey production. The Uttarakhand state has extremely rich bee forage plants. In most of the remote areas where *Apis cerana indica* beekeeping is common, the use of pesticides and chemicals is negligible, the level of dangerous chemicals in the atmosphere is insignificant and the environmental pollution is at minimal level. Honey produced from such areas is purely natural, free of any residues and can be sold as an organic product. There is vast potential for beekeeping in the country. However, due to lack of knowledge, scientific beekeeping is not being practiced by, most of the beekeepers. It is necessary for beekeepers to participate in the trainings / other capacity building programmes on the subject to gain scientific knowledge on the subject. Selection of good apiary site, good quality bees and proper management are the main keys for success of beekeeping. Following are the important points to start beekeeping and further management practices.

1. Selection of good apiary site: Select apiary site by considering the following:

1. Apiary ground should be clean & free from dry leaves etc. to avoid fire during summer
2. Apiary site should be away from power station, brick kilns, highway and train tracks
3. Site should be open & at dry place having shade
4. Site should be easily accessible by road
5. Fresh running water should be easily available near the apiary
6. It should have natural / artificial wind breaks
7. Site should receive early morning and afternoon sunshine
8. There should not be other commercial apiary within 2-3 kilometers from the apiary site
9. There should not be any source of stagnant / dirty water, chemical industry/ sugar mill, etc., nearby the apiary
10. Area should be rich in bee flora

2. Selection of good quality bees: Beekeeping depends on floral resources, climatic conditions, management and also quality of bees, particularly queen. Therefore, the following should be kept in mind to select the bee colonies:

1. Buy disease free bee colonies from existing reputed beekeepers after getting training on the subject.
2. Select and multiply honey bee colonies only from disease resistant, high honey yielding, young, healthy and high egg laying capacity queen, less swarming tendency etc.
3. Keep colonies with good prolific queens
4. Capture few bee colonies from their natural abodes in forests which may be used for further breeding/ multiplication to prevent inbreeding.

3. Management of apiary:

A. Placement of colonies in apiary

1. Hives should be as per specification of BIS/ISI and should be of locally available seasoned light weight wood. Unseasoned and heavy wood should be avoided
2. Avoid nailing the bottom board with the brood chamber
3. Restrict number of bee colonies in a apiary from 50-100
4. Keep row to row and box to box distance as10 and 3 feet, respectively

Hives used for traditional beekeeping in hilly areas are

Wall hives: Wall hives locally known as ‘Khadra’, ‘Jaala’ or ‘Jalota’ are rectangular structures made in the walls of houses and ‘Chhaan’ or ‘Sunni’ (cattle sheds) at the time of construction. Each hive has a small round or rectangular opening on the outer side as an

entrance for bees. The size of 'Jalotas' varies in different locations; usually they are 45-60 cm in length, 25-30 cm in width and 20-30 cm in height . Generally one hive is made in each wall, but numbers may vary from 2-4. The interiors of hives are smoothed with cow dung and clay. In winters due to lack of floral resources and extreme cold in the hills, the population of *Apis cerana* colonies decreases to a great extent. Thick wall hives provide considerable insulation in such conditions.

Log hives: Two types of log hives are found, Type I: These are made up of cylindrical hollowed pieces of tree trunk 60-100cm long and 20-40 cm in diameter; however size depends upon the circumference of available trunks . This type of log hives is usually made from the trunk of *Quercus leucotrichophora, Q. floribunda, Rhododendron arboreum and Pinus roxburbhii.* The entrance is made at the mid front side. Both sides are plastered with a mixture of cow dung and clay. Type II: Old cooperages locally known as 'Pariya' or 'Dokha' when rendered useless for milk products, are used as hives. These are about 70-90 cm long with the diameter at top from 25-35 cm and thickness of log 3-5cm. An entrance is made towards the outside and the hive is placed horizontally on a raised platform of stones or the wall of a courtyard. It is mainly made up of the wood of *Ougeinia oogeinesis, Rhododendron arboreum, Toona* spp. A stripe of old comb is fixed to the upper part, inside the hive, and is plugged with a wooden or metal cover, then sealed with a mixture of clay and cow dung. The wooden lid is fixed at the top with an entrance on it.

Miscellaneous Types: These are rectangular box hives made up of separate wooden boards with movable top cover . Their size varies in different localities. Usually these are 80-110 cm long, 25-30 cm wide and 40-50 cm high. During extraction, the top cover is removed along with attached combs and bees, and taken away from the hive, then each comb is smoked and shaken gently. Bees return to the hive and beekeepers cut combs easily.

All hives are made from locally available materials, thus are economically cheaper and environmentally friendly. These hives have thicker walls as compared to modern hives thus provide protection to bees from extremely low and high temperatures. In higher hills traditional hives are more suitable than modern hives but for the drawback in colony management.

B. Inspection of colonies

1. Adopt general colony and personal hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board, top cover, etc. frequently
2. Check the colonies periodically for any abnormalities or changes in behaviour of bees
3. Inspect colonies on clear sunny days preferably at temperatures between 20 and 30°C
4. Do not inspect colonies in cold, windy and cloudy days
5. Use smoker when needed to subdue the bees
6. Use protective dress and veil while inspecting colonies
7. Handle colonies gently, avoid jerks
8. Avoid crushing bees as it could lead to stinging
9. Isolate the diseased colonies from healthy ones.
10. Handle diseased and healthy colonies separately

C. Provision of fresh water in the apiary

Ensure availability of fresh water preferably in shallow containers near the apiary to maintain a healthy apiary. Water is needed for the following

1. Maintenance of adequate humidity in a colony to ensure proper incubation of eggs
2. For feeding bee bread by nurse bees, the mixture of honey and pollen of certain consistency is required for which water is needed
3. When temperature in the apiary increases beyond 37°C, water is used by bees to evaporate and cool the colony

D. Dearth period management

1. Provide 50% sugar syrup to the colonies during dearth periods when honey stores in the colonies is not adequate and nectar is not available in the area. The syrup should be prepared by boiling clean water in the vessel and sugar added with slow stirring for few minutes. Cover the vessel with lid and let it cool. Feed cooled syrup.
2. Sugar syrup should be kept in such a way that the bees should not drown in it. This should be ensured by using shallow vessels with straw to facilitate easy feeding
3. Do not prepare the feed in open in the apiary and avoid dripping on the ground to prevent robbing by bees and ants
4. Feed the colonies in the evening preferably after sunset
5. Feeding should be given to all colonies in the apiary at one time
6. Pollen substitute comprising of fat free soyabean flour (3 parts) + Brewer's yeast (1 part) + skimmed milk powder (1 part) + sugar (22 parts) +honey (50 parts) made in the form of patties should be provided when pollen stores in the colonies is not adequate and pollen is not available in the area
7. Provide fresh water near the colony in shallow vessels
8. Extra frames should be stored in air tight chambers and fumigated with sulphur powder regularly
9. Old and dark combs should be discarded

E. Care during honey extraction

1. Use honey extractor, containers and other bee hive tools /equipments made of stainless steel / food grade plastic. Don't use tins & containers made of other degraded material
2. Wash all the equipments / containers etc. thoroughly with warm water before honey extraction
3. Extract honey from super chambers only
4. Select frames only with 75% sealed cells with ripened honey for extraction
5. Cover the entrance gate of the colony with small branches or twigs to avoid robbing
6. Extract honey in a closed room and not in the open to avoid robbing
7. Do not leave super and brood frames, after extraction of honey open in the apiary;
8. Do not spill honey in the apiary

F. Care during migration

1. Migrate colonies during non-availability of flora to areas with abundant flora.
2. Before migration survey the area to assess the availability of the flora to locate the colonies
3. Ensure honey extraction before migration
4. Close the entrance gates of the colonies in the evening after all worker bees are inside the colony
5. Pack the colonies internally and externally before migration to avoid jerking
6. Colonies in the vehicle should be packed in such a way that the entrance side should face the front side of the vehicle
7. Start migration late in the evening and ensure the colonies reach the destination within 10-12 hrs. the next day morning and entrance gates are opened after landing in the new location
8. Avoid jerking in the way while transporting bee colonies

G. Seasonal management of apiary

a**) Summer Management**

1. Keep the colonies in thick shade
2. Regulate the microclimate of the apiary by using wet gunny bags over top cover and sprinkling water around the colonies in the apiary during noon hours.
3. Provide fresh water in/near the apiary

b) Monsoon management

1. Clean and bury deep the debris lying on the bottom board
2. Keep the surroundings of the colony clean by cutting the unwanted vegetation which may hamper free circulation of the air
3. Provide artificial feeding (sugar syrup and/or pollen substitute) as per requirement of the colony
4. Check the robbing within the apiary
5. Unite weak/laying worker colonies
6. Control predatory wasps, ants, frogs, lizards in the apiary

c) Post monsoon season management

1. Provide sufficient space in the colony
2. Strengthen the colonies to stimulate drone brood rearing
3. Control ectoparasitic mites, wax moth and predatory wasps

(d) Winter management

1. Examine the colonies and provide winter packings in weak colonies specially in hilly areas
2. Feed sugar/pollen substitute to weak colonies as stimulative feeding to provide energy and initiate brood rearing
3. Shift the colonies to sunny places
4. Protect the colonies from chilly winds by using wind breaks
5. Unite the weak colonies with stronger ones

e) Spring management

1. Unpack the colonies, clean the bottom board, replace the worn out hive parts and provide sufficient space
2. Provide stimulative sugar/pollen substitute to increase brood rearing
3. Equalise the colonies
4. Extra frames should be raised by providing comb foundation sheets
5. Replace the old queens with new ones through mass queen rearing or divide the colonies
6. Manage the colonies in such a way to prevent swarming
7. Monitor regularly for ectoparasitic mites and adopt control measures

H. Protecting colonies from pesticides

1. Persuade the farmers not to use pesticides or use selective pesticides that are less harmful to bees at recommended concentrations
2. Avoid the use of dust formulations as they are more harmful to bees than spray formulations
3. Prior information about spraying would help in reducing poisoning of bees
4. Avoiding spraying of pesticides during flowering of the crop and peak foraging time of the bees would help in reduction in the mortality of foraging bees
5. Spraying may be done in the evening after sun set when bees do not forage
6. Colonies may be temporarily shifted if heavy spraying schedule is fixed
7. If shifting of the colonies is not possible, feed with 200 ml sugar syrup and close the gate by using wire screen for the day of spraying.

I.Methods of attracting and catching swarms

1. Swarming is a natural process for propagation of honey bees. Swarms are the lone source of bees in traditional beekeeping of *Apis cerana* while only a few empty hives are inhabited by absconded or feral colonies.
2. Empty hives are cleaned and smeared with clay, cow dung or both. Honey or jaggery are put inside hive to be used as bait to attract the swarm.
3. Flowering shoots of *Brassica campestris, or Raphanus sativus* can also be used just above the hive entrance, hoping that scout bees will find their home in the empty hive.
4. When swarms is found in the vicinity, water can be sprinkled and soil or ash can be

thrown to settle them. 'Tofri' or 'Garori' (special baskets) made up of 'Ringal' (bamboos); 'Jhola' (bag) can be used to catch and carry swarms. 'Kutrine' (burning cotton cloth) is used as a traditional smoker and 'Talikh' (a cloth) to save faces while catching the swarm.

5. To catch a swarm layer of jaggery or honey is applied at the inner base of the basket and hang it inverted near the settled cluster. The cluster is gently displaced from the other side with smoke to direct the bees towards the basket. As the swarm makes a cluster on the basket, it is transferred to the hive. When the bees are settled the basket is removed. Finally the hive is closed with its wooden cover and be smeared with a mixture of cow dung and clay.

J. Management of Honey Bee Diseases and pest

Honey bees could be affected by diseases and the real cause of abnormality or any disease present in the honey bee broods need to be ascertained before taking up any control measures. It is best to contact the researchers/scientists/beekeeping experts at the nearest centre or university or Government department working on honey bees. After the exact diagnosis of the causal agent of the particular disease, the guidelines/ recommendations given by the expert should be followed in true letter and spirit. However, general advisory for the management of common diseases of honey bees is given below:

1. Select good site to locate the apiary preferably in an open, dry place with shade.
2. Adopt general colony hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board frequently.
3. Select and multiply honey bee colonies only from disease resistant stocks.
4. Keep colonies with good prolific queens.
5. Create broodlessness in colony for at least 15 days by enclosing the queen in a queen cage.
6. Check the colonies periodically for any abnormalities or changes in behaviour of bees.
7. If you observe any colonies with disease, isolate them from healthy ones. Handle diseased and healthy colonies separately.
8. Keep the colonies strong by adding sealed brood comb or worker population only from healthy colonies and also by providing adequate food during dearth periods.
9. Prevent robbing, drifting, absconding and avoid migration of bee colonies when you notice disease symptoms.
10. Follow 'Shook Swarm' or shaking method to remove contaminated combs completely by transferring entirely new combs in one operation to the colonies with disease symptoms. Destroy the removed combs by burning.
11. Sterilise the combs and equipments by any one of the following methods:

a. Disinfect the empty combs and equipments with 80 per cent acetic acid @ 150 ml per hive body in piles for few days at a protected place. Air the treated materials before use.
b. Dip the contaminated equipments and combs in soap solution containing 7 per cent formalin for 24 hours. Then wash the treated material with water, dry and use.

12. Use of antibiotics to control honey bee diseases is likely to result in contamination of honey causing problems in export of honey.
13. The traditional method to check the entry of ants is spreading ash or turmeric powder in
14. their way.

K. Honey Extraction

The main honey seasons in hilly areas are '*Chait*' (April), '*Baisakh*' (May) and '*Ashaad*' (July-August). In some localities, an additional extraction during '*Kartik*' (October) is also done. Colonies yield most honey in '*Chait*'-'*Baisakh*' and the least in '*Kartik*'. Traditional tools used are '*Dathule*'. (sickle) to open the cover or wooden plug and '*Buwan*' (traditional brush) made up of '*Babul*' (*Eriophorum comosum*) to brush off bees. Besides these traditional smokers, large pans for keeping combs, a pot with water and '*Parunla*' or knife for cutting

'*Faur*' or '*Fwar*' (bee combs) are required at the time of harvest. Honey is mostly extracted at night but a few beekeepers do it in day time also. Combs are cut down, leaving the innermost comb for feeding and to attract swarms the next year. Honey combs are squeezed after removing the brood area from the cut combs. The harvested honey has many impurities like insect body parts, wax cells, etc. Usually, squeezed combs are thrown away after extraction, which can be fed to cattle especially bulls. Honey is stored in plastic or metal containers and in bottles.

The beekeepers doing beekeeping with modern hives should use honey extractors to harvest honey. The quality of honey extracted using honey extracting machine is much better than squeezing method.

Mushroom cultivation

The shrinking land, demand for functional foods, priorities for recycling agricultural residues and changing trades in view of globalization are going to play an important role in the agricultural scenario, and secondary agriculture is likely to play a pivotal role. Our country can emerge as a major player in mushroom production in wake of availability of plenty of agricultural residues and labour. To remain competitive it will be important to harness science and modern technologies for solving the problems of production and bio-risk management. Mushroom being an indoor crop, utilizing vertical space offers solution to shrinking land and better water utility. Packages and practices of mushroom cultivation in Almora is as follow:

1. **White Button Mushroom (*Agaricus bisporus*)**

Button mushroom scientifically known as *Agaricus bisporus* and has he widest acceptability. Cultivation of this mushroom is a complex process and requires two different temperature i.e. 22-26^{0}C for spawn run and 14-24^{0}C for fruit body formation. Besides specific temperature, it require proper humidity (80-90%) and enough ventilation during fruit body formation.

Steps of cultivation process

Compost preparation: Compost is an artificially prepared growth medium from which mushroom is able to derive important nutrients required for growth and fructification. Cemented floors and shade over the floor are required for making good quality compost. There are two main methods for compost preparation:

Long method of composting: This is an outdoor process and takes around 28 days in its completion with a total of seven turnings. The following materials are required for long method of compost:

Wheat straw	1000 Kg	Urea	10 kg
Wheat bran	50 kg	Gypsum	100 kg
Ammonium sulphate or calcium ammonium nitrate	30 kg	Furadan	500 g
Super phosphate	10 kg	B.H.C.	500 g
Muriate of Potash	10 kg		

Before making compost, wheat straw is spread on cemented floor and is turned many times with water being sprayed at regular intervals.

Day 0: At the stage, there should be around 75% humidity content in the wheat straw, to which wheat bran, calcium ammonium nitrate, urea, murate of potash, and super phosphate are mixed thoroughly and evenly. The material is then piled 1.5m thick x1.25m high with the help of wooden rectangular block. The blocks are removed. Once the entire material has been stacked up or piled up. Water is sprayed twice or thrice to keep the substrate moist. Temperature should be in the range of 70-750C.

1st turning Day 6: On the sixth day first turning is given to the stack. The purpose of turning is that every portion of the pile should get equal amount of aeration and water. If the turnings are not given, then anaerobic condition may prevail which may lead to the formation of non-

selective compost. In the stack, the central zone is fermenting at its peak and has maximum temperature rest of the portion is either not at all fermented or ferments improperly. The correct method of turning is as: Removing about 15cm of compost from the top and spread it on one side of the floor, the rest part of compost on the other side of the floor. Now turning is done by shaking the outer (top most) part and the inner part of the compost, first separately and then missing them altogether thoroughly with the help of wooden buckets.

2nd turning (Day 10): On the tenth day, again the top most part and the inner part of the compost is separated, water is sprayed on the top part. Again the two parts are piled up together in such a way that now the top part is inside and the inner part is on the top of the stack.

3rd turning (day 13)**:** it is also done in the same way as described earlier and required quantity Gypsum mixed at this stage.

4th turning (day 16)**:** The same process of turning is followed. The required quantity of furadan & lindane are added during this turning.

5th turning (day 19)**:** The compost is turned in the same manner.

6th turning (day 22)**:** The same process of turning is followed. The required quantity of furadan and lindane are added during this turning.

7th turning (day 25)**:** The compost is turned in the same manner

8th *turning (day 28)***:** if no ammonia persists in the compost, spawning is done.

Short method of composting : Compost prepared by short method of composting is superior in production quality and the chances of infection and disease is quite low. Composting by this method requires special infrastructures, equipments etc. that initial cost is to high, therefore, the farmers can purchase the readymade compost from the authentic composting units. The compost when ready for spawning should have the following characteristics:

Moisture	About 68%	**Ammonia**	Below 0.006%
pH	7.2-7.5	**Nitrogen**	Around 2.5%
Fire fangs (Actinomycetes)	Excellent growth		

Proper timing for cultivation: Oct.- Mar. (02 crops)

Cultivated strain: Delta, U-3, S-11, MC-465, A-15

Spawning :The process of mixing of the spawn in the compost is known as spawning. Spawn is thoroughly mixed in the compost at the rate of 600-750 gm per 100 kg of compost (0.6-0.75%). The spawned compost is filled in tray or polypropylene bags covered with formalin treated news papers. In case of bags, they should be folded at the top and covered up. After spawning, temperature and humidity of crop room should be maintained at 22-26^{o}C and 85-90%, respectively for spawn run. Water should be sprayed over the covered news papers, walls and floors of the crop room. After 12-14 days of spawning white mycelial growth is seen running the entire length of the tray/bag. This is then covered with casing soil on the surface.

Casing soil : The significance of casing soil is to maintain the moisture content and exchange of gases within the surface of the compost which helps in the proper growth of the mycelium. The pH of the casing soil should be 7.5-7.8 and must be free from any infection or disease. In our country casing soil is prepared from the following ingredients.

Two years old manure + garden soil	3:1
Two year old manure + garden soil	2:1
Two year old manure + spent compost	1:1
Two year old manure + spent compost	2:1

Pasteurization of casing soil: The casing soil is piled on cemented floor and is treated with 4% formalin solution. Thorough turning of the soil is done and it is covered with polythene sheet for the next 2-3 days. After that remove the polythene cover and turn the casing soil so that it is free from the smell of formalin.

Using the casing soil: A layer of casing soil (3-4cm thick) is being spread uniformly on the compost when the surface has been covered by white mycelium of the fungus. Formalin solution (0.5%) is then being sprayed. Temperature and humidity of the crop room should be maintained at 14-18^{o}C and 80-85%, respectively. Proper ventilation should be arranged with water being sprayed once or twice a day.

Harvesting of crop: Pin head initiation takes place after 12-18 days of casing and the fruiting bodies of the mushroom can be harvested for around 50-60 days. The crops should be harvested before the gills open as this may decrease its quality and market value.

Productivity: From 100 kg compost prepared by long method of composting 14-18 kg of mushroom can be obtained. Similarly, 18-22 kg mushroom can be obtained from pasteurized compost (Short Method Compost).

2. Oyster mushroom

The species of the genus *Pleurotus* are commonly known as oyster mushroom or dhingri mushroom. This mushroom can be cultivated at a temperature range between 20-28^{o}C and relative humidity between 75-90 per cent.

Steps of cultivation process

Substrate and its preparation

The tropical wastes like rice straw, wheat straw, corncobs, dried water hyacinth, sugarcane bagasse, banana leaves, cotton waste or sawdust are used as substrate for cultivation. The straw should be cut into small pieces (3-5cm long) to facilitate proper wetting as well as to increase surface area. Although this mushroom can be cultivated on simple water soaked straw but there are chances of crop failure due to presence of contaminants. In order to avoid contaminations the straw should be treated by hot water and chemical.

Hot water treatment-The substrate should be is treated with hot water at 65^{o}C for 1 hour. The excess water is then drained off and substrate cool down to room temperature for spawning.

Chemical treatment- The materials are usually soaked in water chemically sterilized with carbendazim (7-10g) and formalin (120-150 ml)/ 100 litre of water for 16-18 hours. After that straw is taken out from solution and spread on clean cemented floor or on polythene sheet to evaporate the excess water. The ready substrate should contains 65-68 per cent moisture.

Proper timing for cultivation Feb-April & Aug.-Oct. (02 crops)

Cultivated spices: *P. sajor-caju, P. florida, P. sapidus, P. eryngii, P. cornucopiae, P. flabellatus, P. djmore, P. eous, P. ostreatus*

Spawning and crop management : Oyster mushroom spawn should be about 15-20 days old when mycelium has formed complete coating around the grain. The normal rate of spawning in a pasteurized substrate is 2-3% of the wet substrate. The spawning is usually done by mixing the spawn throughout substrate. Before filling the substrate in polythene bags, holes of about 1 cm diameter are made at 10-15 cm distance all over the surface for free diffusion of gases and heat generated inside. The optimum temperature for growth of mycelium is 23 ±2^{o}C. Relative humidity in growing room should be range between 85-90% during spawn-run. Spawn run usually takes about 15-20 days. After complete spawn run, polythene removed completely with help of sharp knife carefully. Usually 3-4 days after opening the bags, mushroom primordial (pin heads) begin to form. After opening the bags water should be sprayed 2-3 time per day regularly.

Harvesting and yield: Mature mushrooms become ready for harvesting in another 2-3 days. An average biological efficiency (fresh weight of mushrooms harvested divided by dry

substrate weight x 100) can range between 70-80% and sometimes even more. To harvest the mushrooms, they are grasped by the stalk and gently twisted and pulled. A knife should not be used.

3. Milky Mushroom

Calocybe indica is commonly known as milky mushroom or dudhiya mushroom due to its milky white appearance of the fruit body. It can be easily cultivated at the temperature range between 25-35^{o}C and relative humidity 70-90 per cent.

Substrate and its preparation

The tropical wastes like chopped paddy straw and wheat straw are used as substrate for cultivation. To avoid contaminations the straw should be treated by hot water and chemical as like oyster mushroom.

Proper timing for cultivation: April-Sept. (02 crops)

Cultivated species: Calocybe indica and Macrocybe gigentium

Spawning and crop management: About 18-20 days old spawn is used for spawning. Spawning should be done @ 4 per cent of ready substrate. The spawning is usually done by mixing the spawn throughout substrate. The spawned substrate should be filled in polythene bags 4-5kg per bag. The bags should be folded at the top and covered up. The optimum temperature for growth of mycelium, ranges between is 20-37^{o}C. Relative humidity in growing room should be range between 80-85% during spawn-run. Spawn run usually takes about 15-20 days.

Casing: This mushroom needs casing for fruit body initiation. After complete spawn run casing is done and its thickness should be kept 2-3 cm is being spread uniformly on the surface of the spawn run substrate. Temperature and humidity of the crop room should be maintained at 25-35^{o}C and 80-85%, respectively. Proper ventilation and adequate light should be maintained and water being sprayed once or twice a day. After 10-12 day of casing fruit primordia (pin head) are formed and within 5-6 days the mature and ready for harvesting.

Harvesting: The fruit bodies should be harvested before spore release by twisting so that stubs are not left on substrate. After harvesting lower portion of stalk with adhering casing soil should be cut with sharp knife. About 70 kg fresh mushroom can be harvested per quintal of dry substrate.

I. Enabling Policies

1.A Existing policies related with agriculture and animal husbandry:

1. Subsidies and incentives are given on all agricultural inputs.
2. More than 50% subsidies are granted on all inputs and implements.

1.B Policies to be suggested for doubling income in the specific agro-ecological region:

1. Selection of crop and area specific crop production program
2. Timely and assured supply of agricultural inputs to farmers at door.
3. Popularization of playhouses technology for vegetables and flower production
4. Inclusion of hybrid seed programme for crop production.
5. Need to establish more food processing units.
6. Availabilities of credit at minimum interest rate.
7. Assured byback policy for agricultural produce.

2.A Existing Institutions: KVK, NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district:

1. Establishment of food proceesing units at distt level to procure and marketing of surplus.
2. Testing of new crops in non-traditional areas for doubling the crop production.

3.A Existing Incentives:-

3.B Incentives to be suggested for doubling income in the specific agro-ecological region of district:

1. An assured bonus to farmers to grow new crop or higher production potential
2. Selection of farmers at village for trendsetter for dissemination of technical knowledge and technology may be awarded
3. Free access to library and one institute at least once in a year.

4.A Existing risk coverage facilities: Crop and Animal Insurance Schemes

4.B Risk coverage facilities to be suggested for doubling income in the specific agro-ecological region:

1. Risk coverage may be applicable for all agricultural products and animals
2. Declaration and minimum support price be fixed well in time

J. Marketing and value addition in specific agro-ecological region

1.A Existing marketing facilities: Local marketing

1.B Marketing facilities to be suggested for doubling income in the specific agro-ecological region:

1. Contractual farming, linkages with MNCs and NCs,
2. Mahila hat, local hat, weekly bazaar, local mandi,
3. AC van

2.A Existing grading facilities: Nil

2.B Grading facilities to be suggested for doubling income in the specific agro-ecological region:

Mechanical grading facilities should be made available on cluster basis

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.C Processing facilities to be created for better marketing and value addition in the district:

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular commodity
6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity

3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

2.D Packing facilities to be created for better marketing and value addition in the district :

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)
4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxes for particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed

3. Existing marketing and value addition problems in the specific agro-ecological region:

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo
3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chamber
7. Jaggery storage bin

K. Online Management and Evaluation

1.A: Existing online management structure available: Internet etc.

1.B: Restructuring required for online management and evaluation in specific agro-climatic region of district:

1. Each village should be connected by Internet facility with proper device,
2. Awareness about internet user.

2.A: Existing evaluation procedure: Manual

2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: GPS, Email, Whatsapp, ITC tools

3.A: Existing monitoring system: Physical

3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Regular visits and online report submission, farmer feed back

4.A: Existing feedback system: Manually

4.B: Feedback system required for online management and evaluation in specific agro-

climatic region of district: Internet portal and proper software for evaluating ongoing activities

5.A: Existing reading system: Literature, Booklets, Hindi Extension Journals etc

5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Farm advisory portal, online helpdesk services

Specific action plan for doubling agricultural income in agro-ecological region

Strategy 1 : Productivity Enhancement

Introduction, adoption and popularization of high yielding varieties for increasing productivity

1. Promotion of high yielding varieties of wheat (PBW-550. DBW-17,UP-2628, UP2585, HD-2967, UP-2572, VL Gehun 829, VL Gehun 892, VL Gehun 907, VL Gehun 953 and UP 2572), paddy (Pant Shankar dhan -1, Pant Basmati-1 &2, Hybrid rice, PR-113. PR-114, NDR-359 VL Dhan 65, VL Dhan 85 and Vivek Dhan 154, Pant Dhan-19, HKR-127, PB-1509, PA 6444, VNR 2355, Pusa Basmati 1509 & PRH 10,); Barley (VL Jau 118 and VLB 94); in Bastia, aam bag, chandani, phagpur, garikot, Chalthi, Belkhat areas of Champawat block.
2. Promotion of high yielding varieties of finger millets (VL *Mandua* 324, VL *Mandua* 352, PRM1,) and Barnyard millet (PRJ-1, VL *Madira* 172 and VL *Madira* 207) in Champawat block .
3. Amaranthus (VL Chua 44); Buckwheat (VL Ugal 7) in Bastia, aam bag, chandani, phagpur, garikot, Chalthi, Belkhet areas of Champawat block.
4. Promotion of high yielding variety of lentil (Pant Lantil-4 & 5, PL-7, PL-8, VL *Masoor* 125, VL *Masoor* 126, VL *Masoor* 507, VL *Masoor 514*), horse gram (VL *Gahat* 10, VL *Gahat* 15 and VL *Gahat* 19), soybean (VLS 47, VL Soya 59, VL Soya 63 and VL Soya 65, PS-1092) and Pigeon pea (VL *Arhar* 1,) in Champawat block
5. Promotion of high yielding varieties of vegetable pea (Vivek Matar 10and Vivek Matar 12), French bean (VL Bauni Bean 1 & VL Bean 2), tomato (VL Tamatar 4), Onion (VL Piaz 3), VL Shimla Mirch 3 and garlic (VL Lehsun 1) hill areas of Champawat block.

Recommended package and practices will be followed for the above recommended crop varieties

Strengthening of traditional water storage structure

1. Creation of additional water storage tank in *Hill areas of Champawat* block for lean season.
2. Creation of trenches for high percolation of water in slope/ terraces in all areas of this region.
3. Promotion of water conservation techniques like mulch, sprinkler and drip for juvenile plants in *Hill areas of Champawat* block blocks of this region.
4. Popularisation of roof water harvesting system in all region.
5. Rejuvenation and popularisation of traditional water harvesting systems (Naula) in this region.

Adoption of cluster approach for holistic development

1. Strengthening of old fruit belt of *Vanbasa* and *Tanakpur belts* by introduction of new cultivars of mango, Litchi fruits
2. Mass cultivation of Cinnamon plants at low hills in *Lower hill areas as Sukhi Dhang, jajal*
3. Promotion of Ginger/Turmeric cultivation in *Lower hill areas as Sukhi Dhang & jajal* areas under rainfed conditions of this block.
4. Promotion of off season vegetable such as Tomato, potato, onion, garlic/protected cultivation in all blocks of this region.
5. Fallow land development under agro-forestry in all blocks of region.

6. Promotion of hybrid/basmati rice particularly in irrigated areas of *Tanakpur and Vanbasa* and pulses, oilseeds in rainfed areas of all blocks.
7. Promotion of irrigated areas of *Tanakpur and Vanbasa* for seed production of rice and wheat.

Management of wild animal problem

1. Promotion of lime/lemon in fruits, lady finger in vegetable, ginger or turmeric in spices, dual purpose varieties of barley, wheat and oats or Lemon grass at larger scale in cultivated field in all blocks to minimize the damage from wild pigs, monkeys and cows.
2. Enacting legislative measures for protection of crop from wild animals.
3. Promotion of protected cultivation in all blocks.
4. Promotion of bio fencing on trench bunds.

Adoption of Farm mechanisation (Power tiller, thresher etc)

1. Promotion of serrated sickle, wheel hoe, handle fork, handle kutla, power tiller, small wheat thresher, winnowing fan, Vivek Millet thresher cum pearler, VL Paddy thresher and Vivek small tool kit for reduction in drudgery of hill farmers .
2. Popularization of manually operated mini crop harvesters for millets.

Adoption of efficient irrigation techniques

1. Micro Irrigation (Drip and Sprinkler Irrigation) where water is available, etc.
2. Drip Irrigation in integration with water harvesting structure where water for irrigation is limited
3. Green House Cultivation for Vegetables with drip irrigation

Management of soil health in low or valley areas

1. Organic cultivation of traditional crop viz., fingermillet, barnyard millets, black soybean, horse gram, traditional rice in all blocks of this region.
2. Promotion of Bio-fertilizer/soluble fertilizer based farming specially in rainfed areas of this region.
3. Adoption of pulse based crop rotation and maximum use of value added compost/FYM in all blocks of this region.
4. Making available the required recommended nutrients/ micro-nutrients at right time, place and quantity.
5. Adoption of integrated nutrient management in irrigated areas of rice and wheat for *Tanakpur, Vanbasa and irrigated area of Reetha*.
6. Popularization of soil and water conservation measures by pulse based intercropping, contour farming and shoulder bunds in particular rainfed areas.

Strategy 2 : Livestock: Goatary, Poultry, Fisheries

1. Selection of high milk breeds in buffaloes (*Murrah*) and cattle (*Jersy, Red Sindhi and Shaiwal*).
2. Establishment of Fodder Bank in each block to meet fodder requirement of area.
3. Establishment of milk chilling plant at *Sult* block of this region.
4. Promotion of Urea, Molasses, Multinutrient Blocks at *Nyaypanchayt* level.
5. Introduction and promotion of cross Heifer for increasing income of marginal farmer in all blocks.
6. Strengthening of traditional water bodies/rivulets with Mahaseer or carps at *Vanbasa and Tanakpur*.
7. Popularisation of green fodder crops ie sorghum, lobia, maize, oat, berseem in all blocks.
8. Community pasture development at village level.
9. Planning for establishment of *Gaushala* at block level to rear unproductive cattles to avoid the damage crops in cultivated areas.

Strategy 3 : Integrating Farming system

Promotion of different Integrated Farming System modules for 20 nali's or 0.4 ha such as:

Vegetable based – 18 nali protected cultivation + 2 nali composting and Goatry/ Poultry

Protected cultivation (100sqm low cost polyhouse- Capsicum, cucumber, Tomato, nursey raising and cole crops)/ off season vegetable; 18 nali + Composting (50sqm) + Goatry (4F+1M) /backyard poultry (50birds)

Live stock based- 10 nali green fodder + 5 nali Dairy, composting and Goatry/ Poultry+ 5 nali Protected cultivation

Fodder production (10 nali; Sorghum, lobia-Oat in rainfed or berseem in irrigated) + Mini dairy (Crossbreed05) + Composting (50sqm) + Protected cultivation; 5 nali

Crop based- 15 nali crop and vegetable+ 5 nali Dairy, composting and Goatry/ Poultry+ 2 nali Nursery raising Protected cultivation 5 nali

1. Truthfull seed production (Jethi rice, Lentil, onion, radish, frenchbean, Pea); 15 nali + Planting material supply 2 nali + Mushroom + Composting
2. Crop 14 nali (Gahat, madua, soyabean, lentil- 7 nali + vegetable- Cucurbits, French bean, veg pea, tomato, capsicum and leafy vegetables (7 nali)-dairy/backyard poultry; 5 nali +composting (50sqm).

Strategy 4 : Reducing post harvest losses and value addition

1. Establishment of mini fruit grading plant for mango & Litchi stone at *Tanakpur area of Champawat* blocks.
2. Establishment of Food Processing Units for mango & Litchi, mango at *Tanakpur* area of *Champawat* blocks
3. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
4. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in *Tanakpur area of Champawat* blocks.
5. Establishment of Food and Processing Units at *Tanakpur* fo*r* pickle making using wild *Aonla, mango & Jack fruits*.
6. Promotion of common resources on custom hire basis viz. Power tiller, Tractors and other bif agriculture equipment in *Champawar & Vanbasa* areas.
7. Creation of larger facilities of infrastructure for reducing post harvest losses in horticultural commodities viz. Long term storage, warehouses.
8. Development of cottage industries at village level for unfinished products.

Strategy 5 : Waste land development and waste water

1. Contour making for arable purpose in waste land in *Champawat, Jajal, Bastia*and other high hills areas.
2. Afforestation of plants and perennial grasses in steep slope of more than 40% slope in Hill areasthis block.
3. Plantation of *Morus* plants, Wild fruit plants, Fodder trees (*Grewia*, *Alnus*, *Quercus* etc.) may be promoted.
4. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all blocks.
5. Popularization of trenches or silages for percolation of water to avoid surface run off in Hill areasthis block
6. Construction of check dam and artificial structure to maximize water percolation rate in Hill areasthis block.
7. Construction of tank for storage of water for lean season in all blocks.
8. Establishment of storage system for rain water in monsoon season.
9. Establishment of waste water treatment plants based on phycoremediation technique at sewer drainage points.

Strategy 6 : Reduced cultivation cost

1. Promotion of specific fertilizers and micronutrients like Zinc, Boron, Phosphorus, etc.
2. Provision of mechanization (Use of Power tillers, Power weeders, Paddy threshers, Wheat threshers, Mandua/ Madira threshers, Maize Sheller, Wheel Hand hoe, Manual/ power operated Wheat/Paddy reapers etc.)
3. Promotion of well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers
4. Promotion of line sowing and balanced fertilizers application in crops.
5. Promotion of recommended seed rate, spacing and depth.
6. Promotion of need based application of pesticides and other agricultural inputs. `
7. Promotion of hand tools in agricultural and horticultural operations.
8. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
9. Promotion of pressurized irrigation techniques in horticultural crops.

Strategy 7 : Off-farm income

1. Promotion of apiculture/ sericulture/ mushroom for small and landless farmers in all blocks.
2. Promotion of cultivation and collection of medicinal plants in hills areas.
3. Promotion of skill development in women and youth in all three blocks.
4. Creation of new SHGs in other villages of three blocks.
5. Encouragement to existing SHSs for collective farming, opening small scale enterprise like Candle making, Pickle making, Jam & Jelly making, Spice cultivation, Ghee making & packing, etc. may be provided for better performance in all three blocks.

Strategy 8 : Enabling Policies

1. Land consolidation in hill areas of Champawat district is essentially required.
2. Implementation of policies for control of wild animal menace in agricultural areas.
3. Implementation of Soil Health Card Scheme in each block.
4. Increasing institutional support by providing subsidises and incentives to small and marginal farmers.
5. Labelling of organic inputs and certification mechanism for various crops in all four blocks.
6. Popularization of Udhyan and KCC for widespread use of government incentives/ subsidies to farmers.
7. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
8. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

Strategy 9 :Marketing and value addition in specific agro-ecological region

1. Establishment of mini *mandies* at Block level.
2. Creation of better transportation facilities with cool chain van at Block level.
3. Creation of direct linkages with food processing industries for better prices.
4. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.
5. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.
6. Installation of mini grading machines at village level.
7. Promotion of local *Hatt* at Tahsil level in all blocks.
8. Development of proper marketing network to check the interference of middle men in marketing of agricultural produce of the farmers

Strategy 10 : Online Management and Evaluation

1. Development of Mobile apps/ software for online management and evaluation at district level.
2. Development of e-Marketing and kiosk at district level to have information of surplus

commodities at block level.

3. Organization of monthly review meeting at district to solve the problems related with farmers.
4. Promotion of use of community radio, TV talks and Whatsapp etc. for effective implementation of programme.

Agro-ecological region: Region B (1000 m-1500m)

A.General information about Agroeco-region

District: Champawat

Agro-ecological region: Region B (1000 m-1500m)

Main Blocks in Region: Lohaghat, Barakot, Pati, Champawat

Main village cluster in blocks: Kuliyal gaon, chorapita, chora mahta, Chalthia, panthura, panchaswar, Raushal, Belkhat, Padsukhara, Chalthi

Irrigated Clusters: Pareva, Varsi, Reetha, Simalkhat, Panthura, Botari

Rainfed Clusters: Sui, Dungari fartiyal, Phular, Kakad, Hoili piplati, Bapru, Khatikhan

Existing rain water management facilities:

1. Some cemented tanks and some Kaccha tanks in rainfed,
2. Water irrigation channels in lower irrigated hill 1 Micro Irrigation (Drip and Sprinkler Irrigation) where water is available etc.
3. Drip Irrigation in integration with water harvesting structure where water for irrigation is limited
4. Green House Cultivation for Vegetables with drip irrigation

B. Productivity Enhancement

1. Specific Action / Interventions recommended for harvesting and management of rain water in specific agro-ecological region

1. Roof water harvesting system
2. Poly tank for water storage for rainfed area
3. Check dams and irrigation channels for irrigation

2. Existing practices for soil health improvement

1. Use of undecomposed farmyard manure/compost in lower hill and inadequate quantity fertilizer in babhar
2. Meagre/ no use of biofertilizers
3. Imbalanced/ insufficient nutrient use
4. Use of raw/partially decomposed FYM
5. Meagre/ no compost making/recycling of crop residue

3. Specific Action / Interventions recommended to improve soil health in specific agro-ecological region

Cereals and oilseeds

1. Seed/ soil inoculation with *Azotobacter* and Phosphorus solubilising microbial culture (250-300g each/ acre for seed inoculation;/ and 1-1.5 kg each mixed in well decomposed 25 kg FYM/ acre for soil inoculation)..
2. Soil test based balanced use of fertilizers in irrigated areas as per recommendation; INM shall be preferred
3. Scientific preparation of FYM/ recycling of crop residue, weeds through composting and/or vermicomposting
4. Use of FYM @4-5t/ha or application of 2.5-3.0 t/ha vermicompost

Pulses and soybean

1. Seed with specific *Rhizobium* inoculantand Phosphorus solubilising microbial culture.
2. Use of recommended dose of phosphatic fertilizer
3. Use of FYM @4-5t/ha or application of 2.5-3.0 t/ha vermicompost

Vegetables and spices

1. Seed/ nursery soil inoculation with *Azotobacter/ Azospirillum* inoculantand Phosphorus solubilising microbial culture (each of 200 g/m^2 for nursery soil inoculation; for seed inoculation quantity varies depending on seed size).
2. Seedling inoculation with *Azotobacter/ Azospirillum* inoculantand Phosphorus solubilising

microbial culture at transplanting.
3. Soil test based balanced use of fertilizers; INM shall be preferred
4. Use of FYM @4-5t/ha or application of 2.5-3.0 t/ha vermicompost

Apple and other fruits

1. Application of 250 g *Azotobacter*, Phosphorus solubilising microbial inoculants with 50 kg well decomposed FYM/ compost/ Vermicompost @25 kg per tree.
2. Soil test based balanced fertilization as per recommendation along with micronutrients; INM shall be preferred
3. Foliar application of micronutrients as per the requirement

4.Existing crop cultivation strategy being adopted under changing climatic condition

No contingencies plan is used by farmers

5.Specific strategy to be adopted for doubling productivity under changing climatic conditions in the agro-ecological region

1. Use fodder crop i.e Oat, Lobia, Barseem, Fodder maize as supplementary crop
2. Organic production of finger millet
3. sowing of horse gram
4. Sowing of radish /leafy vegetables as cash crop
5. Plantation of citrus / pomegranate /peach/pear / Banana/Mango
6. High yielding and hybrid varieties of wheat and paddy
7. Cultivation of vegetable

6 A. Name of Field Crop: Wheat

i. Existing varieties being used: Lower hill: Mundaria, Lal Mishri, VL-738, VL-616,dal dakhani

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL *Gehun* 829, VL *Gehun* 892, VL *Gehun* 907, VL *Gehun* 953, HS 507, HPW 349 and UP 2572

iii. Existing package of practices being used:

1. Preperation of land- 1 or 2 ploughing with local plough no definit depth
2. Seed rate and seed sowing -150-175 kg/ha, Broad casting
3. Manure and fertilizer-
4. use of un decomposed FYM (rainfed) and un decomposed FYM with small doses of chemical fertiliser by some progreesive farmers (in irrigated conditions)as per availability
5. Irrigation-usually maximum area is rain fed and in valley condition 1 or 2 irrigation

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preperation of land- 2 ploughing + 1 harrowing with mould bold plough upto 10-15 cm
2. Seed rate and seed sowing -100-125kg/ha, line sowing 18-21 cm apart
3. Manure and fertilizer- 10-15 tonne FYM , NPK 100-120:60:40, 50-60:30:20with micronutrients
4. Irrigation-As per irrigation facility 1 irrigation at CRI, jointing stage and one at flowering stage.

v. Major insect pests associated with crop: Army Worm, *Mythimna separata*, Wheat Aphid, *Macrosiphum (Sitobion) avenae* or *Macrosiphum miscanthi* Termites, *Microtermes obesi* and *Odontotermes obesus*

vi. IPM Module for management of insect pests:

Army Worm, *Mythimna separata*

1. Avoid late sowing of crop to save crop from armyworm.
2. Spray in afternoon any of the following insecticides after diluting in 500 litre of water/ha when 4-5larvae are recorded per meter row:
   Monocrotophos 36WSC 1500ml/ha
   DDVP 76EC 500ml/ha
   Quinalphos 25 EC 1000ml/ha

Aphids (*Macrosiphum (Sitobion) avenae* or *Macrosiphum miscanthi*)

1. Avoid late sowing of crop to save crop from aphid.
2. Conservation and enhancement of biocontrol agents like coccinellid beetles, *Chrysopa*, syrphid, *Apanteles* etc. protects the crop against aphid attack.
3. Spray any of the following insecticides after diluting in 500 litre water/ha when more than 5 aphids are recorded per ear head:

Name of the Insecticides	**(gm/ml) ha**	**Waiting period (days)**
Thiamethoxam 25% WSG	50	21
Quinalphos 25 %EC	1000	

Termites, *Microtermes obesi* and *Odontotermes obesus*

1. Dismantle termataria (mound) around fields & killthe termite queen.
2. Summer deep ploughing and burning of stubbles/residue of previous crop.
3. Use well rotten cowdung manure/compost to avoid termites.

Name of the Insecticides	**(gm/ml) ha**
Thiamethoxam 30% FS (Seed Treatment/Kg)	3.3 per Kg

vii. Major disease associated with crop: Loose smut, Yellow rust and Powder mildew

viii. IPM Module for management of disease:

Loose smut: *Ustilago nuda* f.sp. *tritici*

Sticker @ 1 ml per liter of water must be applied along with chemical pesticides to improve the effectiveness of chemical. For control of loose smut seed treatment with fungicide.

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Carbendazim 50% WP (Seed Treatment/Kg)	1.0	2.0
Carboxin 75% WP (Seed Treatment/Kg)	1.5-1.9	2-2.5
Tebuconazole 2% DAS	0.02	1.00
Difenoconazole 3% WS	0.06	2.0

Biofungicides

Name of the Bio-fungicides		
Pseudomonas fluorescens 1.75% WP (In house isolated Strain Accession no. MTCC 5176)	5 g/Kg seed 5 g/lit. water	**Seed Treatment:** Mix the required quantity of seeds with the required quantity of *Pseudomonas fluorescens* 1.75% WP formulations and ensure uniform coating. Shade dry and sow the seeds. **Foliar spray:** Dissolve 5 Kg of *Pseudomonas fluorescens* 1.75% WP in 1000 litres of water and spray.

Yellow rust=stripe rust: *Puccinia striiformis=Puccinia glumarum*

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Propiconazole 25% EC	500	30

. Major weeds associated with crop: *Anagalis arvensis, Argemone mexicana, Asphodelus tenuifolius, Avena fatua, Chenopodium album, Rananculus,Phalaris minor*

x. IPM Module for management of weeds (except organic areas):

Red chickweed: *Anagalis arvensis* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Carfentrazone ethyl 40 %DF	50	80
2,4-D Sodium salt Technical (80WP)	625-1000	90

Methabenzthiazuron 70 %WP (POE-30DS)	2000-2500	100
Metsulfuron methyl 20%WP	20	80
Metsulfuron methyl 20% WG	20	76
Triasulfuron 20 %WG	100	81
Pendimethalin 30% EC (Light soil)	3300	
Pendimethalin 30% EC (Medium soil)	4200	
Clodinafop-propargyl 15%+ Metsulfuron methyl 1 %WP	400	100
Mesoulfuron methyl 3+ Iodosulfuron methyl 0.6 %WG	400	96
Sulfosulfuran 75%+Metsulfuron methyl 5%WG	40	110

Mexican prickly poppy: *Argemone mexicana* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4-D Sodium salt Technical (80WP)	625-1000	90
MCPA Amine salt 40% WSC	2500	

Onion weed: *Asphodelus tenuifolius* (annual, monocot, narrow leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	860-1290	
2,4 D ethyl ester 38 %EC	1320-2200	
MCPA Amine salt 40 %WSC	2500	

Common wild oat: *Avena fatua* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Diclofop methyl 28%EC	2500-3500	90
Isoproturon 50% WP	2000	
Isoproturon 75% WPs	1330	60
Methabenzthiazuron 70 %WP (PE: 2DAS)	1500-2000	100
Methabenzthiazuron 70% WP (POE: 16-18 DAS)	1000-1250	100
Triallate 50% EC	2500	150
Clodinafop Propargyl 15%+ Metsulfuron methyl 1% WP	400	100

Bathua/pigweed: *Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Carfentrazone ethyl 40% DF	50	80
2,4 D Dimethyl amine salt 58% SL	860-1290	
2,4 D ethyl ester 38% EC	1320-2200	
Methabenzthiazuron 70 %WP (POE: 30DAS)	2000-2500	100
Methabenzthiazuron 70 %WP (POE: 16-18 DAS)	1000-1250	100
Metribuzin 70% WP (Medium soil)	250	120
Metribuzin 70% WP (Heavy soil)	300	120
Metsulfuron methyl 20%WP	20	80
Metsulfuron methyl 20%WG	20	76
Triasulfuron 20 %WG	100	81
Pendimethalin 30% EC (Light soil)	3300	

Pendimethalin 30% EC (Heavy soil)	4200	
Sulfosulfuran 75% WG	33.3	110
Clodinafop Propargyl 15%+ Metsulfuron methyl 1% WP	400	100
Fenoxaprop-p-ethyl 7.77%+Metribuzin 13.6%EC	1250	110
Mesoulfuron methyl 3%+ Iodosulfuron methyl 0.6 %WG	400	96
Sulfosulfuran 75%+Metsulfuron methyl 5%WG	40	110

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Wheat-Horse gram/Soybean(rainfed), Wheat-Rice(irrigated)
4. Timely Sowing, Seed treatment,Use of HYV
5. FIRB
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storages conditions
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM,
2. climate changing,
3. Wild animal damages
4. Migration, Poor Irrigation facilities
5. SAAR practice(Shifting area practice)

6B. Name of Field Crop: Rice

i. Existing varieties being used: China-4, lal dhan , lal –safed rikhua, Saket 4

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

Rainfed- Chatki Dhan- VL Dhan 208, VL Dhan 209, Jethi dhan – Vivek Dhan 154, VL Dhan 157, VL Dhan 156 and VL Dhan 158, Pant Dhan-19, HKR-127, PB-1509, PA 6444, VNR 2355, Pusa Basmati 1509 & PRH 10, Irrigated VL *Dhan 65,* VL Dhan 86, VL Dhan 68, VL *Dhan 85*

iii. Existing package of practices being used:

1. Preperation of land- 1 or 2 ploughing with local plough no definit depth, Manual puddling
2. Seed rate and seed sowing -150 kg/ha in dirct seeding rice , and in transplanting 60-70 kg/ha
3. More than 45 days seeding used
4. Manure and fertilizer- use of un decomposed FYM(, undecomposed FYM 1.5-2.0qt./nail) with small doses of chemical fertiliser by some progreesive farmers (in irrigated conditions)as per availability
5. Irrigation-usually maximum area is rain fed and in valley condition as avalability of irrigation roaster
6. Butachlor used by few farmers in irrigated
7. No IPM practices

iv. Specific package of practicesto be suggested for increasing yield in specific agro-ecological region:

1. Preperation of land- 1 or 2 ploughing with local plough , puddling
2. Seed rate and seed sowing -100-125/ha in direct seeding rice , and in transplanting 40-50 kg/ha, basmati20kg/ha,hybrid 20kg/ha, 25-30days seedling used
3. Manure and fertilizer -15 tonne FYM , NPK 100-120:60:40, rainfed 50-60:30:20with micronutrients(Zn, Fe)
4. Irrigation-usually maximum area is rain fed and in valley condition as avalability of irrigation roaster
5. Use of pre and post emergence tp herbicide, rainfed- pre emergence,
6. Use of IPM practcices

v. Major insect pests associated with crop: Stem borer, Plant Hoppers, Rice Hispa, Rice Leaf Folder, Rice Bug

vi. IPM Module for management of insect pests:

Stem borer:

1. In the stem borer endemic area raise the nursery away from light source.
2. Raise nursery in narrow strip and mechanically destroy egg masses and moths
3. Remove seedling with Stem borer eggs before transplanting.
4. Use nitrogenous fertilizer moderately and split the application of it over three growth stages to reduce the damage.
5. For the monitoring install the pheromone traps in the field at the rate of 3 trap per acre at a distance of 60 m in a triangular pattern and record the males trapped daily to access the peak population.
6. For the management of yellow stem borer through pheromone mediated mass trapping of male install the pheromone trap in field at the rate of 20 traps/ha in rows maintaining a distance of 20 and 25 meters between traps and rows, respectively. The traps in the first rows are installed 10 m inside from the boundary of the field. The traps are tied on 1.25-1.5m long straight bamboo sticks or poles with the help of jute or plastic strings.The lures containing 3 and 5 mg pheromone are changed after 3 and 4 week, respectively, whereas 10 mg lure work for whole season. Adjust the trap height at 0.5 m and 1.0 m in the early vegetative and reproductive stage of crop, respectively, or 30 cm above crop canopy in all the stages of the crop.To check the escape of trapped males put a tea spoonful insecticidal dust in the polythene sleeve of dry sleeve trap. Dust is not required in funnel type trap. To Ascertain the quality use lures supplied by 2-3 manufacturers in alternate traps initially and after recording their performance replace the ineffective lures by highly effective lure. Relocate the traps displaced in bad weather and replace the polythene sleeve damaged by weather or animals.
7. Mass rearing and release of some parasitoids such as different species of *Trichogramma* have not been found useful in the rice ecosystems in so many countries including India which are inhabited by *Telenomus* and *Tetrastichus* species. Use of trichocard, therefore, increases the cost of cultivation without any gain. The conservation of *Telenomus* and *Tetrastichus* species is self sufficient to naturally reduce the stem borer population.
8. To increase the effectiveness of parasitoides and predators in the rice field
9. Conserve and enhance the natural enemies which are already present in the field.
10. Create favourable condition for natural enemies.
11. Always leave a pest residue in the field at non-economic level, for natural enemy.
12. Reduce the harmful effect of pesticides on natural enemy by:

VII. Apply insecticide only when necessary, not regularly.
VIII. Apply insecticide only when the pest population reaches Economic Threshold Level.
IX. Applying a selective insecticide which is less toxic to natural enemy.
X. Apply the minimum doses of insecticide toxic to pest and least toxic to natural enemy.
XI. Use selective formulation and application method.
XII. Application of granular formulation is less harmful to natural enemy

13. Following insecticides may be used to control stem borers of rice when the population or damage of pest is recorded to 1 moth or 1 egg mass/ m^2 or 5% dead heart :

50 Days within transplating (2 inch water in field)

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 0.4 %GR	10000	53
Fipronil 0.3% GR	16670-25000	32
Cartap 4% Gr	18750	
Carbofuron 3% CG	33300	
Carbosulfon 6% G	16700	37

50 Days after tranplanting

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 18.5 %SC	150	47
Fipronil 5% SC	1000-1500	32
Fipronil 80 %WG	50-62.5	19
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75 %SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20% WG	125	30
Thiacloprid 21.7 %SC	500	30
Acephate 75% SP	666-1000	15
Acephate 95 %SG	592	30
Chromafenozide 80% WP	94-125	32
Monocrotophos 36% SL	1400	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Carbosulfon 25 %EC	800-1000	14
Chlorpyriphos 20% + Acetamiprid 0.4% EC	2500	10
Phosphamidon 40% + Imidachlorpid 2 %SP	600-700	22
Flubendamide 4%+ Buprofezin 20% SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	

Leaf folder:

Following insecticides may be used to control leaf folders of rice

50 Days within transplating (2 inch water in field)

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 0.4% GR	10000	53
Cartap 4% Gr	18750	

Carbosulfon 6% G	16700	37

50 Days after transplating

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 18.5% SC	150	47
Indoxacarb 15.8 %EC	200	14
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75% SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20 %WG	125	30
Chromafenozide 80% WP	94-125	32
Fipronil 80%WG	50-62.5	30
Acephate 75 %SP	666-1000	15
Acephate 95 %SG	592	30
Monocrotophos 36 %SL	1400	
Dichlorovos 76% EC	627	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Quinalphos 25 %EC	1000	40
Flubendamide 4%+ Buprofezin 20 %SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5
Azadirachtin 5% (Neem extract concentrate containing)	375	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	
Beauveria bassiana 1.15%WP Strain BB-ICAR-RJP	2500	
Beauveria bassiana 1.15%WP Strain ICAR	2500	

Brown plant hopper: *Nilaparvata lugens*

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Buprofezin 25% SC	800	20
Clothianidin 50% WDG	20-24	12
Dinotefuran 20% SG	150-200	10
Flonicamid 50% WG	150	36
Pymetrozin 50% WG	300	19
Imidacloprid 17.8% SL	100-150	40
Imidacloprid 30.5 %SC	60-75	37
Imidaclorpid 70% WG	30-35	7
Acetamiprid 20 %SP	50-100	7
Acephate 75% SP	666-1000	15

Acephate 95 % SG	592	30
Thiamethoxam 25 %WSG	100	14
Monocrotophos 36 %SL	1400	
Fipronil 5 %SC	1000-1500	32
Ethiprole 40%+ Imidacloprid 40% WG	125	15
Chlorpyriphos 20%+ Acetamiprid 0.4%EC	2500	10
Buprofezin 15% + Acephate 35 WP	1250	20
Flubendamide 4%+ Buprofezin 20 SC	175+700	30

Bio- insecticides

Name of the Bio-insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 5% (Neem extract concentrate containing)	375	5
Metarhizium anisopliae 1.15% WP	2500	

Rice hispa: *Dicladispa armigera*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Triazophos 20% EC	1250-2500	40
Chlorpyriphos 20 %EC	1250	30
Quinalphos 25 %EC	2000	40

Rice bug: *Leptocorysa acuta*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Methyl parathion 2% DP	500	25000

vii. Major disease associated with crop: Khaira, rice blast, Brown spot, leaf blight, False smut**,**Sheath blight, bacterial blight

viii. IPM Module for management of disease:

During Nursery Sowing

Deep summer ploughing or soil solarisation

Seed bio priming with bio-control agent (PS @10g/kg seed) or fungicide (Carbendazime 1g/kg seed)

Fertilizers

Basal: Nitrogen= 30 Kg/ha

P2O5= 60 kg/ha

K2O = 40 kg/ha

Zinc sulphate 25kg/ha

After 30 days crop stage Nitrogen= 50 kg/ha

At Panicle initiation = 40 kg/ha

Khaira disease: Due to Zinc deficiency)

Name of the Fungicides	**(gm/ml) /ha**
Zinc sulphate (Apply in soil at the time of plot preparation)	25000
Zinc sulphate spray (2.5 Kg Quick lime & 20 Kg Urea in 1000 lit. water	5000

Sheath blight: *Rhizoctonia solani*

Drain of water to check spread of sheath blight.

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Carbendazim 50 %WP (Seed Treatment)	2	
Carbendazim 50 %WP	250-500	
Propiconazole 25% EC	500	30

Hexaconazole 5% EC	1000	40
Hexaconazole 5% SC	1000	40
Difenoconazole 25% EC	0.05%	25
Flusilazole 40% EC	300	24
Tebuconazole 250% EC (25.9%)	750	10
Validamycin 3% L	2000	14
Iprodione 50% WP	2250	35
Pencycuron 22.9% SC	150-188	600-750
Thifluzamide 24% SC	375	28
Cresoczim-methyl 44.3 %SC	500	30
Tebuconazole 50% +Trifloxystrobin 25% WG	200	21
Carbendazim 12%+Flusilazole 12.5 %SE	800-960	54
Iprodione 25% + Carbendazim 25% WP	500	
Propiconazole 13.9%+ Difenoconazole 13.9% EC	0.07-0.1%	46
Tebuconazole 50% +Trifloxystrobin 25% WGs	200	31

Biofungicides:

Name of the Bio-fungicides		
Trichoderma viride 1% WP (Strain T-14 in house isolate of M/s Indore Biotech Inputs and Research (P) Ltd., Indore)	5 -10 gm/lit water	**Foliar spray:** Mix 2.5 Kg of *Trichoderma viride* 1% WP in 500 lit. of water. Spray three times at 15 days interval uniformly over one hectare land 30 days after planting.

Rice blast: ***Magnaporthe grisea***

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Picoxystobin 22.52% SC	600	12
Isoprothiolan 40 %EC	750	60
Tricyclazole 75% WP	300-400	30
Tebuconazole 25% WG	750	10
Idifenphos 50% EC	500-600	21
Carpropamid 27.8 %SC	500	
Cresoczim-methyl 44.3 SC	500	30
Hexaconazole 5% EC	1000	40
Casugamycin 3 %SL	1000-1500	30
Carbendazim 50 %WP	250-500	
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Tebuconazole 50% +Trifloxystrobin 25% WG	200	31
Carbendazim 12%+Mancozeb 63% WP	750	57
Azoxystrobin 18.2% + Difenoconazole 11.4%SC	0.1%	5

Bacterial leaf blight: ***Xanthomonas oryzae***

4. Do not planting under full or partial shade to avoide bacterial blight (BLB) infection.
5. After bacterial blight infection of drain the water from field and stop the application nitrogenous

fertilizer.

6. Drain of water to check spread of bacterial blight

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Streptocyclin (Seed Treatment)	40ppm	
Streptocyclin (Nursary Treatment)	40-100ppm	
Streptocyclin (Spray)	15	Local recommendation
Copper hydroxide 53.8% DF	1500	10
Copper hydroxide 50 %WP	500	Local recommendation

Biofungicides

Name of the Fungicides		
Pseudomonas fluorescens 1.5% WP (BIL-331 Accession No. MTCC 5866)	5 gm/Kg seed	**Seed Treatment:** Make a thin paste of required quantity of *Pseudomonas fluorescens* 1.5% WP with minimum volume of water and coat the seed uniformly, shades dry the seeds just before showing.

Brown leaf spot: *Cochiobolus miyabianus*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Propineb 70 %WP	1500-2000	
Idifenphos 50% EC	500-600	21
Captan 75% WP	1000	

Biofungicides

Name of the Bio-Fungicides	Kg/ha	Treatment
Pseudomonas fluorescens 1.5% WP (BIL-331 Accession No. MTCC 5866)	2.5 Kg/ha	**Seed Treatment:** Make a thin paste of required quantity of *Pseudomonas fluorescens* 1.5% WP with minimum volume of water and coat the seed uniformly, shade dry the seeds just before sowing.

False smut: *Ustilaginoidea virens*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Copper hydroxide 77% WP	2000	
Copper hydroxide 53.8 %DF	1500	10

Major weeds associated with crop: *Oxalis,Cyperus* spp*, Echinocloa* sp*, Chenopodium album, Commelina bengalensis, Cynodon* spp*, Digitaria sanguinales, Eclipta* spp, *Eleusine* spp

x. IPM Module for management of weeds(except organic areas):

Umbrella plant: *Cyperus rotundus* (annual, monocot, narrow leaves, sedge)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Chlorimuron ethyl 25% WP (Transplanted rice)	24	60
2,4-D Ethyl Ester 4.5% GR (Transplanted rice)	25000	
MCPA, Amine salt 40% WSC (Transplanted rice)	2000-5000	
Metsulfuron methyl 20 %WP (Transplanted rice)	20	60
Orthosulfamuron 50% WG (Transplanted rice)	150	65 Pre
Bensulfuron methyl 0.6% + Pretilachlor 6% G	10000	88 (Transplanted rice)

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period days)
Chlorimuron Ethyl 25% WP (Transplanted rice)	24	60

Long Leaved Dayflower: *Commelina bengalensis* (perennial, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period days)
Chlorimuron Ethyl 25% WP (Transplanted rice)	24	60
Cinmethylin 10% EC (Transplanted rice)	750-1000	60
Metsulfuron Methyl 20% WG (Transplanted rice)	20	71
Paraquat dichloride 24% SL (Before sowing)	1250-3500	

Bermuda Grass: *Cynodon dactylon* (perennial, dicot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period days)
2,4-D Ethyl Ester 4.5% GR (Transplanted rice)	25000	
Bensulfuron methyl 0.6 %+ Pretilachlor 6 %G	10000	88(Transplanted rice)

Bamboo grass: *Digitaria sanguinalis* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period days)
Pretilachlor 37% EW (Transplanted rice)	1500-1875	90

Jungle rice: *Echinochloa colonum, E. crusgali* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period days)
Anilofos 30% EC (Transplanted rice)	1000-1500	30
Anilofos 18% EC (Transplanted rice)	1660-2500	
Anilofos 2% G (Transplanted rice)	20000-25000	30
Bispyribac Sodium 10% SC (Nursary)	200	
Butachlor 50% EC (Transplanted rice)	2500-4000	90&120
Butachlor 50% EW (Transplanted rice)	2500-3000	
Butachlor 5% G	25000-40000	90&120
Chlorimuron ethyl 25% WP (Transplanted rice)	24	60
Clomazone 50% EC (Transplanted rice)	8000-10000	90
Cyhalofop butyl 10% EC	750-800	90
2,4-D Ethyl Ester 38% EC	2500	
2,4-D Ethyl Ester 4.5% GR (Transplanted rice)	25000	
Fenoxaprop-p-ehtyl 9% EC (Transplanted rice)	625	70 Post
Fenoxaprop-p-ehtyl 6.9% EC	812-875	61
Flufenacet 60% DF (Transplanted rice)	200	90-110
Orthosulfamuron 50% WG (Transplanted rice)	150	65 Pre
Oxadiargyl 80% WP (Transplanted rice)	125	97
Oxadiargyl 6% EC (Transplanted rice)	1066	97
Oxadiazon 25% EC (Transplanted rice)	2000	
Oxyflourfen 0.35.5% GR (Transplanted & Direct sown)	30000-40000	
Oxyflourfen 23.5% EC (Transplanted & Direct sown)	650-1000	
Pendimethalin 30% EC (Transplanted & Direct	3300-5000	

sown)		
Pendimethalin 5% G (Transplanted & Direct sown)	20000-30000	
Pretilachlor 37% EW (Transplanted rice)	1500-1875	90
Pretilachlor 30.7% EC (Wet Direct Seeding)	1500-2000	110
Pretilachlor 50% EC (Transplanted rice)	1000-1500	75-90
Anilofos 24%+ 2,4-D ethyl ester 32% EC	1000&1500	90 (Transplanted rice)
Bensulfuron methyl 0.6% + Pretilachlor 6 G	10000	88(Transplanted rice)
Clomazone 20%+ 2,4- D ethyl ester 30% EC	1250	110 (Transplanted rice)
Cinmethylin 10% EC (Transplanted rice)	750-1000	60
Paraquat dichloride 24% SL (Before sowing)	1250-3500	

False Daisy: *Eclipta alba* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Anilofos 30% EC (Transplanted rice)	1000-1500	30
Azimsulfuron 50% DF (Transplanted & Direct sown)	70	59
Bensulfuron methyl 60%DF (Preemergence)	100	88
Bensulfuron methyl 60%DF (Postemergence)	100	71
Bispyribac Sodium 10% SC (Direct seeded)	200	78
Butachlor 50% EC (Transplanted rice)	2500-4000	90-120
Butachlor 50% EW (Transplanted rice)	2500-3000	
Butachlor 5% G	25000-40000	90-120
Chlorimuron ethyl 25% WP (Transplanted rice)	24	60
Clomazone 50% EC (Transplanted rice)	8000-10000	90
Ethoxysulfuron 15 WDG (Transplanted rice)	83.3-100	110
Metsulfuron methyl 20 %WG (Transplanted rice)	20	71
Oxadiargyl 80% WP (Transplanted rice)	125	97
Oxadiazon 25% EC (Transplanted rice)	2000	
Oxyflourfen 0.35.5% GR (Transplanted & Direct sown)	30000-40000	
Oxyflourfen 23.5% EC (Transplanted & Direct sown)	650-1000	
Pendimethalin 30% EC (Transplanted & Direct sown)	3300-5000	
Pendimethalin 5% G (Transplanted & Direct sown)	20000-30000	
Pretilachlor 37% EW (Transplanted rice)	1500-1875	90
Pretilachlor 50% EC (Transplanted rice)	1000-1500	75-90
Bensulfuron methyl 0.6% + Pretilachlor 6 %G	10000	88(Transplanted rice)
Clomazone 20%+ 2,4- D ethyl ester 30% EC	1250	110(Transplanted rice)
Metsulfuron methyl 10%+ chlorimuron ethyl 10 %WP	20	90(Transplanted rice)

Indian goosegrass: *Eleusine indica* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Butachlor 50% EC (Transplanted rice)	2500-4000	90-120
Butachlor 5% G	25000-40000	90-120

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Jethirice- Wheat/Lentil/Barley/oat (fodder) (rainfed), Rice- Wheat /onion/berseem (irrigated),
4. Timely Sowing/Trans planting, Seed treatment,
5. Use of HYV, Hybrid (120-125days), Basmati(120-125days)
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products
13. Avoid early Nursery raising practice and use of 21-30 days old seedling I

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing, Wild animal damages
4. Migration,
5. Poor Irrigation facilities

6C. Name of Field Crop: Finger millet

i. Existing varieties being used: Band mutthi(Garhwali mandua), Khuli muthi(Kumaon mandua)

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL Mandua 324, and VL Mandua 352, PRM1

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. Undecomposed FYM 1.0-2.0qt./nail
3. 1-2 weeding

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 2 or 3ploughing ,
2. Seed rate and seed sowing -14-16kg/ha, Gap filling/Transplanting
3. Manure and fertilizer- -10 tonne FYM , NPK 20:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Stem borer

vi. IPM Module for management of insect pests: Fipronil 5sc @ 2ml/liter of water

vii. Major disease associated with crop: Blast

viii. IPM Module for management of disease: Spray of carbendazim @ 0.1%

ix. Major weeds associated with crop: *Oxalis latifolia, Phylanthus niruri , Amaranthus viridis, Euphorbia hirata, Solanum* sp,*Tribulus* sp, *Cyperus* sp

x. IPM Module for management of weeds: First hand weeding after 10 to 20 days of germination
broadcast of Isoproturan @0.75 kg/ha

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,

3. Fingermillet- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Fingermillet+Horsegram/Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
5. Timely Sowing, Seed treatment,
6. Use of HYV, Gapfilling/Transplating
7. Contour cultivation and care soil & water conservation measures
8. INM(Maximum use of value added compost/FYM
9. and soluble fertiliser)
10. Integrated weed management
11. IPM
12. Good storage condition
13. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages
5. Migration,
6. Poor Irrigation facilities

6D. Name of Field Crop: Barnyard millet

i. Existing varieties being used: Non described

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: PRJ-1, VL Madira 172 and VL Madira 207

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. Undecomposed FYM 1.0-2.0qt./nail
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 2or 3 ploughing,
2. Seed rate and seed sowing -14-16kg/ha, Gap filling
3. Manure and fertilizer- -10 tonne FYM , NPK 20:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Stem borer

vi. IPM Module for management of insect pests: Imidacloprid @ 4ml/10 liter of water

vii. Major disease associated with crop: Blast, Smut

viii. IPM Module for management of disease: Seed treated with carbendazim 2gm/kg seeds

ix. Major weeds associated with crop: *Oxalis latifolia, Phyllanthus niruri, Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cyperus* sp

x. IPM Module for management of weeds(except organic areas): -

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Fingermillet- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Fingermillet+Horsegram/Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
5. Timely Sowing, Seed treatment,
6. Use of HYV, Gapfilling/Transplating
7. Contour cultivation and care soil & water conservation measures

8. INM(Maximum use of value added compost/FYM
9. and soluble fertiliser)
10. Integrated weed management
11. IPM
12. Good storage condition
13. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM, climate changing, Wild animal damages
2. Migration specially from border area
3. Poor Irrigation facilities

7A. Name of the Pulse crop: Horsegram

i. Existing varieties being used: Non described-Paharigahat

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VLG-8, 10, 15

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. Un decomposed FYM 1.5-2.0qt./nali,
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 20-25kg/ha,
3. Spacing 30x10cm
4. Manure and fertilizer- -10 tonne FYM , NPK20:40 :20,
5. Irrigation-usually maximum area is rain fed
6. Use of pre and post emergence herbicide (As per moisture availability), rainfed- pre emergence.
7. Use of IPM practices

v. Major insect pests associated with crop: Pulse beetle

vi. IPM Module for management of insect pests: Spray of neem gold @ 4ml/liter of water before pod stage

vii. Major disease associated with crop: White Rot

iii. IPM Module for management of disease: Spray of carbendazim @ 1ml/liter of water

ix. Major weeds associated with crop: *Oxalis latifolia, Phyllanthus niruri, Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cyperus* sp

x. IPM Module for management of weeds: Manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Horsegram- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Horsegram +Maize+Finger millet - Wheat/Lentil/Barley/oat (fodder) (rainfed),
5. Timely Sowing, Seed treatment,
6. Use of HYV, Gap filling
7. care soil & water conservation measures
8. INM (Maximum use of value added compost/FYM
9. and soluble fertiliser)
10. Integrated weed management
11. IPM
12. Good storage condition

13. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM,
2. Climate changing, Wild animal damages
3. Migration, Poor Irrigation facilities

7B. Name of the Pulse crop: Lentil

i. Existing varieties being used: Chota masur , lal masur

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Masoor 125, VL Masoor 126, VL Masoor 507, VL Masoor 514

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. Un decomposed FYM 1.0-2.0qt./nali,
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 20-25kg/ha, spacing 30*10cm
3. Manure and fertilizer- -10 tonne FYM , NPK20:40 :20,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Pod borer, cut worm

vi. IPM Module for management of insect pests: Quinalphos 25 EC @ 2ml/liter of water

vii. Major disease associated with crop: Wilt

viii. IPM Module for management of disease: Crop rotation, seed treated with cycodarma

ix. Major weeds associated with crop: various weeds

x. IPM Module for management of weeds: Manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Horsegram/Soybean- Lentil (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV, re sowing
6. Care soil & water conservation measures
7. INM (Maximum use of value added compost/FYM
8. and soluble fertiliser)
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs
2. Use of imbalance and un decomposed FYM
3. Climate changing
4. Wild animal damages
5. Migration
6. Poor Irrigation facilities
7. Water scarcity

8. Wild animals
9. Lack of mechanization
10. Lack of rain water harvesting structures

6C. Name of Pulse/oilseed Crop: Soyabean

i. Existing varieties being used: Kala bhatt(Oval), Local yellow

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VLS 47, VL Soya 59, VL Soya 63 and VL Soya 65

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. Undecomposed FYM 1.0-2.0qt./nail.
3. 1-2 manual weeding.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing -100-125/ha,
3. Manure and fertilizer- -10 tonne FYM , NPK 20-80:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rain-fed- pre emergence,
6. Use of IPM practices

v. Major insect pests associated with crop: Semi looper, Bihar hairy catter piller, White fly, Girdle beetle, defoliators, jassid, stem fly etc.

vi. IPM Module for management of insect pests:

Cultural practices: The cultural practices make the environment less favorable for the pests and more favorable for its natural enemies. The following are cultural practices recommended for the management of soybean insect pests.

1. Removal and destruction of infected stubbles followed by deep summer ploughing destroys the pupae of stem fly, girdle beetle, pod borer and tobacco caterpillar present in the soil.
2. Optimal fertilizer dose of NPK and S @ 20:60-80: 30-40:20 kg/ ha should be applied.
3. Application of excessive dose of nitrogen fertilizer causes the infestation of all insect pests on soybean.
4. Crop rotation with non-leguminous plants is recommended for the management of leaf miner.
5. Intercropping of soybean with either asafetida (*Ferula assafoetida* L.) or maize or sorghum in the sequence of 4 rows of soybean with 2 rows of intercrop should be practiced. These intercrops help in conservation of biocontrol agents, like coccinellid beetles, Chrysoperla etc. In girdle beetle and semilooper endemic areas, intercropping with maize or sorghum should be avoided.
6. Planting of trap crops like castor for tobacco caterpillar, groundnut for leaf miner, marigold for pod borer and Dhaincha (*Sesbania sesban*) for girdle beetle.
7. Selection of insect resistant or tolerant varieties for cultivation.

Table1: Resistant or tolerant varieties for insect pests of soybean.

Insect pest	Resistant or tolerant variety
Stem fly	Dsb 25, Himso 1685, JS 20-89, MACS 1370, MACS 1410, NRC 97, JS 20-53,PS 1543, SL 983, Dsb 23-2
Girdle beetle	MACS 1410, Dsb 23-2, Himso 1685, JS 20-89, KDS 726
Defoliators	Dsb 23-2, KDS 726, PS 1543, PS 1569
Pod borer	Dsb 25, SL 683, NRC 97, MACS 1370, JS 20-89
Leaf miner	MACS 1370, Himso 1685, MACS 1370, MACS 1410
Pest complex	DS 2708, Dsb 23-2, Dsb 25, Himso 1685, JS 20-53, JS 20-79, JS 20-89, KDS 726, MACS 1370, MACS 1410, NRC 97, SL 983, PS 1543

Mechanical Control: Reduction of insect pest population by means of manual devices or labour is

called mechanical control. The following measures are recommended for mechanical practices for soybean insect pests.

1. Collection and destruction of girdle beetle infested plant parts, egg masses and gregariously feeding larvae of Bihar hairy caterpillar and tobacco caterpillar.
2. Hand picking and mechanical destruction of matured pod borer larvae.
3. Erection of bird perches @ 10-12/ha to attract predatory birds for preying on defoliator larvae.

Physical control: Reduction of pest population by using device which affect them physically or alter their physical environment. Manipulation of temperature, humidity, light is used for this purpose. This includes the following:

1. Light traps should be placed at ground level early in the season for collection and destruction of the leafminer moths.
2. Installation of light traps in the field for monitoring and collection of adult moths.

Biological Control: The successful management of a pest by means of another living organism (parasitoids, predators and pathogens) is called biological control. The following biological control agents are used in IPM of soybean.

1. Release of *Tricogramma chilonis* @ 50,000/ ha four times at weekly interval against *S. litura*.
2. Spraying of *Bacillus thuringiensis* var. kurstaki @ 0.75 to 1.0 kg/ha for the management of defoliators.
3. Foliar application of HaNPV (*Helicoverpa armigera* Nuclear Polyhedrosis Virus) for *H. armigera* @ 250 LE/ha.
4. The major predators of soybean insect pests are given in the table 2.

Table 2: Major predators of insect pests of soybean

Insect pests attacked	**Predator**
Whiteflies	Lady bird beetles: *Coccinella septumpunctata* *Coccinella transversalis*
Lepidopterous caterpillars	Pentatomid bug *Eocanthecona furcellata*
Lepidopterous caterpillars and Whiteflies	Spiders: *Lynx* spider and Orb weaver spider

Chemical Control: The control of insects with pesticides/insecticides is known is chemical control. The insecticides are applied only when the population of insect pests crossed the Economic Threshold Level (ETL) (Table 3). The list of insecticides recommended for soybean insect pests are given in table 4.

Table 3: Economic Threshold Level (ETL) of soybean insect pests

Insect Pest	**Crop stage**	**Population/ meter**
Green semilooper	Flowering	2 larvae
Tobacco caterpillar	Flowering	4 larvae
Girdle beetle	Flowering	10 % infestation
Pod borer	Podding	3 larvae

Table 4: List of insecticides recommended for soybean insect pests

Insect pest	**Insecticide**	**Dosage**
Sucking pests, stem fly	Thiamethoxam 30 FS (Seed treatment)	10ml/kg seed
Sucking pests	Acetamiprid 20 SP	100 ml/ha
Sucking pests	Spiromesifen 22.9 SC	600ml/ha
Sucking pests	Imidacloprid 17.8 SL	500 ml//ha
Sucking pests and girdle beetle	Triazophos 40 EC	800ml/ha
Defoliators	Dichlorovos 76EC	500 ml/ha

Defoliators and pod borer	Quinalphos 25 EC	1500 ml/ha
Sucking pests and defoliators	Monocrotophos 36 SL	800 ml/ha
Pod borer	Indoxacarb 15.8EC	333 ml/ha
Defoliators, stem fly and girdle beetle	Chlorantraniliprole 18.5 SC	150 ml/ha
Leaf miner	Carbaryl 50WP	2.0 kg/ha
Leaf miner and sucking pests	Oxydemeton methyl 25EC	350 ml/ha
Girdle beetle	Phorate 10 G	10 kg/ha
Stemfly and girdle beetle	Carbofuran 3 G	30 kg/ha

Bio-insecticides

Tobacco caterpillar (*Spodoptera litura*)

Name of the Bio-insecticides	**(gm/ml) /ha**
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

***Hairy caterpillar* (*Spilosoma obliqua*)**

Name of the Bio-insecticides	**(gm/ml) /ha**
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

Semilooper (*Chrysodeixis acuta*)

Name of the Bio-insecticides	**(gm/ml) /ha**
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

Soyabean leaf miner (*Odontota horni*)

Name of the Bio-insecticides	**(gm/ml) /ha**
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750

vii. Major disease associated with crop: Root knot nematode, Rust, collar rot

viii. IPM Module for management of disease:

Rust: *Phakopsora pachyrhizi*

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Hexaconazole 5% SC	500	30
Propiconazole 25% EC	500	26

Collar rot: *Sclerotium rolfsii*

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Carboxin 37.5%+ Thiram 37.5% DAS	3.0/Kg	Seed Treatment

ix. Major weeds associated with crop: *Oxalis latifolia, Phyllanthus niruri ,Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cyperus* sp

x. Production constraints in agro-ecological region:

1. Apply Trifluralin 48%EC @ 1.0 kg a.i/ha as pre plant incorporation.
2. Apply Alachlor 50%EC @ 2-2.5 kg a.i/ha or Pendimethalin 30%EC @ 0.75-1.0 kg a.i/ha or Pendimethalin 30% EC + Imazethapyr 2% EC @ 0.75+0.05 kg a.i/ha or Metribuzin 70%WP @ 0.35-0.525 kg a.i/ha or Diclosulam 84% WDG @ 22-26 g a.i/ha within 3 days after sowing.
3. Apply Quizalofop- ethyl 5%EC @ 0.0375-0.05 kg a.i/ha or Fenoxaprop-p-ethy l 9.3% EC 0.1 kg a.i/ha or Haloxyfop 10.5% EC 108-135 g a.i/ha at 20-25 days after sowing to control grassy weeds.
4. Apply Imazethapyr 10%SL @ 0.1 kg a.i/ha or Imazamox 35%+ Imazethapyr 35% @ 0.07 kg a.i/ha at 20-25 days after sowing to control grassy and non grassy weeds.
5. Apply any pre emergence herbicide followed by one hand weeding at 30-35 days after sowing.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV,
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages
5. Migration,
6. Poor Irrigation facilities

7C. Name of oilseed crop: Toria/sarson

i. Existing varieties being used: Rara,Gharia

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Pant Toria-303, 507, Uttara, PPS-1

iii. Existing package of practices being used:

1. Traditional seed variety ,
2. un decomposed FYM 1.0-2.0qt./nali,
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 4-5kg/ha, spacing 30*10cm
3. Manure and fertilizer- -10 tonne FYM , NPK50:20 :20
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(Asper moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Aphid, Hairy caterpillar, mustard saw fly

vi. IPM Module for management of insect pests:

Mustard aphid: *Lipaphis erysimi*

1. Timely sowing of crop
2. Removal & destruction of Aphid infested twigs at flowering and siliquae formation stages.
3. Release of larvae/adult of lady bird beetle (***Coccinella septempunctata***) @ 50,000/ha

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 25% WSG	50-100	21
Oxydemeton-methyl 25% EC	1000	
Dimethoate 30% EC	660	
Chlorpyriphos 20% EC	500	

Mustard saw fly : *Athalia lugens proxima*

Name of the Insecticides	(gm/ml) /ha

Imidacloprid 70% WS (Seed treatment/Kg)	7.0
Dimethoate 30% EC	660
Quinalphos 25% EC	1200

vii. Major disease associated with crop : Alternaria Blight, White rust, Downy Mildew

viii. IPM Module for management of disease:

Alternaria blight or Leaf spot: *Alternaria brassicae*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Iprodione 50% WP	2250-3000	50

White rust : *Albugo candida*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Metalaxyl 35% WS (Seed treatment/Kg)	6-0	
Metalaxyl 8%+ Mancozeb 64% WP	2500	56
Metalaxyl 4%+ Mancozeb 64% WP	2500	60

Downy mildew: *Peronospora parasitica*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Metalaxyl 4%+ Mancozeb 64% WP	2500	60

ix. Major weeds associated with crop: Bathua, white sweet clover, Yellow sweet clover

x. IPM Module for management of weeds:

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Oxadiargyl 6% EC	1500	35

White sweet clover: *Melilotus alba* (annual-biannual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Oxadiargyl 6% EC	1500	35

Yellow sweetclover: *Melilotus indica* (annual-biannual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Oxadiargyl 6% EC	1500	35

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Sowing as sole cropping ,
2. Timely Sowing, Seed treatment
3. HYV, IPM

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing, Wild animal damages
4. Migration specially from border area
5. Poor Irrigation facilities

8A. Name of Fruit Crop: Peach

i. Existing varieties being used: Paradelux, July Elberta, Red June

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Alaxnder, Red globe, crest heaven, Glo heaven etc. Nectarine-snow Queen

iii. Existing package of practices being used:

1. Use of old and traditional Varieties
2. Poor knowledge of canopy management practices
3. Organic inputs for crop production
4. No knowledge of high density orcharding
5. Irrigation facilities are rarely used

6. Lack of grading and packing facilities
7. No canning or processing unit
8. No availability of waste management of crop residue

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Need to introduce non-clingstone varities with maturity indices on or before June.
2. Use of High denisty plantation with mulch and supplemetation of drip irrigation.

v. Major insect pests associated with crop: Peach Leaf Curl Aphid, Peach Fruit Fly.

vi. IPM Module for management of insect pests :

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause succulent tissue that is very susceptible to infection.
3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Carbosulfan 3% CG	1000	33300
Oxydemetonmethyl 25% EC	0.025%	1500-2000

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Bury the infested fruits at 60 cm deep in the soil.
4. Use Methyl eugenol trap
5. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting.

vii. Major disease associated with crop: Gummosis is major problem

viii. IPM Module for management of disease:

1. Use of proper cultural or field operation with minimum damage to the crop
2. Use of antibiotic as prophylatic spray.

Name of the Fungicides	**(gm/ml) /ha**
Lime sulphur 22% SC	1%

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds: Timely manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: High density plantation with (3x3mts) supplemented with drip irrgation system.

xii. Production constraints in agro-ecological region:

1. Availability of Quality planting material
2. Need to delineate the table and canning type varieties.

8B. Name of Fruit Crop: Pear

i. **Existing varieties being used:** Gola, Victoria, China, Baggugosha, Kashmiri, Thumb pear etc

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** Max Bartlette, Red Bartlette, Willium, Starkrimson, Hokoi

iii. **Existing package of practices being used:**

1. Use of old and traditional varieties
2. Less or no use of mulch for water conservation
3. Canopy management is poor
4. Recommended Cultural practices are rarely applied
5. Maturity indices are rarely use
6. Surplus management of fruit are not done
7. Processing industries are not established for Gola nashpati

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Use of new strains or occidental pears are needed for high hills
2. Introduction of new strains with less gritcells in fruits
3. Need to develop Postharvest management system with minimum losses.
4. Processing facilities needs to be strengthened.

v. **Major insect pests associated with crop:** San Jose Scale , Tent Caterpillar, Codling Moth/ Fruit borer, Peach Leaf Curl Aphid,Peach Fruit Fly.

vi. **IPM Module for management of insect pests :**

San Jose Scale:

1. Collection and destruction of infected pruned material.
2. Adult emergence monitoring with special sex pheromone
3. Traps Parasite, *Encarsia perniciasi* with *Aphytis diaspidis* may give upto 86.5 per cent parasitism.
4. Conserve Coccinellid predators,*Chilocorus bijugus* Mulsant*,Chilocorus rubidus* Hope *Pharoscymnus flexibilies* Mulsant

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Malathion 50% EC	0.05%	1500-2000
Oxydemetonmethyl 25% EC	0.07%	4200-5600

Tent Caterpillar:

1. Pruning and burning of twigs containing egg mass (Dec-Jan).
2. Mopping up the tent with pole and some rags dipped in kerosene tied on its end (at 12.00-3.00 pm).
3. Ues parasitoid Tachnid fly, virus also causes diseases to caterpillar.
4. Spraying with melathion @ 2ml/l or Carbaryl 50 WP @ 2 Kg per 500 lit of water per hac.Spray 0.05% nimbecidine or *B.t.* based Halt 0.02%.

Codling Moth/ Fruit borer:

1. Thorough clean up of orchard.
2. Scrapping lose bark from old trees.
3. Collection and destruction of fallen fruits.
4. Mating disruption dispenser, moth pheromone trap can be used
5. Birds; *Parus major* and *Passer domesticus* prey upon overwintering larvae.
6. Predators, such as ground beetles (Carabidae), ants and crickets, and parasitic wasps, attack larvae as they leave fruit and crawl towards tree trunks
7. Spray of Carpovirusine (GV of moth) at fortnightly interval.
8. Release of *Trichogramma embryophagum* within the first appearance of moth and subsequent release at weekly interval.
9. Spraying (before caterpillar enter into fruit), monocrotophos @ 2ml/l or quinolphos @ 2ml/l or

2.0 kg carbaryl 50 WP in 500 l of water/ha.

10. In case of high abundance, tree should be banded with chemically treated bands.

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause succulent tissue that is very susceptible to infection.
3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion

Peach leaf curl aphid

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Carbosulfan 3% CG	1000	33300
Oxydemetonmethyl 25% EC	0.025%	1500-2000

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Bury the infested fruits at 60 cm deep in the soil.
4. Use Methyl eugenol trap
5. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting.

vii. Major disease associated with crop: Collar rot, Die back, pody mildew

viii. IPM Module for management of disease: Wettable sulphur (sulfex 0.2%), copper oxycloride (Blitox 0.3%)

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds: -

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: Introduction of New Strain *viz*. Anjou, Starkrimson in high hills.

xii. Production constraints in agro-ecological region: Availability of quality planting material

8C. Name of the fruit crop: Plum

i. Existing varieties being used: Santa rosa, Beauty, Burbank

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Italian plum, Prunes *viz* Frontier, for mid and high hills.

iii. Existing package of practices being used:

1. Use of old and traditional varieties
2. Less or no use of pollinizer varieties in plum especially in japnese type varieties
3. Less or no use of mulch for water conservation
4. Canopy management is poor
5. Recommended cultural practices are rarely applied
6. Maturity indices are rarely use
7. Processing industries are not established for plum

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region: High density plantation with drip irrigation system.

v. Major insect pests associated with crop: San Jose scale, Tent Caterpillar, Codling Moth/ Fruit borer, Peach Leaf Curl Aphid, Peach Fruit Fly.

vi. IPM Module for management of insect pests :

San Jose Scale:

1. Collection and destruction of infected pruned material.
2. Adult emergence monitoring with special sex pheromone
3. TrapsParasite, *Encarsia perniciasi* with *Aphytis diaspidis* may give upto 86.5 per cent parasitism.
4. Conserve Coccinellid predators,*Chilocorus bijugus* Mulsant,*Chilocorus rubidus* Hope *Pharoscymnus flexibilies* Mulsant

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Malathion 50% EC	0.05%	1500-2000
Oxydemetonmethyl 25% EC	0.07%	4200-5600

Tent Caterpillar:

1. Pruning and burning of twigs containing egg mass (Dec-Jan).
2. Mopping up the tent with pole and some rags dipped in kerosene tied on its end (at 12.00-3.00 pm).
3. Ues parasitoid Tachnid fly, virus also causes diseases to caterpillar.
4. Spraying with melathion @ 2ml/l or Carbaryl 50 WP @ 2 Kg per 500 lit of water per hac.
5. Spray 0.05% nimbecidine or *B.t.* based Halt 0.02%.

Codling Moth/ Fruit borer:

1. Thorough clean up of orchard.
2. Scrapping lose bark from old trees.
3. Collection and destruction of fallen fruits.
4. Mating disruption dispenser, moth pheromone trap can be used
5. Birds; *Parus major* and *Passer domesticus* prey upon overwintering larvae.
6. Predators, such as ground beetles (Carabidae), ants and crickets, and parasitic wasps, attack larvae as they leave fruit and crawl towards tree trunks
7. Spray of Carpovirusine (GV of moth) at fortnightly interval.
8. Release of *Trichogramma embryophagum* within the first appearance of moth and subsequent release at weekly interval.
9. Spraying (before caterpillar enter into fruit), monocrotophos @ 2ml/l or quinolphos @ 2ml/l or 2.0 kg carbaryl 50 WP in 500 l of water/ha.
10. In case of high abundance, tree should be banded with chemically treated bands.

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause succulent tissue that is very susceptible to infection.
3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Carbosulfan 3% CG	1000	33300
Oxydemetonmethyl 25% EC	0.025%	1500-2000

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Bury the infested fruits at 60 cm deep in the soil.
4. Use Methyl eugenol trap
5. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting.

vii. Major disease associated with crop:-

viii. IPM Module for management of disease:-

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. High density plantation (3x3 mts) with drip irrigation
2. Intercropping of soybean or gahat or lentil in rabi season
3. Mulch technology
4. Post harvest management of perishable with refrigeration system and development of fruit wines factories in the state.

xii. Production constraints in agro-ecological region:

1. Non-availability of reliable and elite planting material
2. Poor technical knowledge

9A. Name of the vegetable crop: Cabbage

i. Existing varieties being used: Pride of India, Golden acre as open pollinated varieties and Varun, Pragati as hybrid varieties

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: All hybrid varieties. Seeds are available in multinational companies.

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
7. Cultivars-In cabbage, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be head formation.
8. Transplanting- Farmers practices improper planting distance.
9. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
10. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
12. Harvesting- The harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Promotion of high yielding, round shaped, 100% heading percentage, mature within 90 days.
2. 1.Soil Testing-Farmers do not test their soil
3. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
4. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
5. Nursery- Nursery soil generally not sterilize by the farmers.
6. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
7. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
8. Cultivars-In cabbage, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be head formation.
9. Transplanting- Farmers practices improper planting distance.
10. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
11. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
12. Weed control- Farmer generally not aware about the proper stage of weed elimination from the

field as well as losses takes place in the crop.

12. Harvesting- The harvesting should not follow as per maturity standards or as per object.

v. Major insect pests associated with crop: Butterflies, Aphids, *Plutell*a and Painted bugs

vi. IPM Module for management of insect pests :

Diamond black moth- plantation of mustard crop as trap crop at margins of cabbage field to attract the adults for egg laying,spray of *Bacillus thurengnsis* @ 1.0 kg /ha or

Cabbage butterfly - mechanically destroy the cluster of eggs, *Helicoverpa* - release of *Tricogramma* spp insect eggs @ 50000 / ha at the time of initation of flowering to 7- 10 days,

Before Planting

1. Deep ploughing in the month of summer to expose immature stages.
2. Hand picking and destruction of cabbage butterfly eggs and larvae in nursery as well as main crop to reduce the pest multiplication.
3. Growing of African bold seeded mustard as trap crop at 22:2 ratio (Cabbage: Mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop may reduce the infestation.

After Planting

1. Regular Monitoring of the plants randomly for the presence of pests on both the leaf surface as well as between the leaves.
2. Hand picking and destruction of leaf webber and egg masses and early instar larvae to reduce further multiplication of pests in the field.
3. Hook out the head borer and destroy mechanically. Spray Neem seed powder extract 4% @ every 10 days interval starting from 30 days after planting (DAT) and alternate spray with Neem cake (5%) to keep the pest in check.
4. Spray Neem soap 1% to manage the sucking pests at 10 days interval from 30 to 90 DAT.

Dimond back moth: *Plutella Xyllostella*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC	50	3
Cyantraniliprole 10.26% OD	600	5
Indoxacarb 14.5% SC	200-266	7
Indoxacarb 15.8% EC	266	5
Spinosad 2.5% SC	600-700	3
Chhlorfenapyr 10% SC	750-1000	7
Emamectin benzoate 5% SG	150-200	3
Flubendamide 480% SC	45-60	7
Flubendamide 20% WG	90-120	7
Chlofluazuron 5.4% EC	1500	7
Diafenthiuron 50% WP	600	7
Lufenuron 5.4% EC	600	14
Novaluron 10% EC	750	5
Metaflumizone 22% SC	750-1000	3
Tolefenpyrad 15% EC	1000	5
Thiodicarb 75% WP	1000-1330	7
Fipronil 5% SC	800-1000	7
Cypermethrin 10% EC	650-760	7

Bioinsecticides

Name of the Bio-Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7
Bacillus thuringiensis var. galleriae 1593 M sero type H 59 5b, 1.3% FC	600-1000	

Bacillus thuringiensis serovar kurstaki (3a,3b,3c) 5% WP	500-1000	
Bacillus thuringiensis serovar kurstaki serotype 3a,3b, SA II WG	500	

Cabbage/cauliflower Aphid

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7
Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

Painted bug

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Dimethoate 30% EC	200	660

vii.Major disease associated with crop: Black rot, damping off, collar rot, leaf spot

viii.IPM Module for management of disease:

Damping off

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Captan 75% WP (Nursary Drenching)	0.25%	2500
Captan 75 %WS (Seed Treatment/ Kg)	15-25	20-30

Collar rot

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Mancozeb 75% WP (Drenching/ lit. water)	2.25	3

Leaf spot

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Mancozeb 75% WP	1125-1500	1500-2000
Zineb 75% WP	1125-1500	1500-2000

ix.Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Use of plastic mulch,
2. Timely manual weeding

xi.Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: Use of hybrid varieties suitable for year round production system for mid or high hills.

xii.Production constraints in agro-ecological region:

1. Less heading in open pollinated cabbage
2. Boron deficiency is becoming serious.
3. Less availability of high quality seeds
4. High prices of hybrid seeds
5. Post-harvest losses are more due to non availability ofstorage facility
6. High prices of fertilizers
7. Low prices of farm produce
8. Lack of knowledge about the cultivation practices
9. Lack of processing facilities
10. So far no minimum support price is fixed for the crop.

9B. Name of the vegetable crop: Cauliflower

i. Existing varieties being used: Pusa Snowball 16, PSB-35 as open pollinated. Snow Queen and

Snow King, Sweta and late group hybrids.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: A large number of hybrids are used in the distt.

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil.
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
7. Cultivars-In cauliflower, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be curd formation.
8. Transplanting- Farmers practices improper planting distance.
9. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
10. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
12. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Seed- Farmers should use improved varieties/ hybrids
4. Soil solarisation practice in nursery must be followed by the farmers because it is easy method of sterilization at low cast.
5. Seed Treatment- For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or *Trichoderma Viride* 4g/kg before sowing.
6. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Cauliflower (Early)-500-750g/ ha open pollinated.
   Cauliflower (Mid and Late)- 300-350g/ha open pollinated.
   Cauliflower (Hybrid)-250-300g/ha.
7. Varieties- Farmers should select proper variety for suitable sowing time as per maturity group.
   For early crop- Early Kunwari, Pusa Kartiki, Pusa Early Synthetic; Mid- Pusa Synthetic, Pusa Shubhra, Pant Shubhra, Hisar No.1 and Late- Pusa Snowball-16, Pusa Snowball Kt-1, Pusa Hybrid-2.
8. Transplanting- Farmers should transplant seedlings properly as for early (30x30cm), medium (45x30cm), and late (60 x 45 cm).
9. Manures and fertilizers- Farmers should incorporate well rotten cow dung (15-20tonnes/ha) and NPK (150:80:60) in irrigated, half dose of NPK in un irrigated condition.
10. Irrigation- Farmers should apply water in the field at proper stage of the crop. As critical growing stage such as proper growing stage, curd formation and maturity stages.
11. Weed control- Farmers must know about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically.
12. Harvesting- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. Major insect pests associated with crop: Aphids are serious problem, cabbage butter fly

vi. IPM Module for management of insect pests :

Diamond black moth- plantation of mustard crop as trap crop at margins of cabbage field to attract the adults for egg laying,spray of *Bacillus thurengnsis* @ 1.0 kg /ha or

Cabbage butterfly - mechanically destroy the cluster of eggs,*Helicoverpa* - release of *Tricogramma* spp insect eggs @ 50000 / ha at the time of initation of flowering to 7- 10 days,

Before Planting

1. Deep ploughing in the month of summer to expose immature stages.
2. Hand picking and destruction of cabbage butterflyeggs and larvae in nursery as well as main crop to reduce the pest multiplication.
3. Growing of African bold seeded mustard as trap crop at 22:2 ratio (Cabbage: Mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop may reduce the infestation.

After Planting

1. Regular Monitoring of the plants randomly for the presence of pests on both the leaf surface as well as between the leaves.
2. Hand picking and destruction of leaf webber and egg masses and early instar larvae to reduce further multiplication of pests in the field.
3. Hook out the head borer and destroy mechanically. Spray Neem seed powder extract 4% @ every 10 days interval starting from 30 days after planting (DAT) and alternate spray with Neem cake (5%) to keep the pest in check.
4. Spray Neem soap 1% to manage the sucking pests at 10 days interval from 30 to 90 DAT.

Dimond back moth: *Plutella Xyllostella*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC	50	3
Cyantraniliprole 10.26% OD	600	5
Indoxacarb 14.5% SC	200-266	7
Indoxacarb 15.8% EC	266	5
Spinosad 2.5% SC	600-700	3
Chhlorfenapyr 10% SC	750-1000	7
Emamectin benzoate 5% SG	150-200	3
Flubendamide 480% SC	45-60	7
Flubendamide 20% WG	90-120	7
Chlofluazuron 5.4% EC	1500	7
Diafenthiuron 50% WP	600	7
Lufenuron 5.4% EC	600	14
Novaluron 10% EC	750	5
Metaflumizone 22% SC	750-1000	3
Tolefenpyrad 15% EC	1000	5
Thiodicarb 75% WP	1000-1330	7
Fipronil 5% SC	800-1000	7
Cypermethrin 10% EC	650-760	7

Bioinsecticides

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7
Bacillus thuringiensis var. galleriae 1593 M sero type H 59 5b, 1.3% FC	600-1000	
Bacillus thuringiensis serovar kurstaki (3a,3b,3c) 5% WP	500-1000	
Bacillus thuringiensis serovar kurstaki serotype 3a,3b, SA II WG	500	

Cabbage/cauliflower Aphid

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7
Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Bio-Insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

vii.Major disease associated with crop: Black rot and stalk rot are serious problem

viii. IPM Module for management of disease:

1. Soil solarization, crop rotation,
2. Seed treated with hot water (50^0C for 30 minutes)
3. Seed treated with streptocycline @0.2gm per liter of water.

ix.Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Use of plastic mulch
2. Timely manual weeding

xi.Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yieldind and disease tolarent varieties,
2. Use of well decomposed FYM,
3. Use of black polythine mulch
4. Drip irrigation system

xii.Production constraints in agro-ecological region:

1. Non availability of suitable varieties as per agro-ecological situation.
2. Buttoning and leafiness are common problem
3. Lack of technical knowledge Less availability of high quality seeds
4. High prices of hybrid seeds

9C. Name of the vegetable crop: Radish

i. Existing varieties being used: Dunagiri, Chinese Pink and Pusa Himani

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Early Mino, Japnese white

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
4. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
5. Planting distance- Farmers practices improper planting distance and sown through broadcast.
6. Manures- Farmers incorporated cow dung in undecomposed stages in the field.
7. Fertilizers: Farmer use imbalance fertilizer
8. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method.
9. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
10. Harvesting- The root harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.

2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Seed Treatment- For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or T*richoderma viride* 4g/kg before sowing
4. Seed Rate- The recommended seed rate of Asiatic type radish 10 Kg/ha and European type 12-14 Kg/ha
5. Planting distance- Farmers should be sown the seed Asiatic type line to line 45 cm and plant to plant 8cm and European type line to line 30 cm and plant to plant 8 cm
6. Manures and fertilizers- should be used as per soil testing , General recommendation are FYM-250q/ha Nitrogen: 60 kg/ Phosphorus: 100 kg/ha and Potassium: 50kg/ha Micronutrient: should be used as per soil testing,
7. Irrigation- Farmers should apply water in the field at proper stage of the crop. Irrigate the crop in winter at 7-8 days interval and in summer 3-4 days interval
8. Harvesting- Depending upon the cultivars, the roots become ready for harvesting in about 25-35 days after sowing. Early and rapid maturing European cultivars reach harvest maturity in 25-30 days after sowing. They become bitter and pithy if the harvesting is delayed. In India, harvesting is done manually. A light irrigation may be given before harvesting to facilitate lifting of roots. In advanced f countries, commercial radish growers use a single row harvester that pulls the plants from the soil, cuts the roots from the tops, and then places them in bags for transportation to a picking shed.

v. Major insect pests associated with crop: Aphids

vi. IPM Module for management of insect pests:

Aphid; *Aphis gossypii* Glover and *Myzus persicae* (Sulzer)

1. Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.
2. Yellow sticky trap is effective for controlling aphid population.
3. Imidacloprid 17.8 SL @ 0.25ml/l or Acetamiprid 20%SP @100g/ha or Thiamethoxam 25%WG@ 100g/ha if needed.

vii. Major disease associated with crop: White rust, Nematodes

viii. IPM Module for management of disease:

1. Crop rotation
2. Use of FYM treated with *Trichoderma* @500gm per 100 kg

ix. Major weeds associated with crop: Not serious

x. IPM Module for management of weeds: Not applied

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of short duration,
2. Non pithy,
3. Coloured varieties for year round production.
4. Farmers should be adopted intensification of the crop such as he should grow at least 3-4 crops in a year such as Cauliflower early- Radish- Bottlegourd
5. Brinjal-Radish –Chilli
6. Bottle bourd-radish-French bean

xii. Production constraints in agro-ecological region:

1. Pithiness problem in low hills
2. Less availability of high quality seeds
3. High prices of hybrid seeds
4. Post-harvest losses are more due to non availability of storage facility
5. High prices of fertilizers

6. Low prices of farm produce
7. Lack of knowledge about the cultivation practices
8. Lack of processing facilities
9. So far no minimum support price is fixed for the crop.

9D. Name of the vegetable crop: Tomato

i. **Existing varieties being used:** Pant T3, Non descriptive varieties as open pollinated, Naveen 2000, Manisha, etc.

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** VL Tamatar 4

iii. **Existing package of practices being used:**

1. Without soil and seed treatment,
2. Poorly managed nurseries,
3. Subterranean staking
4. Non- judicious use of fertilizers,

iv. .**Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Use of indeterminate, round, optimal fruits weight (±120) g weight hybrids,
2. Use of organic manures,
3. Special training and pruning techniques,
4. Upright stacking and earthling up operation, with standard harvesting techniques and stages.

v. **Major insect pests associated with crop:** Fruit borer and white flies and other sucking pests

vi. **IPM Module for management of insect pests:**

Tomato fruit borer *Helicoverpa armigera* (Noctuidae: Lepidoptera)

1. Growing trap crop of African tall marigold as border row before 15 days of transplanting is beneficial in reducing egg laying in main crop.
2. Field sanitation and clean cultivation is effective tool to suppress the pest population.
3. Setting of sex pheromone traps @ 5 trap/acre for monitoring is effective.
4. Spray of Ha NPV @ 500 LE/ha mixed with 0.1 per cent UV retardant (Tinopol) and 0.5 per cent jiggery is effective.
5. Use of Bt @ 0.50kg/acre and NSKE 5 per cent to kill early stage larvae. Release of the egg parasitoid, *Trichogramma chilonis* or *T. brasiliensis* @ 1Lakh/ha coinciding with flower initiation at 15 days interval may reduce the pest population.
6. Development of pyridalyl nanocapsule suspension for efficient management of tomato fruit and shoot borer (*Helicoverpa armigera*) is an efficient approach for frequent delivery and effective management.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Indoxacarb 14.5% SC	400-500	5
Chlorantraniliprole 18.5% SC	150	3
Cyantraniliprole 10.26% OD	900	3
Flubendamide 480% SC	120	5
Flubendamide 20% WG	240	5
Novaluron 10% EC	750	1-3
Novaluron 5.25%+ Indoxacarb 4.5% SC	1700	5
Methomil 40% SP	750-1125	5-6
Lambda cyhalothrin 5% CS	300	5

Management strategies(white fly and other sucking pests)

A. Crop Hygiene

Field hygiene should be a high priority and should be included as an integral part of the overall strategy for managing whitefly populations, Tomato yellow leaf curl virus (TYLCV) incidence, and insecticide resistance. These practices will help reduce the onset of the initial infestation of whitefly,

regardless of biotype, and lower the initial infestation level during the cropping period.

B. Other Cultural Control Practices

1. Use proper pre-planting practices.
2. Vegetative propagated ornamental plants (i.e. *Hibiscus, Poinsettia*, etc.) should not be grown at the same location, especially if bringing in plant materials from other areas.
3. Avoid yellow clothing or utensils as these attract whitefly adults.
4. Delay planting new fall crops as long as possible.
5. Do not plant new crops near or adjacent to old, infested crops.
6. Use proper post-planting practices.
7. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc. Rogue tomato plants with symptoms of TYLCV.
8. Plants should be treated for whitefly adults prior to rouging and, if nymphs are present, should be removed from the field, preferably in plastic bags, and disposed of as far from production fields as possible.
9. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
10. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

C. Insecticidal Control Practices.

1. Restricted the use of neonicotinoids (imidacloprid or acetamiprid) in the field only during the first six weeks of the crop thus leaving a neonicotinoid-free period at the end of the crops.
2. Use selective rather than broad-spectrum control products where possible to conserve natural enemies and enhance biological control.
3. Do not apply insecticides on weeds on field perameters. These could kill whitefly natural enemies and, thus, interfere with biological control.
4. Crop rotation is effective tool to prevent pest population.
5. Avoiding of same group of crop in same field for a long time is beneficial.
6. Sticky trap is effective to control whitefly population.

White fly

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	900	3
Spiromesifen 240% SC	625	3
Thiamethoxam 25% WSG	200	5
Imidacloprid 17.8% SL	150-175	3

Leaf miner, *Liriomyza trifoli*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	900	3

Aphid, *Aphis gossypii*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Thiamethoxam 70 %WS (Seed Treatment/ Kg)	6	
Cyantraniliprole 10.26% OD	900	3

Thrips, *Thrips tabaci*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Thiamethoxam 70 %WS (Seed Treatment/ Kg)	6	
Cyantraniliprole 10.26% OD	900	3

vii. Major disease associated with crop: Buckeye fruit rot, late blight, blossom end rot, saptoria leaf spot

viii. IPM Module for management of disease:

Late blight :

1. Burn the infected crop debris,
2. Avoid excess moisture.

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Famoxadone 16.6%+ Cymoxanil 22.1% SC	500	3
Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Ametoctradin + Dimethomorph 20.27% SC	800-1000	32
Azoxystrobin 23% SC	500	3
Cyazafamid 34.5% SC	200	3-5
Mandipropamid 23.4% SC	0.08%	5
Captan 50% WP	2500	
Copperoxychloride 50% WP	1250	
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Azoxystrobin 18.2%+ Difenoconazole 18.2% SC	0.1%	5

Buck eye rot:

1. Burn the infected fruit, leaves etc. and staking of plants,
2. Remove the leaves upto 9 inches from ground.

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Mancozeb 75% WP	1500-2000	
Propeneb 70% WP	1500	10

ix. Major weeds associated with crop: Various weeds

x. IPM Module for management of weeds:

1. Use of poly mulch,
2. Timely manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yielding varieties grown under ventilated polyhouses using standardized technology with fertigation technology in tomato can enhance the productivity of tomato manifold.
2. Polyhouse technology is a boon for small and marginal farmers with fragmented holdings.

xii. Production constraints in agro-ecological region:

1. Non-availability of reliable hybrid cultivars for continuous cultivation.
2. Poor nursery management in the crop
3. Poor staking and pruning techniques.
4. Poor technical knowhow

9E. Name of the vegetable crop: Potato

i. Existing varieties being used: Up-to-date, Kufri Jyoti, Kufri chandramukhi Tumari Local and Kufri Jyoti

ii.High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Kufri Girriraj, Kufri Chipsona 1, Kufri chipsona 3, K Jyoti, K. Ashok , K. Himsona

iii.Existing package of practices being used:

1. Use of big sized tuber or divion of tuber (50-60 g)
2. No Tuber treatment
3. Use of organic maures, sowing in flat bed.
4. Sowing time is March-April.

5. Limited or no IPM practices
6. Use of HYV variety with proper seed size (with 3 sprouted eyes), sown in line with application of organic manures. Planting time:
   Region B (1000-1500) : Feb-March
7. Spacing: 45-50 x 15-20 cm
8. Farmers are only using FYM along with urea at hills but the farmers in plains are using FYM + 160:100:120kg/ha NPK

iv.Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Late blight resistant variety such as K Girdhari, K.Himalini and K. Shailja should be selected for planting.
2. Fertilizer should be used on soil test basis. Dehaulming practise should be adopted for long duration storage of tubers.
3. Suitable fungicides should be used for control of Late blight disease e.g. mancozeb, cardendazim alone and incombination.

v.Major insect pests associated with crop: White grub, cut worm, aphid, potato tuber moth
Cut worm, wire worm, Epilachina beetle

vi. IPM Module for management of insect pests:

Potato tuber moth: *Phthorimaea operculella*

1. Heaps of green grasses may be kept at suitable interval in infested field during evening and next day early in the morning along with caterpillars to destroy.
2. Clean cultivation and mechanical destruction of caterpillars also help in reducing pest infestation.
3. Irrigation also brings them on the surface and birds shall predate them.
4. Apply chlorpyriphos 20EC at the rate of 2.5ml/l in the soil before seed sowing.

Epilachna beetle: *Epilachna viginatioctopunctata*

1. Hand packing of grubs and collection of beetles by hand nets during early stages of attack, helps in reducing the intensity of infestation.
2. Conservation and augmentation of natural parasitoids viz.*Pediobius foveolatus, Pleunotrogrus faveolatus* and *Tetrastichus* sp.
3. Application of Neem, Mahua, ground nut cakes are efficient in suppressing the pest population.
4. Spray of Malathion 50 EC in 200 liters of water per acre provides effective control of this pest

Aphids: *Myzus persicae*

1. Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.
2. Yellow sticky trap is effective for controlling aphid population.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 25% WSG (Spray)	100	77
Thiamethoxam 25% WSG (Drenching)	200	77
Dimethoate 30% EC	660	
Oxydemeton-metyl 25% EC	1000	
Carbofuran 3% CG	16600	
Phorate 10% CG	10000	

Jassids:

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Fenvalerate 20% EC	300-375	7

White grub:

1. Use of VL Kurmula trap,
2. Use of WGPSB2 Bio-Formulation @ 10 gm/kg vermicompost or FYM,
3. Drenching of Chlorpyriphos @ 2ml/L

vii. Major disease associated with crop: Late blight and common scab disease in the crop and tuber.

viii. IPM Module for management of disease:

Late blight of potato: *Phytophthora infestans*

1. Use resistant verities.
2. Burn the infected crop debris, avoid excess moisture,

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Cyazafamid 34.5% SC	200	27
Chlorothaonil 75% WP (per lit. water)	0.875-1.250	14
Azoxystrobin 23% SC	500	12
Mandipropamid 23.4% SC (per lit. water)	0.8	40
Propineb 70% WP	0.30%	15
Captan 50% WG	1500	21
Captan 75% WP	1667	8
Copperoxychloride 50% WP	1250	
Copperhydroxide 53.8% DF	1500	22
Dimethomorph 50% WP	1000	16
Hexaconazole 2% SC	3000	21
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Metalaxyl 8%+ Mancozeb 64%WP	2500	49
Metalaxyl 4%+ Mancozeb 64%WP	2500	24
Capatan70%+ Hexaconazole 5% WP	500-1000	21
Carbendazim 25%+ Mancozeb 50%WS	0.6-0.7/Kg	Seed Treatment
Cymoxanil 8%8% +Mancozeb 64%WP	1500	10
Famoxadone 16.6%+Cymoxamil 22.1% SC	500	40
Fenamidone 10%+ Mancozeb 50% WG	1250-1500	30
Metiram 55%+ Pyraclostrobin 5% WG	1500-1750	15
Metalaxyl 3.3%+ Chlorothanil 33.1% SC	0.02%	34

Potato scab: *Streptomyces scabiei*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Thiram 75% WS (Seed Treatment/ Kg)	2.5-3.0	7-10

ix. Major weeds associated with crop: *Ranunculus* sp., *Cyperus* sp. and Chenopodium etc.

x. IPM Module for management of weeds:

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	2000	3440
Oxyflourfen 23.5% EC	100-200	425-850

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Early maturing varieties.
2. Use of Kufri Girriraj and Kufri Jyoti varieties supplementation with use of optimal tuber size,
3. Selection of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja.
4. Seed treatment should be followed.
5. Planting of pre-sprouted tubers should be done.
6. Proper crop rotation to should be followed.
7. Winter/ summer ploughing of fields.
8. Use of organic mulching material in appropriate thickness especially under rain fed mid hills

agro climatic conditions.
9. Dehaulming practise should be adopted by the farmers for long duration storage of tubers.
10. Medium size whole tuber should be used as planting material.

xii. Production constraints in agro-ecological region:

1. Timely and adequate seed supply.
2. Facility of poor seed storage in the distt.
3. The seed of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja is not available in sufficient quantity. Use of infected planting material by the farmers.
4. Use of un sprouted seed (newly dug tubers)
5. Proper crop rotation is not followed.
6. Cultivation on sloppy land.
7. In situ moisture conservation techniques such as mulching technology are not followed.
8. Dehaulming technique is not followed.
9. Imbalance use of fertilizers.
10. Use of unrecompensed FYM.
11. Lack of storage facilities.
12. Seed production is not done by the farmers

9F. Name of the vegetable crop: Brinjal

i. Existing varieties being used: Non descriptive or non identified varieties, PPL 74

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Round and purple hybrids like Chhaya, Kanhaya,Ankur etc are hybrid available in local market.
Navkiran, Brinjal 704 (SunGro Seed), Navina, VNR212 (VNR Seed), IndameSupriya (Indo-American), Pant Rituraj, Pant Samrat (Pantnagar), Kashi Taru, Kashi Sandesh (IIVR)

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Nursery- Nursery soil generally not sterilize by the farmers.
4. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
5. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
6. Sowing time: Jan- Feb
7. Transplanting- Farmers practices improper planting distance.
8. Manures- Farmers incorporated cow dung in undecomposed stages in the field.
9. Fertilizers: Farmer use imbalance fertilizer
10. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
12. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Soil Testing-** Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. **Land Preparation**- The farmers are recommended to open the land before sowing the crop for sterilization.
3. **Soil solarisation** practice in nursery must be followed by the farmers because it is easy method of sterilization at low cast.
4. **Seed Treatment-** For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed orCarbandazim @2g/kg of seed or*Trichoderma viride* 4g/kg before sowing

5. **Seed Rate**- The recommended seed rate of brinjal: Hybrid-250g/ha, Open pollinated-500-600g/ha
6. **Transplanting**- Farmers should transplant seedlings properly as for non spreading type varieties- 60cm x 60cm, spreading type varieties - 75cm x 60cm.
7. **Manures and fertilizers**- should be used as per soil testing , General recommendation are **FYM**-250q/ha **Nitrogen**: (Hybrid-200kg/ha, Open pollinated-100-120kg/ha) **Phosphorus**: (Hybrid-100kg/ha, Open pollinated-80kg/ha **Potassium:** (Hybrid-80/ha, Open pollinated-60kg/h), **Micronutrient:** should be used as per soil testing,
8. **Irrigation**- Farmers should apply water in the field at proper stage of the crop. Irrigate the crop in winter at7-8days interval and in summer3-4 days interval
9. **Weed control**- Farmers must know the about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically. Farmer can control the weeds by hand weeding along with pre-planting surface application @ of 1.0-1.5 kg/ha Alachlor.
10. **Growth substances:** Use 2,4-D @ 2ppm at flowering stage
11. **Harvesting**- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. **Harvesting- Major insect pests associated with crop:** Shoot and fruit borers

vi. **IPM Module for management of insect pests:**

Brinjal fruit & shoot borer: *Leucinodes orbonalis*

1. The damaged portions of the plants and fruits should be removed and destroyed.
2. Early removal of drooping shoots will reduce the fruit infestation.
3. Proper collection of all the infested flower buds, fruits during harvest.
4. Continuous cultivation of brinjal also favors the pest infestation.
5. Varieties like Punjab Barsati, (moderate resistant cultivar) Pusa purple round, Punjab Neelam found to be resistant to brinjal fruit borer.
6. Biological method recommended by IIHR, Bengaluru involving release of *Trichogramma chilonis* @10 to 15 lakh parasites/ha/season along with 2 sprays of *Bt* formulation found to be economically effective.
7. Installation of BSFB (brinjal shoot and fruit borer) pheromone traps Lucinure @3/ha to monitor and mass trap the male moths is effective.
8. Neem Seed Kernal Extract(NSKE)5 % per cent at the time of flowering is effective.
9. Prevent continuous growing of same group of crop at same field.
10. Rotate brinjal with cabbage or other crops

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC -	200	22
Emamectin Benzoate 5% SG	200	3
Thiacloprid 21.7% SC	750	5
Thiodicarb 75% WP	625-1000	6
Lambda cyhalothrin 5% CS	300	5
Cypermethrin 25% EC	150-200	1
Betacyfluthrin 8.49%+ Imidacloprid 19.81% OD	200	7
Triazophos 35% + Deltamethrin 1% EC	1250	3
Pyriproxyfen 5%+ Fenpropathrin15% EC	750	7

vii. **Major disease associated with crop:** Phomopsis blight is a serious problem in the hills.

viii. **IPM Module for management of disease:**

1. Use healthy seed materials for sowing.

2. Seed should be extracted only from disease free fruits.
3. After extraction of seeds it should be dried for a week and then stored.
4. Avoid continuous cultivation of brinjal. A rotation of brinjal - paddy - gingelly will helps to check the disease development.
5. In the fields the affected plants and debris should be collected and burnt
6. During summer deep ploughing should be given.
7. Spray following insecticides

Blight

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: *Euphobia hirta, Cynadon dactylon , Cyperus and oxalis, Cyperus rotundus, Panicum repens, Cynodon dactylon, Amaranthus virdis, Parthenium hysterophorus*

x. IPM Module for management of weeds:

1. Hand weeding only
2. The field should be kept weed-free, especially in the initial stage of plant growth, as weeds compete with the crop and reduce the yield drastically.
3. Frequent shallow cultivation should be done at regular interval so as to keep the field free from weeds and to facilitate soil aeration and proper root development. Deep cultivation is injurious because of the damage of roots and exposure of moist soil to the surface.
4. Two-three hoeing and the earthing up are required to keep the crop free of weeds.
5. Preemergence application of Fluchloralin (1.5 kg a.i./ha) coupled with one hand weeding 30 days after transplanting is effective for control of weeds

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of hybrids can increase productivity 2 to 3 times higher.
2. Use of mulch in rainy season.
3. Farmers should be adopted intensification of the crop such as he should grow at least 3-4 crops in a year such as Brinjal- Radish-Bottle gourd, Brinjal- spinach-cowpea, Brinjal- Turnip-Amaranthus, Brinjal- Spinach-Bitter gourd etc.

xii. Production constraints in agro-ecological region:

1. Non-availability of suitable hybrids
2. Wild animals problems
3. Poor technical knowhow
4. Marketing problem in rainy season
5. Less availability of high quality seeds
6. High prices of hybrid seeds
7. Post-harvest losses are more due to non availability of storage facility
8. High prices of fertilizers
9. Low prices of farm produce
10. Lack of knowledge about the cultivation practices
11. Lack of processing facilities
12. So far no minimum support price is fixed for the crop.

9G. Name of the vegetable crop: Chilli

i. Existing varieties being used: Jwala, Yellow mirch (Lakhaur mirch) local strains and non descriptive varieties,Local, Andhara Jyoti, LCA-206

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3 Kashi Anmol, Pant C-1, Tajwasni, Pusa

ii. Existing package of practices being used:

1. Traditional seeds,
2. No seed treatment,
3. Poor nursery management,
4. Transplanting on or before rainy or monsoon season, Crop geometry knowledge is poor,
5. Poor dry fruit storage.
6. Growing local varieties.
7. No line transplanting.
8. Generally they plant two over aged seedling at one place.
9. No or very less use of fertilizer.
10. Sowing of untreated seed.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Seed treatment with Pant bioagent 3 for managing seed and soil borne diseases.
2. Earthening up of plants within 45 days after transplantation to get rid of water logging
3. Use of tall and cluster bearing type like local strain Lakhaur mirch.
4. Use of maximumquantity of organic manure i.e. 200 q/Ha increases productivity and incidence of dieback and Anthracnose.
5. Grow high yielding varieties.
6. Treat the seed with copper containing fungicides before sowing.
7. Adopt soil testing.
8. Transplant one seedling at one place.
9. Transplant the seedlings when they attain 5-6 leaf stage.
10. Transplant the seedlings at proper spacing-
11. Dwarf varieties like Kashi Anmol at 45 x 30 cm
12. Tall varieties like Pusa Sadabahar, Pant C-1 at 50 x 50 cm.
13. Apply recommended dose of fertilizer (15-20 t FYM + 120: 60:60NPK/ha) after soil test in irrigated condition, whereas under unirrigated condition apply half dose of recommended NPK.

v. Major insect pests associated with crop: Thrips, aphid, white fly

vi. IPM Module for management of insect pests:

Chilli thrips, *Scirtothrips dorsalis* Hood

1. Thrips *Franklinothrips vespiformis* (Crawford) and *Erythrothrips asiaticus* R. &. M. are predaceous in nature and their population may be encouraged by avoiding chemical sprays.
2. Yellow or blue sticky trap is effective for controlling this pest.
3. If still the population persist spraying of imidacloprid 70% WG @ 0.25ml/l or acetamiprid 20%SP @ 0.2g/l or thiomethoxam 25%WG @ 0.2g/l or metasystox@1.5ml/l is effective.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 30% FS (Seed Treatment)	7/Kg	
Imidacloprid 70% WS (Seed Treatment)	10-15/Kg	
Cyantraniliprole 10.26% OD	600	3
Emamectin benzoate 5% SG	200	3
Spinosad 480% SC	160	3
Acetamiprid 20% SP	50-100	3
Thiacloprid 21.7% SC	225-300	5
Indoxacarb 14.5%+ Acetamiprid 7.7% SC	400-500	5
Flubendamide 19.92%+ Thiacloprid 19.92%	200-250	5
Methomil 40% SP	750-1125	5&6
Lambda cyhalothrin 5% EC	300	5
Ethion 50% EC	1500-2000	5
Fipronil 5% SC	800-1000	7

Imidacloprid 17.8% SL	125-250	40

Aphid

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Imidacloprid 70% WS (Seed Treatment)	10-15/Kg	
Cyantraniliprole 10.26% OD -	600	3
Fipronil 5% SC	800-1000	7
Carbosulphon 25% EC	800-1000	8
Imidacloprid 17.8% SL	125-250	40
Oxydemetonmethyl 25% EC	1600	
Quinalphos 25% EC	1200	

White fly

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Fanpropathrin 30% EC	250-340	7
Pyriproxyfen5%+ Fanpropathrin 15% EC	750	7

vii. Major disease associated with crop: Dieback and Anthracnose is major disease

viii. IPM Module for management of disease: -

ix. Major weeds associated with crop: *Euphobia hirta, Cynadon dactylon, Cyprus and Oxalis* sp.

x. IPM Module for management of weeds: Timely manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of tall hybrids supplentation of organic packages of practices to be followed
2. Grow high yielding varieties.
3. Treat the seed with copper containing fungicides before sowing.
4. Adopt soil testing.
5. Transplant one seedling at one place.
6. Transplant the seedlings when they attain 5-6 leaf stage.
7. Transplant the seedlings at proper spacing

xii. Production constraints in agro-ecological region:

1. High incidence of flower and fruit drop in chillies
2. Fruit losses due to high incidence of dieback and anthracnose.
3. Non availability of quality seed.
4. Less irrigation facilities.
5. High cost of hybrid seeds.
6. Unaware about the insect-pest management.

9H. Name of the vegetable crop: Cucumber

i. **Existing varieties being used:** Kalyanpur Green, Japanese Long Green, Poona Khira, Pant Khira-1, Poinsette, Japanese Long Green, Straight Eight, Swarna Sheetal, Swarna Poorna, Swarna Ageti etc.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

For open field condition: Pusa Udhay, Pusa Barkha,Shubhangi, Himangi, Punjab Naveen, Tasty, Ruchi, Mandakini, Kumud, Noori, Alamgir, Rani, Don etc,

For protected condition: Pant Parthenocarpic Cucumber-2 & 3, Hilton, Kian, Isatis, Malini etc.

iii. Existing package of practices being used:

1. Use of traditional seeds,
2. Planting in rainy season,
3. Traditional stacking method,
4. Long harvest duration season,
5. Sale at local market Random selection of variety (May or may not be suited to Agroeco-region).

6. Untimely sowing / planting of crop.
7. Use of untreated seed.
8. Unbalanced use of fertilizers.
9. Use of plant protection chemicals having long wetting period.
10. Use of traditional irrigation system.
11. No soil solarisation/ treatment during lean period.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Glasshouse or polyhouse technology
2. Use of Hybrids or/and Pathenocarpic varieties
3. Management of crop geometry.
4. Use of organic manure or fertigation inside playhouse.
5. Management of fruit flies.
6. Use of protected cultivation.
7. Adoption of crop/ soil health related crop rotations.
8. Recommended/suitable variety for Agroeco-region.
9. Use recommended spacing eg. 60-200 × 50-100 cm
10. Treating seed before sowing.
11. Balanced use of fertilizers (125: 155: 125 Kg N: P: K/ha, respectively) with water soluble fertilizers (fertigation).
12. Selection of eco-friendly plant protection chemicals having short wetting period, recommended for protected cultivation.
13. Selection of optimum planting period.
14. Sowing time : (Protected cultivation): Feb to June
15. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
16. Adoption of micro irrigation technologies for efficient use of available water.
17. Adoption of fertigation system for efficient use of fertilizers

v. Major insect pests associated with crop: Fruit flies

vi. IPM Module for management of insect pests:

Fruitflies, *Bactrocera cucurbitae* Coq. and *B. ciliatus* Loew (Tephritidae : Diptera)

1. To avoid infestation by fruit flies, growing of resistant or early maturing varieties has been recommended.
2. To check the damage by these flies, fruits should be harvested before they start ripening.
3. All the fallen and infested fruits should be collected and destroyed to prevent the carryover of the pest. Frequent raking of the soil under the vines or ploughing the infested fields after the crop is harvested can help in killing the pupae.
4. Baits prepared with 10% ripe banana, 10% jaggery mixed with 0.1% malathion or 1g carbofuran used in bait traps was found effective or this bait mixture is to be applied as 200 spot splashes per hectare on the undersurface of cucurbit leaves.
5. Use of 0.4 ml methyl engenol with 1ml of Dichlorvos in bait traps was also found effective

Pumpkin beetle *Raphidopalpa foveicollis* (Lucas) (red beetle

1. Cultural practices like clean cultivation and early sowing will reduce pest damage.
2. After harvesting deep ploughing of infested field to kill the grub in the soil.

Dichlorovos 76% SC	500	627

vii. Major disease associated with crop: Powdery mildew and downy mildew, anthracnose

viii. IPM Module for management of disease:

Downy mildew

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Zineb 75% WP	1500-2000	

Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Azoxystrobin 23% SC	500	7
Amectoctradin+ Dimethomorph 20.27% SC	800-1000	3

Powdery mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300

Anthracnose

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: Various weeds

x. IPM Module for management of weeds:

1. Use of black Poly mulch,
2. Timely weeding
3. Crop rotation.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Polyhouse technology and hybrid cultivars can increase productivity 3-4 times in mid and high hills. Use of well designed and recommended protected technology suited to area i. e poly houses, net house, insect proof net house, shed net house, poly tunnels with the use of mulches & micro irrigation structures.
2. To follow proper crop rotation.
3. Selection of varieties suited to Agroeco-region.
4. Use recommended spacing eg. 60-200 × 50-100 cm
5. To use sufficient quantity of fully decomposed Farm Yard Manure (two year old)/ vermi compost.
6. Balanced use of fertilizers through fertigation.
7. To use technology such as soil solarisation/ chemical treatments for effective control of pests.
8. Timely sowing/ transplanting of crop.
9. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
10. Use bio pesticides/ plant protection chemicals recommended for protected cultivation.
11. Timely harvesting of crop.
12. To save the precious natural resource water, follow micro irrigation technologies (drip irrigation).
13. Use genetically pure & treated seed.

xii. Production constraints in agro-ecological region:

1. Lack of plant growing structures.
2. Monkey, baboon, wild pigs are serious threats.
3. Good quality seed is inaccessible.
4. High cost of seed & poor purchasing power of farmers.
5. Water scarcity.
6. Protected cultivation is cost involving technologies.
7. Repair of the poly houses/ micro irrigation structures is a tedious task.
8. Damage of crop / poly houses /micro irrigation structure by wild animals.
9. Unawareness about scientific technologies.
10. Involvement of middle men in marketing.
11. Availability of agriculture inputs is not easy.

12. Use of unsafe agro chemicals.
13. Difficult labour availability.
14. Different biotic and abiotic stresses.

9I. Name of the vegetable crop: Vegetable Pea

i. Existing varieties being used: Traditional field pea , Arkel and Azad pea 3

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Vivek Matar 10, Vivek Matar 11 and Vivek Matar 12

iii. Existing package of practices being used:

1. Sowing in of Autumn month
2. No line sowing,
3. High seed rate,
4. Mature more than 120 days,
5. Stacking is done for tall varieties,
6. Dual purpose varieties

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of tall varieties sown in line with effective stacking methods.
2. Management of powdery mildew, Aschochyta blight and other diseases and Fusarium wilt in autumn season
3. Sowing early maturing varieties at closer spacing (30 cm plant to plant and about 5-10 cm between plants) and higher seed rate (120 kg/ha).
4. Sowing time: Nov- Dec
5. Seed rate: 100 Kg/ ha
6. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time.
7. If available, at least one ton of farmyard manure per ha should be incorporated in the soil at the time of land preparation. Add fertilizers containing NPK as 30: 70: 50 kg/ha all apply as basal dose.
8. Water the crop as per need especially during flowering and pod setting.

v. Major insect pests associated with crop: Leaf miner, pea stem fly

vi. IPM Module for management of insect pests: Spray of Dimethoate 0.01% or Imedachloroprid 1 ml/l

vii. Major disease associated with crop:

1. Powdery mildew in all agroecological situations
2. Fusarium wilt in autumn sown crop
3. Aschochya blight in rainy season in high hills.

viii. IPM Module for management of disease:

1. Seed treatment with bioagent -3 (4g) and carbendazim (1g) @ one Kg seed for the management of white rot and Fusarium wilt.
2. Foliar spray of tilt @ 0.1% for the management of powdery mildew.

ix. Major weeds associated with crop: All seasonal weeds

x. IPM Module for management of weeds: Use pendimethaline @ 1kg ai/ha as pre-emergence and one hoeing 25-30 days after sowing.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. To follow proper crop rotation.
2. Selection of varieties suited to Agroeco-region.
3. Use recommended spacing eg. 60-200 × 50-100 cm
4. To use sufficient quantity of fully decomposed Farm Yard Manure (two year old)/ vermi compost.

5. Balanced use of fertilizers through fertigation.
6. To use technology such as soil solarisation/ chemical treatments for effective control of pests.
7. Timely sowing/ transplanting of crop.
8. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
9. Use bio pesticides/ plant protection chemicals recommended for protected cultivation.
10. Timely harvesting of crop.
11. To save the precious natural resource water, follow micro irrigation technologies (drip irrigation).
12. Use genetically pure & treated seed.

xii. Production constraints in agro-ecological region:

1. Monkey Menace
2. Need to increase seed production program in distt.

9J. Name of the vegetable crop: Leafy vegetables

i. **Existing varieties being used:** Locally available varieties of palak, methi and amaranthus

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

Palak- All Green, Pusa Harit
Methi- Pant Ragini, Pusa Early Bunching and Kasuri Selection
Amaranth- Chhoti Chaulai, Badi Chaulai, Pusa Kiriti,
Pusa Kiran and Pusa Lal Chaulai.

iii. Existing package of practices being used:

1. Varieties- – farmers are using the local varieties of leafy vegetable
2. Sowing methods: Broadcasting method of sowing is used by farmers.
3. seed Treatment- farmers of the state do not treat the seed materials
4. Manures and fertilizers- Farmers incorporated undecomposed cow dung in the field.
5. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
6. Cuttings- The leaves are not picked as per recommended practices as per variety.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Seed- Farmers should use improved varieties/ hybrids of leafy vegetables
2. Seed Treatment- to protect crops from different diseases, farmers must treat the seed by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or *Trichoderma viride* 4g/kg before sowing of seeds.
3. Seed sowing: Seed is sown by line sowing method
4. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Palak- winter crop-10-15 kg seeds/ha
   Summer crop-25-30 kg/ha
   Methi- direct sowing -20-30 kg/ha
   Amaranthus
   direct sowing-2kg/ha
   Transplanting- 1kg/ha
4. Spacing: sowing of seed should be done at proper spacing
   Palak: Row to Row- 20cm and plant to plant -5cm
   Methi: Row to Row-20-30 cm and plant to plant 10-15cm Amaranth: Row to Row-20-30 cm and plant to plant-10 cm
5. Manures and fertilizers- Farmers should incorporate well rotten cow dung (10-15 tonnes/ha) and NPK (50: 50:20). On the basis of soil testing. Top dressing of nitrogen after each cutting.Application of Vermicompost @ 5qt/ha in the field is beneficial for leafy vegetables.

6. Cutting: cutting should be done at proper stage at 25-30 days after sowing.

v. **Major insect pests associated with crop:** Aphid, white fly, gross hopper

vi. **IPM Module for management of insect pests:**

Foliar spray of quinalphos 25EC @0.2%

vii. **Major disease associated with crop:** Powder mildew

viii. **IPM Module for management of disease:** Spray of wettable sulphur @ 0.2%

ix. **Major weeds associated with crop:**

Palak- jangli palak (Rumex acutus)

Methi- bathua, senji (*Melilotus alba)*

Amaranthus- Jungli Chauli (*A. viridis*) kataili chauli, Bathua

x. **IPM Module for management of weeds:** Timely weeding

xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:**

1. Follow deep summer / winter ploughing
2. Line sowing should be prefer
3. Follow proper crop rotation
4. Use of improve varieties of leafy vegetable
5. Timely weeding and hoeing should be done
6. Ttimely cuttings of leaves

xii. **Production constraints in agro-ecological region:**

1. Unavailability of quality seed
2. Farmers are not aware about improved varieties of leafy vegetables
3. Seed treatment is not being followed
4. Proper method of sowing is not followed
5. Imbalance use of fertilizers.
6. Disease and insect pest problem. They do not know how protect leafy vegetable from biotic stress.

10A.Name of the fodder crop: Berseem

i. **Existing varieties being used:** Mescavi

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** Vardan

iii. **Existing package of practices being used:** Practice in irrigated(after puddle rice)/ marshy land

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Soil : loam to clay soil
2. Field preparation: 3-4 Harrowing + Leveling the field.
3. HYVS. – Mescavi, Vardan. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
4. Seed rate: 25-30 kg/ha
5. Sowing method:

a. Wet method-like rice in puddled field

b.Dry method: Without puddled.

6. Broad casting
7. Sowing time: First an week of October
8. Fertilizer: 30:60:70:: N:P2O5 K2O kg/ha
9. Irrigation: Field should remain at field capacity throughout the crop period after germination.
10. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
11. Cutting management: First cut -45-50 DAS
12. Other cutting at 25-30 days interval- total 5-6 cutting are taken
13. Yield: 800-1000g/ha. Green forage.

v. **Major insect pests associated with crop:**

vi. **IPM Module for management of insect pests:**

vii. **Major disease associated with crop:**
viii. **IPM Module for management of disease:**
ix. **Major weeds associated with crop:** Kasni
x. **IPM Module for management of weeds:** hand weeding
xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:**

1. Use of HYV
2. Judicious use of fertiliser
3. Timely sowing
4. Sale of green fodder

xii. **Production constraints in agro-ecological region:** Shortages of variety/seed, water

10B.Name of the fodder crop: Maize

i. **Existing varieties being used:** Ganga, Kanchan
ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:**
Early -Gourav, Vivak, Kanchan, Pant Sankar makka – 1, Vivak hybrid maize-25, 33 & 39
Mid mature – Tarun, Naveen, Sweta
iii. **Existing package of practices being used:** Line sowing
iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Soil: Well drained alluvial soil with soil PH 5.5-7.5.
2. Field preparation: 4-5 harrowing + leveling
3. HYVS: African Tall, J-1006. Pratap Makka Chari-b.
4. Seed rate: 50kg/ha
5. Spacing : 30-45 cm(row to row distanced)
   10-15 cm (plant to plant)
6. Sowing time
   Rainfed: Onset of monsoon
   Irrigated : Feb to July
7. Sowing method : Line sowing is proposed over broadcasting
8. Fertilizer : 100-120 : 60:40: 20::: P_2O_5 : K_2O: ZnSo4 kg/ha
9. Irrigation: Fodder maize grown under irrigated condition should be irrigated at 20 days interval. Spring/summer crop requires 5-6 irrigations.
10. Weed control: Pendimethalin @ 0.75 kg ai/ha (PE) application.
11. Harvesting: The crop should be harvested at tasseling /silling stage or 50-55 days after sowing.
12. Yield: Green fodder: 350-450q/ha.

v. **Major insect pests associated with crop: -**
vi. **IPM Module for management of insect pests: -**
vii. **Major disease associated with crop: -**
viii. **IPM Module for management of disease:-**
ix. **Major weeds associated with crop:** Local weeds
x. **IPM Module for management of weeds:** Hand weeding
xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:**

1. Use of high yielding variety,
2. Production of sweet corn & baby corn, Maize with quality protein maize

xii.**Production constraints in agro-ecological region:** Local varieties, thining & Imbalance fertilizer

9C.Name of the fodder crop: Jai (Oat)

i. **Existing varieties being used:** Local

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: UPO212, Kent

iii. **Existing package of practices being used:** Traditional methods

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil : Loam soils
2. Field preparation : 2-3 Harrowing + leveling
3. HYVS: UPO-94, 212, Pant Oat-3, 06, Kent, Bundel Jai-822, 851, 992 Phule Harita,05-6
4. Seed rate: 100 kg/ha
5. Spacing : 30cm line to line distance
6. Sowing time: first week of October to last October

v. Major insect pests associated with crop:

vi. IPM Module for management of insect pests:

vii. Major disease associated with crop:

viii. IPM Module for management of disease:

ix. **Major weeds associated with crop:** Local weeds

x. **IPM Module for management of weeds:** hand weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

xii. Production constraints in agro-ecological region: Local varieties & Imbalance fertilizer

C1. Livestock: Buffalo

1.A Existing breeds available: Mostly non-descript, Neeli-Ravi cross, Murraha cross

1.B Specific breeds to be introduced: Murraha, Neeli-ravi

2.A Existing feeds being used:

1. Wild grasses, paddy straw, wheat straw, wild dried grasses
2. Leaves of trees such as silver oak, bhemal, khadeek, mulberry

2.B Specific feeds to be introduced / advised:

1. UMBB, Feed blocks, Fodder maize, multi cut chari, multi Barseem, Hybrid napier, tall fascue, Italian rai, cox foot, orchard grass fodder trees etc
2. Fortification of local Fodder, use of Chaff cutter and mangers etc

3.A Existing health services:

1. State animal husbandry department (Vet. Hospital, LEO Centers)
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

Village level workers for first aid, vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction,
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds,
2. Shortage of feed and fodder,

3. Improper feeding, poor housing and management of animals,
4. Improper health services,
5. Mostly unproductive animals

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed,
3. Low cost of milk

C2. Livestock: Cattle

1.A Existing breeds available: Mostly non-descript, Badri, Cross bred of Jursey, HF, Sahiwal

1.B Specific breeds to be introduced: Jersey, HF, Sahiwal

2.A Existing feeds being used:

1. Wild grasses, paddy straw, wheat straw, dry grasses,

2. Leaves of trees as silver oak, bhemal, khadeek, mostly rearing on grazing

2.B Specific feeds to be introduced / advised:

1. Fodder maize, multi cut sorgam (chari), Berseem, Hybrid Napier, fodder trees etc
2. Fodder treatment, Chaff cutter, mangers etc

3.A Existing health services:

1. State animal husbandry department
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

Village level workers for first aid, vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder,
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction,
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds,
2. Shortage of feed and fodder,
3. Improper feeding, poor housing and management of animals,
4. Improper health services,
5. Mostly unproductive animals,

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed,
3. Low cost of milk

C3. Livestock: Goatary

1.A Existing breeds available: Mostly non-descript,Chobarkha, Udaipuri

1.B Specific breeds to be introduced: Barbari, Jamunapari

2.A Existing feeds being used: Grazing

2.B Specific feeds to be introduced / advised: Grazing

3.A Existing health services: State animal husbandry department

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Village level workers for first aid
2. Vaccination

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district: Development of pasture land, scientific management

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Lack of range land management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Lack of range land management,
2. Managemental problems as proper vaccination,
3. Ecto and endo parasite control
4. Breed improvement

C3. Livestock: Sheep

1.A Existing breeds available: Mostly non-descript,gaddi, black sheep

1.B Specific breeds to be introduced: Gaddi, selective breeding of local breed

2.A Existing feeds being used: Grazing

2.B Specific feeds to be introduced / advised: Grazing

3.A Existing health services: State animal husbandry department,

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Village level workers for first aid
2. Vaccination

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder,
4. Improper vaccination,
5. Long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Development of pasture land
2. Scientific management

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Lack of range land management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Lack of range land management,
2. Managemental problems as proper vaccination,
3. Ecto and endo parasite control
4. Breed improvement

C5. Livestock: Poultry

1.A Existing breeds available: Poultry: Local, Croiler, RIR, uttara fowl

1.B Specific breeds to be introduced: Poultry: Croiler, Kadaknath, Cob, Cari-davendra, cari-nirbheek

2.A Existing feeds being used: Kitchen waste

2.B Specific feeds to be introduced / advised:

1. Starter, grower
2. Finisher feed according to age

3.A Existing health services: State animal husbandry department, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

Specific poultry management services

4.A Existing management practices: Mostly backyard

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. High yielding breeds
2. Proper feeding and management practices

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Poor breed and management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing: Poor breed and management

C6. Livestock: Fisheries

1.A Existing breeds available: Local, Silver carp, grass carp and common carp

1.B Specific breeds to be introduced: Silver carp, grass carp and common carp

2.A Existing feeds being used: House hold waste

2.B Specific feeds to be introduced / advised: pelleted fish feed having 25-30% protein

3.A Existing health services: State fisheries deptt. (fisheries inspector at district level)

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:-

4.A Existing management practices: -

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:-

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:-

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing: Non availability of quality fish seed is major problem

Vet. Health services

Resouces		Manpower							Infrastructure		
		No.	V. O.	LEO	Pharmacist	Lab. Tech.	Livestock Assistant	Para vets	Buildings	Equipments	Others
Vety. Hospitals	Existing	13	13	-	15	-	31	1	12	Available	13
	Proposed	3	3	-	3	-	6	-	3	-	3
Mobile Vety. Unit	Existing	1	1	-	1	-	2	-	No	Not Available	1
	Proposed	1/ block+1	05	-	05	05	5	-	-	Needs to be procured	1/ block+1
Vety. Dispen.	Existing	23	-	23 (vacant-09)	-	-	-	-	9	-	23
	Proposed	2	-	2	-	-	-	-	2	-	2
AI centres	Existing	28	13	15	-	-	-	-	-	Available	28
	Proposed	2	-	2	-	-	-	-	-	-	2
Disease Diag. Labs	Existing	Nill	1	-	-	Vacant	1	-	1	Available	Nill
	Proposed	1	1	-	1	1	1	-	-	-	1
Polyclinic	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	1	-	-	-	-	-	-	Required	Required	1
Ambu. Clinics	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	-	-	-	-	-	-	-	-	-	-

Availability of Medicines/ Vaccines: Adequate

Specific health services to be required/ advised for doubling income in specific agro-ecological zone:

Nutritional gap needs to be filled. Farmers should be provided feed &fodder supplements at subsidised rates, minimum support prize should be fixed for the farm products, improved market infastrustureand market scppe.

Any other suggestions to improve the quality of Vety. Health services:

Need restructuring of the department especially for the hilly areas so as to fulfill the staff requirement.

Refresher course should be organised for the doctors.

Problems of Animal Husbandry

Specific problems due to which income is not increasing	Poor accessibility	yes(some remote hilly area)
	Water scarcity	Almost in the whole district
	Natural disasters	Frequency is low
	Wild life conflicts	Yes frequency is very high due to which farming intensity is decreased to a significant level
	Marketing of animals	No availability of structured market
	Marketing of products	Due to Low cost of milk and milk product marketing is not upto the mark, transportation cost is also very high thus making is not feasible, need chilling plants at regular distance
	Budget	Allocation is low
	Manpower shortage	Yes. Monopoly gender role in livestock activity
	Capacity building	Para veterinary staff and refreshal courses of vetenarians is required
	Equipment & Implements (old/ shortage, etc.)	Adequate
	Mobility	Huge Problem. Dependence on the public vehicle is very high. Difficult terrain. Difficult road connectivity.
	Risk cover (Insurance)	Is must, though inappropriate action by insuarance companies in settlement of claims discourage farmers
	Relook to policies	-

D. Integrating Farming system

1.A Existing farming system: Animalhusbandry +crop/Vegetable

1.B Specific farming system for doubling income in specific agro-ecological region:

Agri-Hort-Animal based farming system

Activity Area

A. Cropping system: 8 nali

Paddy-Cabbage/Pea
Capsicum-radish-cauliflower
Paddy-Radish-garden pea-Frenchbean

B.Horticulture **8 nali**

Peach, plum apricot and walnut

C. Livestock **2 nali**

a. Cow/buffalo
b. Backyard poultry
c. Gottary
d. Fishery
e. Beekeeping

D.Processing **2 nali**

Washing and cleaning of season vegetables, biogas/vermicompost/biopesticides

Total cost : 50,000.0

Total income : 1.5 lakhs

Net income : 1.00 lakh (Approx.)

E. Reducing post harvest losses and value addition

1.A Existing grading facilities: Not available in area

1.B Grading facilities to be advised/ setup for doubling income in the agro-ecological region of district:

Establishment of minimal processing plants in various location based on crop and area specific.

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.A Existing processing facilities:

1. Food processing units of Deptt. of Horticulture.
2. Units of some NGOs

2.B Processing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular commodity
6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

3.A Existing packing facilities: Not available

3.B Packing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

A factory based on plastic cartoon, *Kilta*, *Dalia* of various grade and size based on weight of the fruit is needed at least at distt level to meet the requirement of apple and seasonal vegetables.

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)
4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxesfor particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed
8. Litchi peeling and shredding unit

4.A Existing storage facilities: At present no storage facilities are available in the distt.

4.B Storage facilities to be advised/ setup for doubling income in the agro-ecological region of district:

A warehouse for hill potato is required.

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo
3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chambers
7. Jaggery storage bin

F. Waste land development and waste water

1.A Existing practices of soil water conservation:

1. Using indigenous technology use for water conservation includes formations of bund, growing of Napier and other perennial grasses,
2. Multiple forest species as per need are requirement.

1.B Package of practices to be advised/ developed for management of wasteland and wastewater in the agro-ecological region of district:

1. Storage of wastewater by using low cost water harvesting technology as *kuchha* and *Pucca* tank. Polytank can be constructed as (5x3x2m) capacity to meet the lean season demand of seasonal vegetables and for non agricultural use also.
2. In wasteland, a wide scope of fodder plantation of Morus, Chhanchru, and Melilotus sp can be utilized. In dry and unirrigated situation there is scope of bael, amla can be included. There is need to put fodder crops in wasteland.

2.A Existing plantation: Tun, shirish, Bheemal, Kachnar, Kharik, shisham in low and mid hills Utis, banj, chhanchru, leucinia, Mulberry

2.B Plantation suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of district:

1. Morus, Shirish, Kharik, Utis, Oak, Bheemal, Kachnar, Vilyati khair etc are useful as dual purpose species to meet fodder, firewood and other requiremnt of the farmes.
2. Sufficient plants are avaialble at forest nurseries for planations.

3.A Existing fodder production: Crop stobbers, wild grasses, Forest leaves etc.

3.B Fodder suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of district:

Napier grass, Tall fescue, Perrennial rye, Pangola grass, Clovers

4.A Type of waste water: Home and kitchen waste

4.B Existing treatment facilities: NA

4.CTreatment facilities to be advised/ developed for waste water treatment and utilization in the agro-ecological region of district:

1. Multistage filteration unit should be established to recycle the waste water for multiple uses.
2. Domestic wastewater from kitchen and bathroom should be treated before being used for irrigation in vegetables and other crops.
3. Industrial wastewater should not be used for irrigation directly; and must be treated by the concerned industries at their factory level as per norms to make it suitable for irrigation or other uses.
4. Sewage water from cities should be treated by municipal corporations or other agencies.

G. Reduced cultivation cost

1.A Existing inputs being given:

1. Traditional and unprocessed inputs are used in agricultural practices.
2. Drudgery prone implements/tools are in practice for various operations.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district: Application of nutrients based on soil test basis as major and micro elements.

Rice-wheat/Soybean-wheat

1. Annexure–II is enclosed for N,P and K.
2. In Zn deficient soils, application of 25 (sandy loam)- 50 (Clay loam) kg $ZnSO_4$ (21% Zn) /ha or foliar spray of 0.5% $ZnSO_4$ + 0.25% lime in standing crop
3. In Cu deficient soils, application of 4-5 kg $CuSO_4$/ha or foliar spray of 0.25% $CuSO_4$ + 0.125% lime in standing crop
4. In deficient soils, application of 215 kg gypsum/ha
5. Foliar spray of 1% $FeSO_4$ in rice nursery

Capsicum-Potato

1. In Zn deficient soils, application of 25 (sandy loam)- 50 (Clay loam) kg $ZnSO_4$ (21% Zn)/ha or foliar spray of 0.5% $ZnSO_4$ + 0.25% lime in standing crop
2. In deficient soils, application of 215 kg gypsum/ha

Apple

1. In deficient soils, application of 300-450 g lime/tree every third year
2. Two foliar spray of 0.2% Borax at fortnightly interval in June
3. Two foliar spray of 0.2% $CuSO_4$ + 0.1% lime at fortnightly interval in May/ June

2.A Existing mechanization:

Limited use of power driven implements in land preparation. Small tools like sickle, hand hoe etc are being adopted by progressive farmers

Paddy

1. Seedbed preparation by animal drawn Nasuda followed by wooden planker.
2. Conventional nursery rising.
3. Puddling by *damala* / peg type wooden puddler.
4. Manual transplanting.
5. Manual weed control.
6. Manual fertilizer application.
7. Manual harvesting.
8. Manual threshing.
9. Hand operated paddy thresher –cum-winnower.
10. Cleaning by winnowing fan.

Pulses

1. Seedbed preparation by animal drawn *Nasuda* followed by wooden planker.
2. Manual broadcasting / line sowing / manual thinning.
3. Manual weed control.
4. Manual fertilizer application.
5. Manual harvesting.
6. Manual threshing.
7. Cleaning by Winnowing fan

Millets

1. Seedbed preparation by animal drawn *Nasuda* followed by wooden planker.
2. Manual broadcasting / line sowing / manual thinning or by animal drawn *danala*.
3. Manual weed control.
4. Manual fertilizer application.
5. Manual harvesting.
6. Manual threshing.
7. Cleaning by Winnowing fan

Soybean

1. Seedbed preparation by animal drawn *Nasuda* followed by wooden planker.
2. Manual line sowing.
3. Manual weed control.
4. Manual fertilizer application.
5. Manual harvesting.
6. Manual threshing.
7. Cleaning by Winnowing fan.

Maize

1. Seedbed preparation by animal drawn *Nasuda* followed by wooden planker.
2. Manual line sowing.
3. Manual weed control.
4. Manual earthing-up of plants.
5. Manual fertilizer application.
6. Manual harvesting.
7. Manual shelling.

Potato

1. Seedbed preparation by animal drawn *Nasuda* followed by wooden planker.
2. Furrow making manually or by animal drawn *Nasuda*.
3. Manual planting and ridge making.

4. Manual weed control.
5. Manual fertilizer application.
6. Manual harvesting / using animal drawn Nasuda.

Management of Orchards

1. Manual digging of holes for sapling planting.
2. Manual watering of plants.
3. Manual interculture operations.
4. Manual pruning of branches.
5. Manual plant protection.
6. Manual picking of fruits.
7. Manual grading.

2.B Mechanization required for reducing cost of cultivation in the specific agro-ecological region of district:

Power tiller, power weeder, and shrub cutter, Multiple crops threshers are becoming popular and are available in pockets.

Old wooden based impelents are being replaced with iron/alloy (Plough, danalla,) based tools are available.

Paddy

1. Seedbed preparation by using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Puddling by light weight power tiller / animal drawn improved Pant *damala*.
3. Weed control by conoweeder.
4. Manual harvesting / harvesting by power cutter / power tiller front mounted vertical conveyor reaper.
5. Threshing by Pant axial flow power hill thresher / hand operated paddy thresher-cum-winnower.

Wheat

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Sowing by single or double row Pant zero-till drill / light weight power tiller operated seed drill.
3. Weed control by improved wheel hoe.
4. Plant protection by manually operated sprayers.
5. Manual harvesting / harvesting by power cutter / power tiller front mounted vertical conveyor reaper.
6. Threshing by Pant wheat thresher for hills.

Pulses

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Sowing by single or double row Pant zero-till drill / light weight power tiller operated seed drill.
3. Weed control by improved wheel hoe.
4. Plant protection by manually operated sprayers.
5. Manual harvesting using improved sickles.
6. Pant axial flow power hill thresher.

Millets

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Manual line sowing / improved millet seed drill.
3. Weed control by improved wheel hoe.
4. Plant protection by manually operated sprayers.
5. Manual harvesting using improved sickles.
6. Threshing by VPKAS millet thresher.

Soybean

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Sowing by Pant zero-till single/double row seed drill/ light weight power tiller operated seed drill.
3. Weed control by improved wheel hoe/light weight power weeder.
4. Plant protection by manually operated sprayers.
5. Manual harvesting using improved sickles.
6. Light weight soybean thresher/ Pant multi-crop hill thresher.

Maize

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Manual sowing / power tiller operated maize planter.
3. Weed control by improved wheel hoe/light weight power weeder.
4. Manual earthing-up of plants
5. Plant protection by manually operated sprayers.
6. Manual harvesting using improved sickles.
7. Shelling by hand held maize sheller/power operated maize sheller.

Potato

1. Seedbed preparation using light weight power tillers/ animal drawn improved Pant hill plough followed by light weight planker made of composite material.
2. Furrow making manually or by animal drawn Pant hill plough/furrower.
3. Weed control by improved wheel hoe/light weight power weeder.
4. Earthining by power tiller operated or animal drawn ridger.
5. Plant protection by manually operated sprayers.
6. Harvesting by animal/power tiller operated potato digger.
7. Grading by mechanical potato grader.

Management of Orchards

1. Digging of holes by light weight power tiller operated post hole digger.
2. Watering by fertigation using drip method.
3. Pruning by power chain saw/mechanical pruners.
4. Fruit picking by mechanical hand held pickers
5. Plant protection by aero blast sprayer.
6. Grading by mechanical graders

3.A Existing collective inputs:

1. Community pasture land, Service bulls, Irrigation channel and source,
2. Irrigation tanks, Chemical Fertilizers, Insecticides, Pesticides, Farm Yard Manure, Seed,
3. Water and Tillage Machinery

3.B Collective inputs suggested for reducing cost of cultivation in the specific agro-ecological region of district:

Custom hiring energy based implements viz. Small tractor, tiller, Power sprayers, Mandau thresher; Hydrum irrigation can reduce the cost of cultivation along with reduction of farm labour.

Mid Hills

1. Encourage furrow application of P and K fertilizer and half dose of nitrogenous fertilizers at sowing based on soil test value.
2. Avoid broadcasting of chemical fertilizers preferably spraying method should be followed for application of N and micronutrients.
3. Encourage use of organic manures and biofertilizers.
4. Need based application of insecticides and pesticides, preferably enhanced the use of bio-agents.
5. Farmer should use high yielding variety seed and multiply at his own site for next 02-03

seasons.

6. Use optimum and recommended seed rate at optimum spacing and depth.
7. Encourage water harvest technology for irrigation.
8. Use sprinkler and drip method for irrigation should be encouraged.
9. Use of mulches and available composts/organic manures
10. Follow contour farming and grow perennial fodder crop on bunds to check soil erosion.
11. Promote reduced tillage operations.

4. Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district:

1. Labour cost
2. High hybrid seed cost
3. No storage facilities for perishable product
4. No chilling plant for milk

Irrigated valleys and lower hills (600-1200m area)

Situation-I Represent subtropical climate with moderating high temperature (18-30 ^{0}C) medium rainfall, low humidity (40-50%) and experiences no snowfall. 80% of total precipitation is received during June to September. Sal in outer Himalayas and pine and oak in middle and inner Himalayas are the predominant vegetation. Soils are alluvial sandy loam to loam.

Rainfed lower hills (600-1200m)

Situation-II Soils are gravelly and chirty, deep, sandy loam to silty clay loam. Soils are slightly to moderately acidic in nature.

Mid hills south aspects (1200-1700m)

Situation-III Area better suited to human settlement due to forest free cultivated land and maximum exposure to sunlight and represent sub-temperate climate. About 75% of total precipitation is received during rainy season, 12% in winter and 13% in summer. The situation is dominated by chir (pine) forest vegetation. Most of the area is rainfed. The soils are eroded, chirty/gravelly sandy loam to silty loam. Soils are heterogenous and poor in fertility.

Mid hills north aspects (1200-1700m)

Situation-IV The irrigated area is 8% by gulls. It has good cover of oak and its association. Duration of exposure to sunlight is the major factor influencing the microclimate and type of vegetation. Relative humidity is high (60-70%). Temperature is moderately low due to vegetation and high shading effect. Rainfall is high with occasionally snowfall. About 75% precipitation is received during rainy season, 15% in winter and 10% in summer. The soils are moderately to highly acidic in nature especially at mid and high elevation areas.

H. off-farm income

1.A Existing SHGS operative in specific agro-ecological region of district: ATMA, AAJIVIKA, GRASS, SAMBANDH, NIDHI, BAIF, KAGAS,

1.B SHGS to be created/ encouraged in the specific agro-ecological region of district for doubling agricultural income:

1. Milk collection and chilling group
2. Honey collection and production group
3. Mango and Litchi collection centres
4. Crop collection centre
5. There is need to have regular monitoring and follow up of SHG's by the forming agencies and time to time evaluation of the group.
6. Regular monitoring by the concerned agency must be ensured like ensuring regular meeting of the SHG, checking their register, regular collection of the money, help during conflicts, solving problems occurring during banking etc. and submitting the monitoring report to their concerned officials so that steps can be taken by the high officials to ensure regular continuity of the SHG.
7. Imparting the information to the groups about various govt. schemes regarding loan, trainings

and marketing of the product.

8. A large number of groups discontinued as they were not having knowledge regarding income generating activities that can be started (what activities can be taken up, how to operate it, where to market the produce etc.) So there is need of encouragement, motivation along with imparting knowledge, skills and linking them to market.
9. Trainings should be provided to the rural women on income generating activities as per the need of rural women, marketing potential and availability of locally available resources.
10. Loan procedure should be made more flexible with less interest rate.
11. As there were problems like non-cooperation among members, confusion regarding money matter, lack of confidence on office bearers with respect to group money etc., there is need of organizing training on good governance, democratic election and how to solve financial and administrative issues.
12. SHG's formed should be grouped into clusters, federations and registered cooperatives so as to converge with govt. schemes, facilitate collective purchase of input and marketing of products.
13. To encourage people to form and sustain SHG's so that new enterprise developed, intensive work needs to be done with them in sustainable manner.
14. Enterprises need to be identified depending upon local resources- human and material.
15. Market linkages need to be developed so that people can sell their produce gainfully.
16. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
17. Target should not be only to form large number of SHGs but care should be taken that formed SHG may be in less number are functioning properly.

1.C Problems related with SHG:

1. Not interested in continuing the group
2. Non-cooperation among the members
3. Problem in getting loan
4. Lack of resources like money, space
5. Lack of knowledge regarding various income generating activities,
6. Lack of trainings
7. Lack of follow-up and monitoring from the forming agencies.
8. In hills farm holdings are very small and large part is rainfed depending upon rains with very low and uncertain productivity.
9. Young people do not stay in villages and move to other areas or take up other profession such as tourism, transport, hospitality etc.
10. People remaining in villages are not very enterprising.

2.A Existing Micro-entrepreneur employment:

Bisht fal sanraakshan udhyog

2.B Micro-entrepreneur employment to be generated in the specific agro-ecological region of district for doubling agricultural income:

1. Poultry growing group
2. Honey and honey products unit
3. Milk and milk products shops
4. Honey collection and production group

3.A Existing skill development facilities: Extension training institute

3.B Skill development facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units

5. Value addition and food chain centre
6. Storage, grading and Packaging centre
7. Silk worm based skill development units
8. Bioagent and bio fertilizers production lab
9. Tissue culture lab for massive production of elite planting material
10. Medicinal plant growing and processing units

4.A Existing women skilling facilities: Not Available

4.B Women skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Khadi and Kargha training for women skill
2. Drudgery reduction practices for high efficiency
3. Herbal dye based skill training and skill for local textiles.
4. Value addition skill for women

5.A Existing youth skilling facilities: Extension training institute

5.B Youth skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units
5. Value addition and food chain centre
6. Storage, grading and Packaging centre
7. Silk worm based skill development units
8. Bioagent and bio fertilizers production lab
9. Tissue culture lab for massive production of elite planting material
10. Medicinal plant growing and processing units

Beekeeping

Beekeeping is an environment friendly and agro-forestry based occupation. It provides enormous potential for income generation, poverty alleviation and sustainable use of forest resources. Beekeeping is one of the oldest traditions in India for collecting the honey. Honey bee farming is becoming popular due its demand in national and international markets as well. *Apis cerana indica* is the indigenous bee, is known to be the ideal pollinator for organically grown mountain crops due to its capacity to significantly enhance agricultural productivity. India has a potential to keep about 120 million bee colonies that can provide self-employment to over 6 million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tons of honey and about 15,000 tons of beeswax.

Less Investment: Bee Farming is not a manufacturing activity, as such costly machine and tools are not required. There is nothing like production capacity as well. Only small wooden frames with boxes are needed. Their sizes are also standardized. To begin with around 15 such sets/boxes can be purchased or assembled at rate of Rs.1500.00 per box that would cost Rs.22, 500/- for 15 Boxes. Honey extractors would cost to the tune of Rs.5, 000/- each with filtration facilities. For other miscellaneous expenditures including training and consultancy services a sum of Rs.5000.00 can be earmarked. That means total of Rs.32, 000.00 would be required to start Bee Farming with 15 Boxes which is equivalent or less than the cost of cultivation of one acre of paddy field.

More Returns: As per the established norms, each box comprises 7-8 hives which is able to harvest around 30-35 kg of honey in a year. The annual harvest of honey starting with 15 bee boxes could be 450-525 kg depending on the flowering season. Even after considering very conservative selling price of Rs. 150/- per kg; the annual realisation would be to the tune of Rs. 67,500/- to Rs.78,750/-. Therefore, Bee Farming can be considered as an excellent, profitable agro-based green enterprise for landless farmers and entrepreneurs.

Beekeeping in Uttarakhand: Beekeeping has been an integral part of human society since centuries in hill regions of Uttarakhand state. The state of Uttarakhand has a predominantly agrarian economy and large number of small and marginal farmers in the mountainous state call for augmenting agricultural production by organic means. The indigenous bee sub-species *Apis cerana indica* commonly is ideal pollinator for organically grown mountain crops, with the capacity to significantly enhance agricultural productivity with an indirect but vital role in combating soil degradation by pollinating wild plants thereby enabling improved regeneration of bio mass, to be returned to the soil. Beekeeping with *Apis cerana indica F*. is a common practice in hills of Garhwal and Kumoun Himalaya which is carried out mostly by using traditional methods since long past and is stationary in nature. In these regions, beekeeping is also carried out with *Apis mellifera,* but in winter season, due to temperature lower than 20ºC, colonies are being migrated to plains. According to report given by KVK Jeolikot(2017), in Uttarakhand, there are about 4,790 beekeepers with 45,247 number of *A. cerana indica* colonies yielding 546.70 mt of honey production. Whereas, in Almora region of Uttarakhand, there are about 400 beekeepers with 1,165 number of *A. cerana indica* colonies yielding 16.4 mt of honey production. The Uttarakhand state has extremely rich bee forage plants. In most of the remote areas where *Apis cerana indica* beekeeping is common, the use of pesticides and chemicals is negligible, the level of dangerous chemicals in the atmosphere is insignificant and the environmental pollution is at minimal level. Honey produced from such areas is purely natural, free of any residues and can be sold as an organic product. There is vast potential for beekeeping in the country. However, due to lack of knowledge, scientific beekeeping is not being practiced by, most of the beekeepers. It is necessary for beekeepers to participate in the trainings / other capacity building programmes on the subject to gain scientific knowledge on the subject. Selection of good apiary site, good quality bees and proper management are the main keys for success of beekeeping. Following are the important points to start beekeeping and further management practices.

1. Selection of good apiary site: Select apiary site by considering the following:

1. Apiary ground should be clean & free from dry leaves etc. to avoid fire during summer
2. Apiary site should be away from power station, brick kilns, highway and train tracks
3. Site should be open & at dry place having shade
4. Site should be easily accessible by road
5. Fresh running water should be easily available near the apiary
6. It should have natural / artificial wind breaks
7. Site should receive early morning and afternoon sunshine
8. There should not be other commercial apiary within 2-3 kilometers from the apiary site
9. There should not be any source of stagnant / dirty water, chemical industry/ sugar mill, etc., nearby the apiary
10. Area should be rich in bee flora

2. Selection of good quality bees: Beekeeping depends on floral resources, climatic conditions, management and also quality of bees, particularly queen. Therefore, the following should be kept in mind to select the bee colonies:

1. Buy disease free bee colonies from existing reputed beekeepers after getting training on the subject.
2. Select and multiply honey bee colonies only from disease resistant, high honey yielding, young, healthy and high egg laying capacity queen, less swarming tendency etc.
3. Keep colonies with good prolific queens
4. Capture few bee colonies from their natural abodes in forests which may be used for further breeding/ multiplication to prevent inbreeding.

3. Management of apiary:

A. Placement of colonies in apiary

1. Hives should be as per specification of BIS/ISI and should be of locally available seasoned light

weight wood. Unseasoned and heavy wood should be avoided
2. Avoid nailing the bottom board with the brood chamber
3. Restrict number of bee colonies in a apiary from 50-100
4. Keep row to row and box to box distance as10 and 3 feet, respectively

Hives used for traditional beekeeping in hilly areas are

Wall hives: Wall hives locally known as 'Khadra', 'Jaala' or 'Jalota' are rectangular structures made in the walls of houses and 'Chhaan' or 'Sunni' (cattle sheds) at the time of construction. Each hive has a small round or rectangular opening on the outer side as an entrance for bees. The size of 'Jalotas' varies in different locations; usually they are 45-60 cm in length, 25-30 cm in width and 20-30 cm in height. Generally one hive is made in each wall, but numbers may vary from 2-4. The interiors of hives are smoothed with cow dung and clay. In winters due to lack of floral resources and extreme cold in the hills, the population of *Apis cerana* colonies decreases to a great extent. Thick wall hives provide considerable insulation in such conditions.

Log hives: Two types of log hives are found, Type I: These are made up of cylindrical hollowed pieces of tree trunk 60-100cm long and 20-40 cm in diameter; however size depends upon the circumference of available trunks. This type of log hives is usually made from the trunk of *Quercus leucotrichophora, Q. floribunda, Rhododendron arboreum and Pinus roxburbhii.* The entrance is made at the mid front side. Both sides are plastered with a mixture of cow dung and clay. Type II: Old cooperages locally known as 'Pariya' or 'Dokha' when rendered useless for milk products, are used as hives. These are about 70-90 cm long with the diameter at top from 25-35 cm and thickness of log 3-5cm. An entrance is made towards the outside and the hive is placed horizontally on a raised platform of stones or the wall of a courtyard. It is mainly made up of the wood of *Ougeinia oogeinesis, Rhododendron arboreum, Toona* sp. A stripe of old comb is fixed to the upper part, inside the hive, and is plugged with a wooden or metal cover, then sealed with a mixture of clay and cow dung. The wooden lid is fixed at the top with an entrance on it.

Miscellaneous Types: These are rectangular box hives made up of separate wooden boards with movable top cover. Their size varies in different localities. Usually these are 80-110 cm long, 25-30 cm wide and 40-50 cm high. During extraction, the top cover is removed along with attached combs and bees, and taken away from the hive, then each comb is smoked and shaken gently. Bees return to the hive and beekeepers cut combs easily.

All hives are made from locally available materials, thus are economically cheaper and environmentally friendly. These hives have thicker walls as compared to modern hives thus provide protection to bees from extremely low and high temperatures. In higher hills traditional hives are more suitable than modern hives but for the drawback in colony management.

B. Inspection of colonies

1. Adopt general colony and personal hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board, top cover, etc. frequently
2. Check the colonies periodically for any abnormalities or changes in behaviour of bees
3. Inspect colonies on clear sunny days preferably at temperatures between 20 and 30°C
4. Do not inspect colonies in cold, windy and cloudy days
5. Use smoker when needed to subdue the bees
6. Use protective dress and veil while inspecting colonies
7. Handle colonies gently, avoid jerks
8. Avoid crushing bees as it could lead to stinging
9. Isolate the diseased colonies from healthy ones.
10. Handle diseased and healthy colonies separately

C. Provision of fresh water in the apiary

Ensure availability of fresh water preferably in shallow containers near the apiary to maintain a healthy apiary. Water is needed for the following

1. Maintenance of adequate humidity in a colony to ensure proper incubation of eggs

2. For feeding bee bread by nurse bees, the mixture of honey and pollen of certain consistency is required for which water is needed
3. When temperature in the apiary increases beyond 37°C, water is used by bees to evaporate and cool the colony

D. Dearth period management

1. Provide 50% sugar syrup to the colonies during dearth periods when honey stores in the colonies is not adequate and nectar is not available in the area. The syrup should be prepared by boiling clean water in the vessel and sugar added with slow stirring for few minutes. Cover the vessel with lid and let it cool. Feed cooled syrup.
2. Sugar syrup should be kept in such a way that the bees should not drown in it. This should be ensured by using shallow vessels with straw to facilitate easy feeding
3. Do not prepare the feed in open in the apiary and avoid dripping on the ground to prevent robbing by bees and ants
4. Feed the colonies in the evening preferably after sunset
5. Feeding should be given to all colonies in the apiary at one time
6. Pollen substitute comprising of fat free soyabean flour (3 parts) + Brewer's yeast (1 part) + skimmed milk powder (1 part) + sugar (22 parts) +honey (50 parts) made in the form of patties should be provided when pollen stores in the colonies is not adequate and pollen is not available in the area
7. Provide fresh water near the colony in shallow vessels
8. Extra frames should be stored in air tight chambers and fumigated with sulphur powder regularly
9. Old and dark combs should be discarded

E. Care during honey extraction

1. Use honey extractor, containers and other bee hive tools /equipments made of stainless steel / food grade plastic. Don't use tins & containers made of other degraded material
2. Wash all the equipments / containers etc. thoroughly with warm water before honey extraction
3. Extract honey from super chambers only
4. Select frames only with 75% sealed cells with ripened honey for extraction
5. Cover the entrance gate of the colony with small branches or twigs to avoid robbing
6. Extract honey in a closed room and not in the open to avoid robbing
7. Do not leave super and brood frames, after extraction of honey open in the apiary;
8. Do not spill honey in the apiary

F. Care during migration

1. Migrate colonies during non-availability of flora to areas with abundant flora.
2. Before migration survey the area to assess the availability of the flora to locate the colonies
3. Ensure honey extraction before migration
4. Close the entrance gates of the colonies in the evening after all worker bees are inside the colony
5. Pack the colonies internally and externally before migration to avoid jerking
6. Colonies in the vehicle should be packed in such a way that the entrance side should face the front side of the vehicle
7. Start migration late in the evening and ensure the colonies reach the destination within 10-12 hrs. the next day morning and entrance gates are opened after landing in the new location
8. Avoid jerking in the way while transporting bee colonies

G. Seasonal management of apiary

a**) Summer Management**

1. Keep the colonies in thick shade
2. Regulate the microclimate of the apiary by using wet gunny bags over top cover and sprinkling water around the colonies in the apiary during noon hours.

3. Provide fresh water in/near the apiary

b) Monsoon management

1. Clean and bury deep the debris lying on the bottom board
2. Keep the surroundings of the colony clean by cutting the unwanted vegetation which may hamper free circulation of the air
3. Provide artificial feeding (sugar syrup and/or pollen substitute) as per requirement of the colony
4. Check the robbing within the apiary
5. Unite weak/laying worker colonies
6. Control predatory wasps, ants, frogs, lizards in the apiary

c) Post monsoon season management

1. Provide sufficient space in the colony
2. Strengthen the colonies to stimulate drone brood rearing
3. Control ectoparasitic mites, wax moth and predatory wasps

(d) Winter management

6. Examine the colonies and provide winter packings in weak colonies specially in hilly areas
7. Feed sugar/pollen substitute to weak colonies as stimulative feeding to provide energy and initiate brood rearing
8. Shift the colonies to sunny places
9. Protect the colonies from chilly winds by using wind breaks
10. Unite the weak colonies with stronger ones

e) Spring management

1. Unpack the colonies, clean the bottom board, replace the worn out hive parts and provide sufficient space
2. Provide stimulative sugar/pollen substitute to increase brood rearing
3. Equalise the colonies
4. Extra frames should be raised by providing comb foundation sheets
5. Replace the old queens with new ones through mass queen rearing or divide the colonies
6. Manage the colonies in such a way to prevent swarming
7. Monitor regularly for ectoparasitic mites and adopt control measures

H. Protecting colonies from pesticides

1. Persuade the farmers not to use pesticides or use selective pesticides that are less harmful to bees at recommended concentrations
2. Avoid the use of dust formulations as they are more harmful to bees than spray formulations
3. Prior information about spraying would help in reducing poisoning of bees
4. Avoiding spraying of pesticides during flowering of the crop and peak foraging time of the bees would help in reduction in the mortality of foraging bees
5. Spraying may be done in the evening after sun set when bees do not forage
6. Colonies may be temporarily shifted if heavy spraying schedule is fixed
7. If shifting of the colonies is not possible, feed with 200 ml sugar syrup and close the gate by using wire screen for the day of spraying.

I.Methods of attracting and catching swarms

1. Swarming is a natural process for propagation of honey bees. Swarms are the lone source of bees in traditional beekeeping of *Apis cerana* while only a few empty hives are inhabited by absconded or feral colonies.
2. Empty hives are cleaned and smeared with clay, cow dung or both. Honey or jaggery are put inside hive to be used as bait to attract the swarm.
3. Flowering shoots of *Brassica campestris, or Raphanus sativus* can also be used just above the hive entrance, hoping that scout bees will find their home in the empty hive.
4. When swarms is found in the vicinity, water can be sprinkled and soil or ash can be thrown to settle them. 'Tofri' or 'Garori' (special baskets) made up of 'Ringal' (bamboos); 'Jhola' (bag)

can be used to catch and carry swarms. 'Kutrine' (burning cotton cloth) is used as a traditional smoker and 'Talikh' (a cloth) to save faces while catching the swarm.

5. To catch a swarm layer of jaggery or honey is applied at the inner base of the basket and hang it inverted near the settled cluster. The cluster is gently displaced from the other side with smoke to direct the bees towards the basket. As the swarm makes a cluster on the basket, it is transferred to the hive. When the bees are settled the basket is removed. Finally the hive is closed with its wooden cover and be smeared with a mixture of cow dung and clay.

J. Management of Honey Bee Diseases and pest

Honey bees could be affected by diseases and the real cause of abnormality or any disease present in the honey bee broods need to be ascertained before taking up any control measures. It is best to contact the researchers/scientists/beekeeping experts at the nearest centre or university or Government department working on honey bees. After the exact diagnosis of the causal agent of the particular disease, the guidelines/ recommendations given by the expert should be followed in true letter and spirit. However, general advisory for the management of common diseases of honey bees is given below:

1. Select good site to locate the apiary preferably in an open, dry place with shade.
2. Adopt general colony hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board frequently.
3. Select and multiply honey bee colonies only from disease resistant stocks.
4. Keep colonies with good prolific queens.
5. Create broodlessness in colony for at least 15 days by enclosing the queen in a queen cage.
6. Check the colonies periodically for any abnormalities or changes in behaviour of bees.
7. If you observe any colonies with disease, isolate them from healthy ones. Handle diseased and healthy colonies separately.
8. Keep the colonies strong by adding sealed brood comb or worker population only from healthy colonies and also by providing adequate food during dearth periods.
9. Prevent robbing, drifting, absconding and avoid migration of bee colonies when you notice disease symptoms.
10. Follow 'Shook Swarm' or shaking method to remove contaminated combs completely by transferring entirely new combs in one operation to the colonies with disease symptoms. Destroy the removed combs by burning.
11. Sterilise the combs and equipments by any one of the following methods:

c. Disinfect the empty combs and equipments with 80 per cent acetic acid @ 150 ml per hive body in piles for few days at a protected place. Air the treated materials before use.

d. Dip the contaminated equipments and combs in soap solution containing 7 per cent formalin for 24 hours. Then wash the treated material with water, dry and use.

12. Use of antibiotics to control honey bee diseases is likely to result in contamination of honey causing problems in export of honey.
13. The traditional method to check the entry of ants is spreading ash or turmeric powder in their way.

K. Honey Extraction

The main honey seasons in hilly areas are '*Chait*' (April), '*Baisakh*' (May) and '*Ashaad*' (July-August). In some localities, an additional extraction during '*Kartik*' (October) is also done. Colonies yield most honey in '*Chait*'-'*Baisakh*' and the least in '*Kartik*'. Traditional tools used are '*Dathule*'. (sickle) to open the cover or wooden plug and '*Buwan*' (traditional brush) made up of '*Babul*' (*Eriophorum comosum*) to brush off bees. Besides these traditional smokers, large pans for keeping combs, a pot with water and '*Parunla*' or knife for cutting '*Faur*' or '*Fwar*' (bee combs) are required at the time of harvest. Honey is mostly extracted at night but a few beekeepers do it in day time also. Combs are cut down, leaving the innermost comb for feeding and to attract swarms the next year. Honey combs are squeezed after removing the brood area from the cut combs. The

harvested honey has many impurities like insect body parts, wax cells, etc. Usually, squeezed combs are thrown away after extraction, which can be fed to cattle especially bulls. Honey is stored in plastic or metal containers and in bottles.

The beekeepers doing beekeeping with modern hives should use honey extractors to harvest honey. The quality of honey extracted using honey extracting machine is much better than squeezing method.

Mushroom cultivation

The shrinking land, demand for functional foods, priorities for recycling agricultural residues and changing trades in view of globalization are going to play an important role in the agricultural scenario, and secondary agriculture is likely to play a pivotal role. Our country can emerge as a major player in mushroom production in wake of availability of plenty of agricultural residues and labour. To remain competitive it will be important to harness science and modern technologies for solving the problems of production and bio-risk management. Mushroom being an indoor crop, utilizing vertical space offers solution to shrinking land and better water utility. Packages and practices of mushroom cultivation in Almora is as follow:

1. **White Button Mushroom (*Agaricus bisporus*)**

Button mushroom scientifically known as *Agaricus bisporus* and has he widest acceptability. Cultivation of this mushroom is a complex process and requires two different temperature i.e. 22-26^{0}C for spawn run and 14-24^{0}C for fruit body formation. Besides specific temperature, it require proper humidity (80-90%) and enough ventilation during fruit body formation.

Steps of cultivation process

Compost preparation: Compost is an artificially prepared growth medium from which mushroom is able to derive important nutrients required for growth and fructification. Cemented floors and shade over the floor are required for making good quality compost. There are two main methods for compost preparation:

Long method of composting: This is an outdoor process and takes around 28 days in its completion with a total of seven turnings. The following materials are required for long method of compost:

Wheat straw	1000 Kg	Urea	10 kg
Wheat bran	50 kg	Gypsum	100 kg
Ammonium sulphate or calcium ammonium nitrate	30 kg	Furadan	500 g
Super phosphate	10 kg	B.H.C.	500 g
Muriate of Potash	10 kg		

Before making compost, wheat straw is spread on cemented floor and is turned many times with water being sprayed at regular intervals.

Day 0: At the stage, there should be around 75% humidity content in the wheat straw, to which wheat bran, calcium ammonium nitrate, urea, murate of potash, and super phosphate are mixed thoroughly and evenly. The material is then piled 1.5m thick x1.25m high with the help of wooden rectangular block. The blocks are removed. Once the entire material has been stacked up or piled up. Water is sprayed twice or thrice to keep the substrate moist. Temperature should be in the range of 70-750C.

1st turning Day 6: On the sixth day first turning is given to the stack. The purpose of turning is that every portion of the pile should get equal amount of aeration and water. If the turnings are not given, then anaerobic condition may prevail which may lead to the formation of non-selective compost. In the stack, the central zone is fermenting at its peak and has maximum temperature rest of the portion is either not at all fermented or ferments improperly. The correct method of turning is as: Removing about 15cm of compost from the top and spread it on one side of the floor, the rest part of compost on the other side of the floor. Now turning is done by shaking the outer (top most) part and the inner part of the compost, first separately and then missing them altogether thoroughly with the help of

wooden buckets.

2nd turning (Day 10): On the tenth day, again the top most part and the inner part of the compost is separated, water is sprayed on the top part. Again the two parts are piled up together in such a way that now the top part is inside and the inner part is on the top of the stack.

***3rd turning (day 13)*:** it is also done in the same way as described earlier and required quantity Gypsum mixed at this stage.

***4th turning (day 16)*:** The same process of turning is followed. The required quantity of furadan & lindane are added during this turning.

***5th turning (day 19)*:** The compost is turned in the same manner.

***6th turning (day 22)*:** The same process of turning is followed. The required quantity of furadan and lindane are added during this turning.

***7th turning (day 25)*:** The compost is turned in the same manner

8th *turning (day 28)*: if no ammonia persists in the compost, spawning is done.

Short method of composting: Compost prepared by short method of composting is superior in production quality and the chances of infection and disease is quite low. Composting by this method requires special infrastructures; equipments etc. that initial cost is to high, therefore, the farmers can purchase the readymade compost from the authentic composting units. The compost when ready for spawning should have the following characteristics:

Moisture	About 68%	**Ammonia**	Below 0.006%
pH	7.2-7.5	**Nitrogen**	Around 2.5%
Fire fangs (Actinomycetes)	Excellent growth		

Proper timing for cultivation: Sept. – Nov.& Feb.-April (02 crop)

Cultivated strain: Delta, U-3, S-11, MC-465, A-15

Spawning :The process of mixing of the spawn in the compost is known as spawning. Spawn is thoroughly mixed in the compost at the rate of 600-750 gm per 100 kg of compost (0.6-0.75%). The spawned compost is filled in tray or polypropylene bags covered with formalin treated news papers. In case of bags, they should be folded at the top and covered up. After spawning, temperature and humidity of crop room should be maintained at 22-26^{o}C and 85-90%, respectively for spawn run. Water should be sprayed over the covered news papers, walls and floors of the crop room. After 12-14 days of spawning white mycelial growth is seen running the entire length of the tray/bag. This is then covered with casing soil on the surface.

Casing soil : The significance of casing soil is to maintain the moisture content and exchange of gases within the surface of the compost which helps in the proper growth of the mycelium. The pH of the casing soil should be 7.5-7.8 and must be free from any infection or disease. In our country casing soil is prepared from the following ingredients.

Two years old manure + garden soil	3:1
Two year old manure + garden soil	2:1
Two year old manure + spent compost	1:1
Two year old manure + spent compost	2:1

Pasteurization of casing soil: The casing soil is piled on cemented floor and is treated with 4% formalin solution. Thorough turning of the soil is done and it is covered with polythene sheet for the next 2-3 days. After that remove the polythene cover and turn the casing soil so that it is free from the smell of formalin.

Using the casing soil: A layer of casing soil (3-4cm thick) is being spread uniformly on the compost when the surface has been covered by white mycelium of the fungus. Formalin solution (0.5%) is then being sprayed. Temperature and humidity of the crop room should be maintained at 14-18^{o}C

and 80-85%, respectively. Proper ventilation should be arranged with water being sprayed once or twice a day.

Harvesting of crop: Pin head initiation takes place after 12-18 days of casing and the fruiting bodies of the mushroom can be harvested for around 50-60 days. The crops should be harvested before the gills open as this may decrease its quality and market value.

Productivity: From 100 kg compost prepared by long method of composting 14-18 kg of mushroom can be obtained. Similarly, 18-22 kg mushroom can be obtained from pasteurized compost (Short Method Compost).

2. Oyster mushroom

The species of the genus *Pleurotus* are commonly known as oyster mushroom or dhingri mushroom. This mushroom can be cultivated at a temperature range between 20-28^{o}C and relative humidity between 75-90 per cent.

Steps of cultivation process

Substrate and its preparation

The tropical wastes like rice straw, wheat straw, corncobs, dried water hyacinth, sugarcane bagasse, banana leaves, cotton waste or sawdust are used as substrate for cultivation. The straw should be cut into small pieces (3-5cm long) to facilitate proper wetting as well as to increase surface area. Although this mushroom can be cultivated on simple water soaked straw but there are chances of crop failure due to presence of contaminants. In order to avoid contaminations the straw should be treated by hot water and chemical.

Hot water treatment-The substrate should be is treated with hot water at 65^{o}C for 1 hour. The excess water is then drained off and substrate cool down to room temperature for spawning.

Chemical treatment- The materials are usually soaked in water chemically sterilized with carbendazim (7-10g) and formalin (120-150 ml)/ 100 litre of water for 16-18 hours. After that straw is taken out from solution and spread on clean cemented floor or on polythene sheet to evaporate the excess water. The ready substrate should contains 65-68 per cent moisture.

Proper timing for cultivation March.- May & July.-Sept (02 crop)

Cultivated spices: *P. sajor-caju, P. florida, P. sapidus, P. eryngii, P. cornucopiae, P. flabellatus, P. djmore, P. eous, P. ostreatus*

Spawning and crop management : Oyster mushroom spawn should be about 15-20 days old when mycelium has formed complete coating around the grain. The normal rate of spawning in a pasteurized substrate is 2-3% of the wet substrate. The spawning is usually done by mixing the spawn throughout substrate. Before filling the substrate in polythene bags, holes of about 1 cm diameter are made at 10-15 cm distance all over the surface for free diffusion of gases and heat generated inside. The optimum temperature for growth of mycelium is 23 ±2^{o}C. Relative humidity in growing room should be range between 85-90% during spawn-run. Spawn run usually takes about 15-20 days. After complete spawn run, polythene removed completely with help of sharp knife carefully. Usually 3-4 days after opening the bags, mushroom primordial (pin heads) begin to form. After opening the bags water should be sprayed 2-3 time per day regularly.

Harvesting and yield: Mature mushrooms become ready for harvesting in another 2-3 days. An average biological efficiency (fresh weight of mushrooms harvested divided by dry substrate weight x 100) can range between 70-80% and sometimes even more. To harvest the mushrooms, they are grasped by the stalk and gently twisted and pulled. A knife should not be used.

3. Milky Mushroom

Calocybe indica is commonly known as milky mushroom or dudhiya mushroom due to its milky white appearance of the fruit body. It can be easily cultivated at the temperature range between 25-35^{o}C and relative humidity 70-90 per cent.

Substrate and its preparation

The tropical wastes like chopped paddy straw and wheat straw are used as substrate for cultivation. To avoid contaminations the straw should be treated by hot water and chemical as like oyster

mushroom.

Proper timing for cultivation: May - Aug (01 crop)

Cultivated species: Calocybe indica and Macrocybe gigentium

Spawning and crop management: About 18-20 days old spawn is used for spawning. Spawning should be done @ 4 per cent of ready substrate. The spawning is usually done by mixing the spawn throughout substrate. The spawned substrate should be filled in polythene bags 4-5kg per bag. The bags should be folded at the top and covered up. The optimum temperature for growth of mycelium, ranges between is 20-37^{o}C. Relative humidity in growing room should be range between 80-85% during spawn-run. Spawn run usually takes about 15-20 days.

Casing: This mushroom needs casing for fruit body initiation. After complete spawn run casing is done and its thickness should be kept 2-3 cm is being spread uniformly on the surface of the spawn run substrate. Temperature and humidity of the crop room should be maintained at 25-35^{o}C and 80-85%, respectively. Proper ventilation and adequate light should be maintained and water being sprayed once or twice a day. After 10-12 day of casing fruit primordia (pin head) are formed and within 5-6 days the mature and ready for harvesting.

Harvesting: The fruit bodies should be harvested before spore release by twisting so that stubs are not left on substrate. After harvesting lower portion of stalk with adhering casing soil should be cut with sharp knife. About 70 kg fresh mushroom can be harvested per quintal of dry substrate.

I. Enabling Policies

1.A Existing policies related with agriculture and animal husbandry:

1. Subsidies and incentives are given on all agricultural inputs.
2. More than 50% subsidies are granted on all inputs and implements.

1.B Policies to be suggested for doubling income in the specific agro-ecological region:

1. Selection of crop and area specific crop production program
2. Timely and assured supply of agricultural inputs to farmers at door.
3. Popularization of playhouses technology for vegetables and flower production
4. Inclusion of hybrid seed programme for crop production.
5. Establishment of seed production units for temperate crops.
6. Need to establish more food processing units.
7. Availabilities of credit at minimum interest rate.
8. Assured byback policy for agricultural produce.

2.A Existing Institutions:

1. Directorate of cold water fisheries research farm,
2. KVK,
3. Cow Breeding Centre of State Government,
4. NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district:

1. Establishment of food proceesing units at distt level to procure and marketing of surplus.
2. Testing of new crops in non-traditional areas for doubling the crop production.

3.A Existing Incentives:-

3.B Incentives to be suggested for doubling income in the specific agro-ecological region of district:

1. An assured bonus to farmers to grow new crop or higher production potential
2. Selection of farmers at village for trendsetter for dissemination of technical knowledge and technology may be awarded
3. Free access to library and one institute at least once in a year.

4.A Existing risk coverage facilities: Crop and Animal Insurance Schemes

4.B Risk coverage facilities to be suggested for doubling income in the specific agro-ecological region:

1. Risk coverage may be applicable for all agricultural products and animals
2. Declaration and minimum support price be fixed well in time

J. Marketing and value addition in specific agro-ecological region

1.A Existing marketing facilities:Local market

1.B Marketing facilities to be suggested for doubling income in the specific agro-ecological region:

Contractual farming, linkages with MNCs and NCs, Mahila hat, local hat, weekly bazaar, local mandi, AC van,

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.A Existing grading facilities: Nil

2.B Grading facilities to be suggested for doubling income in the specific agro-ecological region:

Mechanical grading facilities should be made available on cluster basis

2.C Processing facilities to be created for better marketing and value addition in the district:

Grading and packaging facilities, small scale fruit and vegetable processing units

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular commodity
6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

2.D Packing facilities to be created for better marketing and value addition in the district :

No marketing facility, No value addition facility, High transportation cost

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)

4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxesfor particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed
8. Litchi peeling and shredding unit

3. Existing marketing and value addition problems in the specific agro-ecological region:

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo
3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chambers
7. Jaggery storage bin

K. Online Management and Evaluation

1.A: Existing online management structure available: Internet etc.

1.B: Restructuring required for online management and evaluation in specific agro-climatic region of district:

Each village should be connected by Internet facility with proper device, awareness about internet user.

2.A: Existing evaluation procedure: Manual

2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: GPS, Email, What up, ITC tools

3.A: Existing monitoring system: Physical

3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Regular visits and online report submission, farmer feed back

4.A: Existing feedback system: Manually

4.B: Feedback system required for online management and evaluation in specific agro-climatic region of district: Internet and proper software for evaluating ongoing activities

5.A: Existing reading system: Literature, Booklets, Hindi Extension Journals etc

5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Farm advisory portal, online helpdesk services

Specific action plan for doubling agricultural income in agro-ecological region

Strategy 1 : Productivity Enhancement

Introduction, adoption and popularization of high yielding varieties for increasing productivity

1. Promotion of high yielding varieties of wheat (VL *Gehun* 829, VL *Gehun* 892, VL *Gehun* 907, VL *Gehun* 953, HS 507, HPW 349 and UP 2572), paddy (Rainfed- Chatki Dhan- VL Dhan 208, VL Dhan 209, Jethi dhan – Vivek Dhan 154, VL Dhan 157, VL Dhan 156 and VL Dhan 158, Pant

Dhan-19, HKR-127, PB-1509, PA 6444, VNR 2355, Pusa Basmati 1509 & PRH 10, Irrigated VL *Dhan 65,* VL Dhan 86, VL Dhan 68, VL *Dhan 85*); Barley(VL Jau 118 and VLB 94); Amaranthus (VL Chua 44); Buckwheat (VL Ugal 7) in Lohaghat, Barakot, Pati & Hill areas of Champawat blocks.

2. Promotion of high yielding varieties of finger millets (VL *Mandua* 324, VL *Mandua* 352, , PRM1,) and Barnyard millet (PRJ-1, VL *Madira* 172 and VL *Madira* 207) in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
3. Promotion of high yielding variety of lentil (VL *Masoor* 125, VL *Masoor* 126, VL *Masoor* 507, VL Masoor 514), horse gram (VL *Gahat* 10, VL *Gahat* 15 and VL *Gahat* 19), soybean (VLS 47, VL Soya 59, VL Soya 63 and VL Soya 65) and Pigeon pea (VL *Arhar* 1) in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
4. Promotion of high yielding varieties of vegetable pea (Vivek Matar 10, Vivek Matar 11 and Vivek Matar 12), French bean (VL Bauni Bean 1 & VL Bean 2), tomato (VL Tamatar 4), Onion (VL Piaz 3), VL Shimla Mirch 3 and garlic (VL Lehsun 1) in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.

Recommended package and practices will be followed for the above recommended crop varieties

Strengthening of traditional water storage structure

1. Strengthening of existing water storage structures like ponds, Naula and Check dam in most of the villages of all blocks of the region.
2. Creation of rain water harvesting structure in private as well as government buildings in all the villages of the region.
3. Creation of trenches for high percolation of water in most of the area of Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
4. Promotion of water conservation techniques like mulch, sprinkler and drip in juvenile plants in low or valley areas of all the blocks of this region.

Adoption of cluster approach for holistic development

1. Cultivation of citrus fruit (lime/ lemon/ malta) plants at mid hills in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
2. Promotion of ginger cultivation in all *blocks of the region*.
3. Promotion of organic cultivation of turmeric in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
4. Promotion of off season vegetables (tomato, capsicum, cole crops etc.,) cultivation inLohaghat, Barakot, Pati, Hill areas of Champawat blocks.
5. Promotion of production of vegetable pea, okra in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
6. Promotion of production of pigeon pea in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
7. Promotion of production of lentil

Management of wild animal problem

1. Promotion of live fencing of lime/ lemon at larger scale in fruit crops, ginger or turmeric in shady areas, Lemon grass to ward off wildlife in cultivated field.
2. Enacting legislative measures for protection of crop from wild animals.
3. Promotion of protected cultivation of vegetables (Tomato, Capsicum, Cabbage, Cauliflower and Cucumber) in Lohaghat, Barakot, Pati, Hill areas of Champawat blocks.
4. Promotion of cultivation of Kafal, Mango, Hishalu and other wild fruits in different pockets in forest areas for wild animals.

Adoption of Farm mechanisation (Power tiller, thresher etc)

1. Popularization of multi crop thresher and Power Tiller/ Mini Tractor at Nyay Panchayat level in all the blocks.

2. Promotion of improved sickle, maize sheller, Vivek Millet thresher cum pearler, VL Paddy thresher and Vivek small tool kit for reduction in drudgery of hill farmers.

Adoption of efficient irrigation techniques

1. Micro Irrigation (Drip and Sprinkler Irrigation) where water is available,
2. Drip Irrigation in integration with water harvesting structure where irrigation water is not available
3. Green House Cultivation for Vegetables

Management of soil health in low or valley areas

1. Popularization of soil testing in intensive mode and distribution of soil health card to farmers for judicious use of fertilisers.
2. Promotion of vermi composting unit and green manuring in all the villages of this region.
3. Promotion of cultivation of green manuring crops like Sesbania and Sunhemp in different blocks.
4. Organic cultivation of local grain and millets in different blocks.

Others

1. Cluster approach for holistic development.
2. Promotion of timely and local availability of high yielding varieties of all the cereal, pulse, High Value Crops like vegetable, fruits, spices, etc.
3. Cultivation of fodder crops & medicinal plants.
4. Adoption of only well decomposed FYM/ value added compost.
5. Adoption of efficient and timely use of IPM and IDM practices.
6. Compulsion of seed treatment through bio agent/ chemical in the cluster.
7. Promotion of moisture conservation practices.
8. Promotion to focus on timely weed management.

Strategy 2 : Livestock: Goatary, Poultry, Fisheries

1. Promotion of high milk breeds of cows (Shaiwal, Red Sindhi & Jersey), buffaloes (Murrah) and goats (Barbari, Beetal, Sirohi & Jamunapari) in Lohaghat, Barakot, Pati & Champawat blocks.
2. Establishment of Fodder Bank in Lohaghat, Barakot, Pati, Champawatblock to meet fodder requirement of area particularly during lean period.
3. Establishment of mini milk chilling plant at Lohaghat, Barakot, Pati, Champawat blocks.
4. Promotion of Urea, Molasses, and Mineral mixer at blocks lavel
5. Establishment of hatcheries for need of broilor or croilor at district level to meet out the requirement of chicks to the farmer's.
6. Availability of feed material with low prices & Timely health check-ups of animals.
7. Introduction and promotion of Cross bred milch breed of animal for increasing income of marginal farmer.
8. Replacement of Carp in fisheries and croilers dual purpose in mid and high hills etc.

Strategy 3 : Integrating Farming system

Following Integrated farming system model may be developed:

Cropping system (Area 4000m^2)

Rice - Wheat
Maize- Wheat
Horse gram/ Pigeon pea – Lentil
Tomato/ Capsicum – Vegetable Pea
Okra – Potato

Horticulture

Citrus fruits (100 plants)

Livestock

Cow (01)/ Buffalo(01) + Backyard Poultry (100)

Others

Vermi-composting (20m^2)

Fodder production in terrace risers and bunds.

Strategy 4 : Reducing post harvest losses and value addition

1. Establishment of mini fruit grading plant for mango & Litchi stone at *Tanakpur area of Champawat* blocks.
2. Establishment of Food Processing Units for mango & Litchi, mango at*Tanakpur* area *of Champawat* blocks
3. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
4. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in Lohaghat, Barakot, Pati, Champawat blocks.
5. Establishment of Food and Processing Units at *Tanakpur* fo*r* pickle making using wild *Aonla, mango & Jack fruits*.
6. Promotion of common resources on custom hire basis viz. Power tiller, Tractors and other bif agriculture equipments in *Champawar & Vanbasa* areas.
7. Creation of larger facilities of infrastructure for reducing post harvest losses in horticultural commodities viz. Long term storage, warehouses.
8. Development of cottage industries at village level for unfinished products.

Strategy 5 : Waste land development and waste water

1. Contour making for arable purpose in waste land in *Champawat, Jajal, Bastia,* and other high hills areas.
2. Afforestation of plants and perennial grasses in steep slope of more than 40% slope in Lohaghat, Barakot, Pati, Champawatblocks.
3. Plantation of Mulberry plants, Wild fruit plants, Fodder trees (Bheemal, Utees, Oak etc.) may be promoted in Lohaghat, Barakot, Pati, Champawatblocks.
4. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all blocks.
5. Popularization of trenches or silages for percolation of water to avoid surface run off in Lohaghat, Barakot, Pati, Champawatblocks.
6. Construction of check dam and artificial structure to maximize water percolation rate in Lohaghat, Barakot, Pati, Champawat blocks.
7. Construction of tank for storage of water for lean season in all blocks.
8. Establishment of storage system for rain water in monsoon season.
9. Establishment of waste water treatment plants based on phycoremediation technique at sewer drainage points.

Strategy 6 : Reduced cultivation cost

1. Promotion of specific fertilizers and micronutrients like Zink, Boron, Phosphorus, etc. may be provided.
2. Provision of mechanization (Use of Power tillers, Power weeders, Paddy threshers, Wheat threshers, Mandua/ Madira threshers, Maize Sheller, Wheel Hand hoe, Manual/ power operated Wheat/Paddy reapers etc.).
3. Promotion of well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers in Lohaghat, Barakot, Pati, Champawatblocks.
4. Promotion of line sowing and balanced fertilizers application in crops.
5. Promotion of recommended seed rate, spacing and depth.
6. Promotion of need based application of pesticides and other agricultural inputs. `
7. Promotion of hand tools in agricultural and horticultural operations.
8. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
9. Promotion of pressurized irrigation techniques in horticultural crops

Strategy 7 : Off-farm income

1. Promotion of apiculture/ sericulture/ mushroom for small and landless farmers in all blocks of

Champawat district.
2. Promotion of cultivation and collection of medicinal plants in Lohaghat, Barakot, Pati, Champawatblocks.
3. Promotion of skill development in women and youth in all four blocks.
4. Creation of new SHGs in other villages of four blocks.
5. Encouragement to existing SHSs for collective farming, opening small scale enterprise like Candle making, Pickle making, Jam & Jelly making, Spice cultivation, Ghee making & packing, etc. may be provided for better performance in all four blocks.

Strategy 8 : Enabling Policies

1. Land consolidation in Champawat district is essentially required.
2. Policies must be implemented for control of wild animal menace in agricultural areas.
3. Implementation of Soil Health Card Scheme in each block.
4. Increasing institutional support by providing subsidises and incentives to small and marginal farmers in four blocks.
5. Labelling of organic inputs and certification mechanism for various crops in all four blocks.
6. Popularization of Udhyan and KCC for widespread use of government incentives/ subsidies to farmers.
7. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
8. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

Strategy 9 :Marketing and value addition in specific agro-ecological region

1. Installation of mini *mandies* at Block level.
2. Creation of better transportation facilities with cool chain van at Block level.
3. Creation of direct linkages with food processing industries for better prices.
4. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.
5. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.
6. Installation of mini grading machines at village level.
7. Establishment of cold room.
8. Promotion of local *Hatt* at Tahsil level in all blocks.
9. Development of proper marketing network to check the interference of middle men in marketing of agricultural produce of the farmers

Strategy 10 : Online Management and Evaluation

1. Development of Mobile apps/ software for online management and evaluation at district level.
2. Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level.
3. Organization of monthly review meeting at district to solve the problems related with farmers.
4. Promotion of use of radio, TV talks and use of Whatsapp etc. for effective implementation of program

Agro-ecological region: Region C (1500 m-2400m)

A.General information about Agroeco-region
District: Champawat
Agro-ecological region: Region C (1500 m-2400m)
Main Blocks in Region: Pati
Main village cluster in blocks: Devidhura
Irrigated Clusters: -
Rainfed Clusters: Balik, Ramak, Mangal lakh, Garsh lakh, Dharonch
Existing rain water management facilities:
Some cemented tanks and some earthen tank

B. Productivity Enhancement
1. Specific Action / Interventions recommended for harvesting and management of rain water in specific agro-ecological region:

1. Roof water harvesting system
2. Poly tank for water storage for scattered fields

2. Existing practices for soil health improvement:
Use of undecomposed farmyard manure/compost
3. Specific Action / Interventions recommended to improve soil health in specific agro-ecological region:
1. Bio-fertiliser/soluble fertiliser based farming
2. Soil test based fertilizer application
3. Promotion of pulse based crop rotation
4. Integrated fertilizer application
5.Maximum use of value added compost/FYM
4.Existing crop cultivation strategy being adopted under changing climatic condition
No contigencies plan is used by farmers
5.Specific strategy to be adopted for doubling productivity under changing climatic conditions in the agro-ecological region
1. Use fodder crop i.e Oat, Lobia,Barseem, Fodder maize as supplementary crop
2. Organic production of finger millet
3. sowing of horse gram
4. Sowing of radish /leafy vegetables as cash crop
5. Plantation of citrus / pome granate/peach/pear
6. High yielding varieties of wheat
7. Cultivation of off season vegetable

6 A. Name of Field Crop: Wheat
i. Existing varieties being used: Mundaria, Lal Mishri, VL-738, VL-616,dal dakhani
ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:
UP-2572, VL *Gehun* 829, VL *Gehun* 907, VL *Gehun* 953, HS 507, HPW 349 (from 1500 to 1700m amsl), VL Gehun 832 and HPW 155, HS 365 (from 1700 to 2400m amsl)
iii. Existing package of practices being used:
1. Preperation of land- 1 or 2 ploughing with local plough no definit depth
2. Seed rate and seed sowing -150-175 kg/ha, Broad casting
3. Manure and fertilizer- use of un decomposed FYM (rainfed) and un decomposed FYM with small doses of chemical fertiliser by some progreesive farmers (in irrigated conditions)as per availability
iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preperation of land- 2 ploughing + 1 harrowing with mould bold plough upto 10-15 cm
2. Seed rate and seed sowing -100-125kg/ha, line sowing 18-21 cm apart
3. Manure and fertilizer- 10-15 tonne FYM , NPK 100-120:60:40, 50-60:30:20with micronutrients

v. Major insect pests associated with crop:

Army Worm, *Mythimna separata* ,**Wheat Aphid,** *Macrosiphum (Sitobion) avenae*or *Macrosiphum miscanthi,* **Termites,** *Microtermes obesi* and *Odontotermes obesus*

vi. IPM Module for management of insect pests(except organic areas):

Army Worm, *Mythimna separata*

1. Avoid late sowing of crop to save crop from armyworm.
2. Spray in afternoon any of the following insecticides after diluting in 500 litre of water/ha when 4-5 larvae are recorded per meter row:

Monocrotophos 36WSC 1500ml/ha
DDVP 76EC 500ml/ha
Quinalphos 25 EC 1000ml/ha

Aphids (*Macrosiphum (Sitobion) avenae* or *Macrosiphum miscanthi*)

1. Avoid late sowing of crop to save crop from aphid.
2. Conservation and enhancement of biocontrol agents like coccinellid beetles, Chrysopa, syrphid, Apanteles etc. protects the crop against aphid attack.
3. Spray any of the following insecticides after diluting in 500 litre water/ha when more than 5 aphids are recorded per ear head:

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Thiamethoxam 25% WSG	50	21
Quinalphos 25 %EC	1000	

Termites: *Microtermes obesi* and *Odontotermes obesus*)

1. Dismantle termataria (mound) around fields & kill the termite queen.
2. Summer deep ploughing and burning of stubbles/residue of previous crop.
3. Use well rotten cowdung manure/compost to avoid termites.

Name of the Insecticides	(gm/ml) /ha
Thiamethoxam 30% FS (Seed Treatment/Kg)	3.3 per Kg

vii. Major disease associated with crop: Loose smut, Yellow rust

viii. IPM Module for management of disease:

Loose smut: *Ustilago nuda* f.sp. *tritici*

Sticker @ 1 ml per liter of water must be applied along with chemical pesticides to improve the effectiveness of chemical. For control of loose smut seed treatment with fungicide.

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Carbendazim 50% WP (Seed Treatment/Kg)	1.0	2.0
Carboxin 75% WP (Seed Treatment/Kg)	1.5-1.9	2-2.5
Tebuconazole 2% DAS	0.02	1.00
Difenoconazole 3% WS	0.06	2.0

Biofungicides

Name of the Bio-fungicides	g/kg seed or g/lit. water	Treatment

Pseudomonas fluorescens 1.75% WP (In house isolated Strain Accession no. MTCC 5176)	5 g/Kg seed 5 g/lit. water	**Seed Treatment:** Mix the required quantity of seeds with the required quantity of *Pseudomonas fluorescens* 1.75% WP formulations and ensure uniform coating. Shade dry and sow the seeds. **Foliar spray:** Dissolve 5 Kg of *Pseudomonas fluorescens* 1.75% WP in 1000 litres of water and spray.

Yellow rust=stripe rust: *Puccinia striiformis=Puccinia glumarum*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Propiconazole 25% EC	500	30

ix. Major weeds associated with crop: *Anagalis arvensis, Argemone mexicana, Asphodelus tenuifolius Avena fatua, Chenopodium album , Rannanculus ,Phalaris minor*

x. IPM Module for management of weeds(except organic areas):

Red chickweed: *Anagalis arvensis* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Carfentrazone ethyl 40 %DF	50	80
2,4-D Sodium salt Technical (80WP)	625-1000	90
Methabenzthiazuron 70 %WP (POE-30DS)	2000-2500	100
Metsulfuron methyl 20%WP	20	80
Metsulfuron methyl 20% WG	20	76
Triasulfuron 20 %WG	100	81
Pendimethalin 30% EC (Light soil)	3300	
Pendimethalin 30% EC (Medium soil)	4200	
Clodinafop-propargyl 15%+ Metsulfuron methyl 1 %WP	400	100
Mesoulfuron methyl 3+ Iodosulfuron methyl 0.6 %WG	400	96
Sulfosulfuran 75%+Metsulfuron methyl 5%WG	40	110

Mexican prickly poppy: *Argemone mexicana* (annual, dicot, broad leaves, leafy)

2,4-D Sodium salt Technical (80WP)	625-1000	90
MCPA Amine salt 40% WSC	2500	

Onion weed: *Asphodelus tenuifolius* (annual, monocot, narrow leaves, leafy)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	860-1290	
2,4 D ethyl ester 38 %EC	1320-2200	
MCPA Amine salt 40 %WSC	2500	

Common wild oat: *Avena fatua* (annual, monocot, narrow leaves, grass)

Name of the Herbicides	(gm/ml) /ha	Waiting period (days)
Diclofop methyl 28%EC	2500-3500	90

Isoproturon 50% WP	2000	
Isoproturon 75% WPs	1330	60
Methabenzthiazuron 70 %WP (PE: 2DAS)	1500-2000	100
Methabenzthiazuron 70% WP (POE: 16-18 DAS)	1000-1250	100
Triallate 50% EC	2500	150
Clodinafop Propargyl 15%+ Metsulfuron methyl 1% WP	400	100

Bathua/pigweed: *Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Herbicides	**(gm/ml) /ha**	**Waiting period (days)**
Carfentrazone ethyl 40% DF	50	80
2,4 D Dimethyl amine salt 58% SL	860-1290	
2,4 D ethyl ester 38% EC	1320-2200	
Methabenzthiazuron 70 %WP (POE: 30DAS)	2000-2500	100
Methabenzthiazuron 70 %WP (POE: 16-18 DAS)	1000-1250	100
Metribuzin 70% WP (Medium soil)	250	120
Metribuzin 70% WP (Heavy soil)	300	120
Metsulfuron methyl 20%WP	20	80
Metsulfuron methyl 20%WG	20	76
Triasulfuron 20 %WG	100	81
Pendimethalin 30% EC (Light soil)	3300	
Pendimethalin 30% EC (Heavy soil)	4200	
Sulfosulfuran 75% WG	33.3	110
Clodinafop Propargyl 15%+ Metsulfuron methyl 1% WP	400	100
Fenoxaprop-p-ethyl 7.77%+Metribuzin 13.6%EC	1250	110
Mesoulfuron methyl 3%+ Iodosulfuron methyl 0.6 %WG	400	96
Sulfosulfuran 75%+Metsulfuron methyl 5%WG	40	110

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Wheat-Horse gram/Soybean(rainfed), Wheat-Rice(irrigated),
4. Timely Sowing, Seed treatment,Use of HYV
5. FIRB
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storages conditions
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM,
2. Climate changing,
3. Wild animal damages
4. Migration
5. Poor Irrigation facilities
6. SAAR practice(Shifting area practice)

6B. Name of Field Crop: Rice

i. Existing varieties being used: Badpasa, Lal Dhan, Kathuri,Choumadia,Mouknia

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

1. Rainfed- Chatki Dhan-VL 206, 207, 208
2. Jethi dhan –VL 154

iii. Existing package of practices being used:

1. **Preparation of land**- 1 or 2 ploughing with local plough no definit depth, Manual puddling
2. **Seed rate and seed sowing** -100 kg/ha in dirct seeding rice
3. **Manure and fertilizer**- use of un decomposed FYM(1-2.0qt./nali) with small doses of chemical fertiliser by some progressive farmers (in irrigated conditions)as per availability
4. Butachlor used by few farmers in irrigated
5. No IPM practices

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Preparation of land**- 1 -2 ploughing with local plough, puddling
2. **Seed rate and seed sowing** -100-125/ha in direct seeding rice
3. **Manure and fertilizer-** 15 tonne FYM , NPK 100-120:60:40, rainfed 50-60:30:20with micronutrients(Zn, Fe)
4. Use of pre and post emergence herbicide, rainfed-pre-emergence
5. Use of IPM practices

v. Major insect pests associated with crop: Stem borer, Rice leaf folder, gallmidge rice bug,Yellow Stem Borer Plant Hoppers Rice Hispa, Rice Leaf Folder, Rice Bug

vi. IPM Module for management of insect pests:

Stem borer:

1. In the stem borer endemic area raise the nursery away from light source.
2. Raise nursery in narrow strip and mechanically destroy egg masses and moths
3. Remove seedling with Stem borer eggs before transplanting.
4. Use nitrogenous fertilizer moderately and split the application of it over three growth stages to reduce the damage.
5. For the monitoring install the pheromone traps in the field at the rate of 3 trap per acre at a distance of 60 m in a triangular pattern and record the males trapped daily to access the peak population.
6. For the management of yellow stem borer through pheromone mediated mass trapping of male install the pheromone trap in field at the rate of 20 traps/ha in rows maintaining a distance of 20 and 25 meters between traps and rows, respectively. The traps in the first rows are installed 10 m inside from the boundary of the field. The traps are tied on 1.25-1.5m long straight bamboo sticks or poles with the help of jute or plastic strings.The lures containing 3 and 5 mg pheromone are changed after 3 and 4 week, respectively, whereas 10 mg lure work for whole season. Adjust the trap height at 0.5 m and 1.0 m in the early vegetative and reproductive stage of crop, respectively, or 30 cm above crop canopy in all the stages of the crop.To check the escape of trapped males put a tea spoonful insecticidal dust in the polythene sleeve of dry sleeve trap. Dust is not required in funnel type trap. To

Ascertain the quality use lures supplied by 2-3 manufacturers in alternate traps initially and after recording their performance replace the ineffective lures by highly effective lure. Relocate the traps displaced in bad weather and replace the polythene sleeve damaged by weather or animals.

7. Mass rearing and release of some parasitoids such as different species of *Trichogramma* have not been found useful in the rice ecosystems in so many countries including India which are inhabited by *Telenomus* and *Tetrastichus* species. Use of trichocard, therefore, increases the cost of cultivation without any gain. The conservation of *Telenomus* and *Tetrastichus* species is self sufficient to naturally reduce the stem borer population.
8. To increase the effectiveness of parasitoides and predators in the rice field
9. Conserve and enhance the natural enemies which are already present in the field.
10. Create favourable condition for natural enemies.
11. Always leave a pest residue in the field at non-economic level, for natural enemy.
12. Reduce the harmful effect of pesticides on natural enemy by:
    I. Apply insecticide only when necessary, not regularly.
    II. Apply insecticide only when the pest population reaches Economic Threshold Level.
    III. Applying a selective insecticide which is less toxic to natural enemy.
    IV. Apply the minimum doses of insecticide toxic to pest and least toxic to natural enemy.
    V. Use selective formulation and application method.
    VI. Application of granular formulation is less harmful to natural enemy
13. Following insecticides may be used to control stem borers of rice when the population or damage of pest is recorded to 1 moth or 1 egg mass/ m^2 or 5% dead heart :

50 Days within transplating (2 inch water in field)

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 0.4 %GR	10000	53
Fipronil 0.3% GR	16670-25000	32
Cartap 4% Gr	18750	
Carbofuron 3% CG	33300	
Carbosulfon 6% G	16700	37

50 Days after tranplanting

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5 %SC	150	47
Fipronil 5% SC	1000-1500	32
Fipronil 80 %WG	50-62.5	19
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75 %SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20% WG	125	30
Thiacloprid 21.7 %SC	500	30
Acephate 75% SP	666-1000	15
Acephate 95 %SG	592	30
Chromafenozide 80% WP	94-125	32
Monocrotophos 36% SL	1400	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Carbosulfon 25 %EC	800-1000	14

Chlorpyriphos 20% + Acetamiprid 0.4% EC	2500	10
Phosphamidon 40% + Imidachlorpid 2 %SP	600-700	22
Flubendamide 4%+ Buprofezin 20% SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	

Leaf folder:

Following insecticides may be used to control leaf folders of rice

50 Days within transplating (2 inch water in field)

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 0.4% GR	10000	53
Cartap 4% Gr	18750	
Carbosulfon 6% G	16700	37

50 Days after transplating

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Chlorantraniliprole 18.5% SC	150	47
Indoxacarb 15.8 %EC	200	14
Cartap hydrochloride 50 %SP	1000	21
Cartap hydrochloride 75% SG	425-500	35-89
Flubendamide 39.35% SC	50	40
Flubendamide 20 %WG	125	30
Chromafenozide 80% WP	94-125	32
Fipronil 80%WG	50-62.5	30
Acephate 75 %SP	666-1000	15
Acephate 95 %SG	592	30
Monocrotophos 36 %SL	1400	
Dichlorovos 76% EC	627	
Chlorpyriphos 20 %EC	2500	30
Quinalphos 25% EC	2000	40
Quinalphos 25 %EC	1000	40
Flubendamide 4%+ Buprofezin 20 %SC	175+700	30
Flubendamide 3.5%+ Hexaconazole 5 %WG	1000	20

Bio-insecticides

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**

Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 0.03% EC (Neem oil based)	2500-5000	5
Azadirachtin 5% (Neem extract concentrate containing)	375	5
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	1500	
Beauveria bassiana 1.15%WP Strain BB-ICAR-RJP	2500	
Beauveria bassiana 1.15%WP Strain ICAR	2500	

Brown plant hopper: *Nilaparvata lugens*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Buprofezin 25% SC	800	20
Clothianidin 50% WDG	20-24	12
Dinotefuran 20% SG	150-200	10
Flonicamid 50% WG	150	36
Pymetrozin 50% WG	300	19
Imidacloprid 17.8% SL	100-150	40
Imidacloprid 30.5 %SC	60-75	37
Imidaclorpid 70% WG	30-35	7
Acetamiprid 20 %SP	50-100	7
Acephate 75% SP	666-1000	15
Acephate 95 % SG	592	30
Thiamethoxam 25 %WSG	100	14
Monocrotophos 36 %SL	1400	
Fipronil 5 %SC	1000-1500	32
Ethiprole 40%+ Imidacloprid 40% WG	125	15
Chlorpyriphos 20%+ Acetamiprid 0.4%EC	2500	10
Buprofezin 15% + Acephate 35 WP	1250	20
Flubendamide 4%+ Buprofezin 20 SC	175+700	30

Bio- insecticides

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.15% EC (Neem seed kernel based)	2500-5000	5
Azadirachtin 5% (Neem extract concentrate containing)	375	5
Metarhizium anisopliae 1.15% WP	2500	

Rice hispa: *Dicladispa armigera*

Triazophos 20% EC	1250-2500	40
Chlorpyriphos 20 %EC	1250	30
Quinalphos 25 %EC	2000	40

Rice bug: *Leptocorysa acuta*

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Methyl parathion 2% DP	500	25000

vii. Major disease associated with crop: -

viii. IPM Module for management of disease: Seed treatment

ix. Major weeds associated with crop: *Oxalis, Cyperus* sp*, Echinocloa* sp*, Chenopodium album, Commalina bengalensis, Cynodon* sp*, Digitaria sanguinales, , Eclipta* sp, *Eleusine* sp

x. IPM Module for management of weeds:

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Jethirice- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Rice- Wheat /onion/berseem (irrigated),
5. Timely Sowing/Trans planting, Seed treatment,
6. Use of HYV, Hybrid (120-125days), Basmati(120-125days)
7. Contour cultivation and care soil & water conservation measures
8. Maximum use of value added compost/FYM
9. INM and soluble fertiliser
10. Integrated weed management
11. IPM
12. Good storage condition
13. Sale of value added products
14. Avoid early Nursery raising practice and use of 21-30 days old seedling I

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs, use of imbalance and un decomposed FYM, climate changing, Wild animal damages
2. Migration, Poor Irrigation facilities

6C. Name of Field Crop: Finger millet

i. Existing varieties being used: Band muthi (Garhwali Mandau), Khuli muthi (Kumaon Mandau)

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL Mandua 352 upto 2000m amsl and PRM1

iii. Existing package of practices being used:

1. Traditional seed variety,
2. Undecomposed FYM 1.5-2.0qt./nail
3. 1-2 weeding

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 2 or 3ploughing ,
2. Seed rate and seed sowing -14-16kg/ha, Gap filling/Transplanting
3. Manure and fertilizer- -10 tonne FYM , NPK 20:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Stem borer of ragi

vi. IPM Module for management of insect pests : Spray of Fipronil 5 SC @1lt./ha or Chloropyriphos 20 EC @2.5 lt./ha

vii. Major disease associated with crop: Blast

viii. IPM Module for management of disease:

1. Seed treatment with Carbandazim 1 gr./kg seed and 2 spray of carbandazim @0.1% after

50% earhead initiation then second spray after 10 days of first spray
2. Grow resistant variety such as VL 149
3. Seed treatment with carbendazim @ 1g/kg seed followed by 2 sprays of carbendazim @ 0.1% (first when 50 per cent ear heads are formed and second 10 days later)
4. For organic farming seed treatment with Bioagents like *T. Harzianum* @ 10g/kg seed followed by 2 sprays of same @ 10g/litre of water (first when 50 per cent ear heads are formed and second 10 days later).

ix. Major weeds associated with crop: *Oxalis latifolia, Phylanthus niruri , Amaranthus viridis, Euphorbia hirata, Solanum* sp*,Tribulus* sp*, Cyperus* sp

x. IPM Module for management of weeds: First hand weeding after 10 to 20 days of germination broadcast of Isoproturan @0.75 kg/ha

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Finger millet- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Finger millet +Horse gram/Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
5. Timely Sowing, Seed treatment,
6. Use of HYV, Gap filling/Transplanting
7. Contour cultivation and care soil & water conservation measures
8. Maximum use of value added compost/FYM
9. INM and soluble fertiliser
10. Integrated weed management
11. IPM
12. Good storage condition
13. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages
5. Migration
6. Poor Irrigation facilities

6D. Name of Field Crop: Barnyard millet

i. Existing varieties being used: Non described

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: PRJ-1,VL Madira -172

iii. Existing package of practices being used:

1. Traditional seed variety,
2. Un decomposed FYM 1.5-2.0qt./nali
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 2or 3 ploughing,
2. Seed rate and seed sowing -14-16kg/ha, Gap filling
3. Manure and fertilizer- -10 tonne FYM , NPK 20:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence,
6. Use of IPM practices

v. **Major insect pests associated with crop:** Stem borer
vi. **IPM Module for management of insect pests:-**
vii. **Major disease associated with crop:** Blight
viii. **IPM Module for management of disease:-**
ix. **Major weeds associated with crop:** *Oxalis latifolia, Phyllanthus niruri, Amaranthus viridis,Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cyperus* sp
x. **IPM Module for management of weeds(except organic areas): -**
xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:**

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Barnyard millet- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Gap filling
5. Timely Sowing, Seed treatment,
6. Use of HYV, Gap filling/Transplanting
7. Contour cultivation and care soil & water conservation measures
8. Maximum use of value added compost/FYM
9. INM and soluble fertiliser
10. Integrated weed management
11. IPM
12. Good storage condition
13. Sale of value added products

xii. **Production constraints in agro-ecological region:**

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing, Wild animal damages
4. Migration specially from border area
5. Poor Irrigation facilities

7A. Name of the Pulse crop: Horsegram

i. **Existing varieties being used:** Non described-Paharigahat
ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** VLG-8, VL Gahat 10, VL Gahat 15
iii. **Existing package of practices being used:**

1. Traditional seed variety,
2. Un decomposed FYM 1.5-2.0qt./nali
3. 1-2 inter culture

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 20-25kg/ha, spacing 30*10cm
3. Manure and fertilizer- -10 tonne FYM , NPK20:40 :20,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. **Major insect pests associated with crop:** Pulse beetle
vi. **IPM Module for management of insect pests: -**
vii. **Major disease associated with crop:** Root rot
viii. **IPM Module for management of disease: -**
ix. **Major weeds associated with crop:** *Oxalis latifolia, Phyllanthus niruri, Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cyperus* sp

x. IPM Module for management of weeds: -

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Sowing of Baby corn and Sweet corn Shot duration hybrid Varieties ,Seed treatment , HYV, Inter cropping, Gap filling ,Weed Management
2. Organic cultivation,
3. Adoption of low-cost based cultivation practices,
4. Horse gram- Wheat/Lentil/Barley/oat (fodder) (rainfed),
5. Horse gram +Maize + Finger millet - Wheat/Lentil/Barley/oat (fodder) (rainfed),
6. Timely Sowing, Seed treatment,
7. Use of HYV, Gap filling
8. Contour cultivation and care soil & water conservation measures
9. Maximum use of value added compost/FYM
10. INM and soluble fertiliser
11. Integrated weed management
12. IPM
13. Good storage condition
14. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM, climate changing,
3. Wild animal damages
4. Migration
5. Poor Irrigation facilities

7B. Name of the Pulse crop: Lentil

i. Existing varieties being used: Chota masur , lal masur

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: PL-4, PL-5

iii. Existing package of practices being used:

1. Traditional seed variety,
2. Un decomposed FYM 1.5-2.0qt./nali
3. 1-2 inter culture

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing – 20-25kg/ha, spacing 30*10cm
3. Manure and fertilizer- -10 tonne FYM , NPK20:40 :20,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rainfed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop:

Mustard Aphid, *Lipaphis erysimi*, Mustard Saw Fly, *Athalia lugens proxima,* Painted Bug, *Bagrada cruciferarum,* Groundnut Aphid, *Aphis craccivora,* White Grub, *Holotrichia consanguinea*, Castor Capsule, Castor Hairy Caterpillar, *Euproctis lunata*, Til Leaf and Pod Caterpillar, *Antigastra catalaunalis*, Sesame Gall-fly, Asphondylia sesami , Linseed Gall-midge, Dasyneura lini, Soybean Stem Fly, *Melanagromyza sojae,* Bihar Hairy Caterpillar , Spilarctia

vi. IPM Module for management of insect pests:

Mustard Aphid, *Lipaphis erysimi*

Management:

1. Sow tolerant varieties of B.juncea such as T6342, B85, RW-29-2.
2. As the cold and cloudy weather favours the pest multiplication, sowing the crop earlier than the
3. normal sowing time escape the pest attack.
4. Removal of affected/ infected branches.
5. Conserve natural predators such as Coccinelid beetles and Syrphid flies
6. Spraying of crop with any of the following insecticides after diluting in 600-1000 litre of water when
7. 30% plants are infested or 5-10 aphids are recorded per twig
8. Thiamethoxam 25 WSG @ 50-100 g/ha
9. Methyl-o-dematon 25 EC @ 1000 ml/ha
10. Dimethoate 30EC @ 660 ml/ha
11. Repeat the spray at 15 days interval if required.
12. pray Malathion 50 EC@ 500ml/ha if used as fodder.
13. Spray in after noon to avoid pollinators.

Mustard Saw Fly, *Athalia lugens proxima*

Management:

1. Malathion 50 EC@ 500ml/ha
2. Dimethoate 30 EC @ 660 ml/ha
3. Quinalphos 25 EC @ 1200 ml/ha

Painted Bug, *Bagrada cruciferarum*

Management:

Dichlorvos 76 EC @ 627 ml/ha

Malathion 50 EC @ 500ml/ha controls both nymphs and adults.

Groundnut Aphid, *Aphis craccivora*

Management:

1. Cultivate varieties with dense hairs and stiff leaves
2. Conserve natural predators such as Coccinelid beetles and Syrphid flies
3. Spray any of the following insecticides
4. Imidacloprid 17.8 SL @ 125 ml/ha
5. Methyl-o-dematon 25 EC @ 1000 ml/ha
6. Chlorpyrifos 20 EC @ 1000 ml/ha

White Grub, *Holotrichia consanguinea*

Management:

1. Plough the fields twice during May-June. It would help in exposing the beetles resting in the soil.
2. Treat the seed before sowing with 12.5 ml of Chlorpyriphos 20 EC per kg kernels. For treating the
3. seed, make a thin layer of kernels on tarpaulin or floor and spray the insecticide with the help of a
4. Sprayer. Mix it properly and allow to dry.The seed can further be treated with the recommended
5. Fungicides.

   Sow the crop early i.e. between 10-20 June wherever possible.

   Apply Fipronil 0.3 G@ 25kg/ha or Carbofuran 3G @ 33kg/ha in the soil at or

Castor Capsule Borer, *Dichocrocis punctijeralis* Management

Spray Monocrotophos 36WSL@1000ml or Quinalphos
25EC@ 1500ml/ha

Castor Hairy Caterpillar, *Euproctis lunata*

Management : Spray Monocrotophos 36WSL@1000ml or Quinalphos 25EC@ 1500ml/ha

Til Leaf and Pod Caterpillar, *Antigastra catalaunalis*

Management :

Spray Monocrotophos 36WSL@1000ml or Quinalphos 25EC@ 1500ml/ha

Sesame Gall-fly, *Asphondylia sesami*

Management:

Spray Monocrotophos 36WSL@1000ml or Quinalphos 25EC@ 1500ml/ha

Linseed Gall-midge, *Dasyneura lini*

Management

1. The adult flies can be killed by using light traps.
2. The flies are also attracted in day-time to molasses or gur added to water.
3. As the incidence of this pest is more on the late-sown crop as compared with the normal-sown
4. crop, the practice of normal-sown crops should be adopted if possible,
5. Spray Monocrotophos 36WSL@1000ml or Quinalphos 25EC@ 1500ml/ha

Soybean Stem Fly, *Melanagromyza sojae*

Management

1. Various cultural practices such as ridging of young plants, planting after green manure crop, crop rotation, fertilization and mulching with rice straw enhance plant growth and induce tolerance to bean fly damage.
2. Avoid late plantings since infestations of bean fly are heavier.
3. The critical period is the first three to four weeks after germination.
4. Weekly spraying of monocrotophos or dimethoate during the first four weeks is effective against stem fly.
5. Carbofuran or carbosulfan can be coated on seeds before sowing. Such treatment protects plants against bean flies for two to three weeks.
6. One or two additional sprays of one of the three insecticides mentioned above may be necessary to further protect the crop.

Bihar Hairy Caterpillar , *Spilarctia* (=*Diacrisia, Spilosoma*)

Management

1. Mechanical destruction of egg masses and early instarlarvae which feed gregariously.
2. Spray with
   Emamectin Benzoate 5 SG 250ml/ha
   Lufenuron 5EC 800ml/ha
   Triazophos 40EC 750ml/ha
   Monocrotophos 36 WSC 1250 ml/ha.

vii. Major disease associated with crop: Wilt

viii. IPM Module for management of disease:

Seed Treatment with Trichoderma,Fortification of FYM with trichoderma

ix. Major weeds associated with crop: Grassy and non grassy weeds, broad leaf weeds

x. IPM Module for management of weeds:

1. Weeding within 40-50 DAS.
2. Foliar spray of Pendimitheline after sowing

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Horse gram/Soybean- Lentil (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV,
6. Contour cultivation and care soil & water conservation measures

7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs
2. Use of imbalance and un decomposed FYM
3. Climate changing
4. Wild animal damages
5. Migration
6. Poor Irrigation facilities
7. Water scarcity
8. Wild animals
9. Lack of mechanization
10. Lack of rain water harvesting structures

7C. Name of Pulse/oilseed Crop: Soyabean

i. Existing varieties being used: Kala bhatt(Oval), Local yellow

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: VL S-56, VLS-47, PS-1092 , VLS-63

iii. Existing package of practices being used:

1. Traditional seed variety,
2. Undecomposed FYM 1.0-2.0qt./nali.
3. 1-2 manual weeding.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Preparation of land- 1 or 2 ploughing ,
2. Seed rate and seed sowing -100-125/ha,
3. Manure and fertilizer- -10 tonne FYM , NPK 20-80:40,
4. Irrigation-usually maximum area is rain fed
5. Use of pre and post emergence herbicide(As per moisture availability), rain-fed- pre emergence, Use of IPM practices

v. Major insect pests associated with crop: Semi lopper, Hairy caterpillar, Whitefly, Girdle beetle, defoliators, jassid, stem fly etc.

vi. IPM Module for management of insect pests:

Cultural practices: The cultural practices make the environment less favorable for the pests and more favorable for its natural enemies. The following are cultural practices recommended for the management of soybean insect pests.

1. Removal and destruction of infected stubbles followed by deep summer ploughing destroys the pupae of stem fly, girdle beetle, pod borer and tobacco caterpillar present in the soil.
2. Optimal fertilizer dose of NPK and S @ 20:60-80: 30-40:20 kg/ ha should be applied.
3. Application of excessive dose of nitrogen fertilizer causes the infestation of all insect pests on soybean.
4. Crop rotation with non-leguminous plants is recommended for the management of leaf miner.
5. Intercropping of soybean with either asafetida (*Ferula assafoetida* L.) or maize or sorghum in the sequence of 4 rows of soybean with 2 rows of intercrop should be practiced. These intercrops help in conservation of biocontrol agents, like coccinellid beetles, Chrysoperla

etc. In girdle beetle and semilooper endemic areas, intercropping with maize or sorghum should be avoided.

6. Planting of trap crops like castor for tobacco caterpillar, groundnut for leaf miner, marigold for pod borer and Dhaincha (*Sesbania sesban*) for girdle beetle.
7. Selection of insect resistant or tolerant varieties for cultivation.

Table1: Resistant or tolerant varieties for insect pests of soybean.

Insect pest	Resistant or tolerant variety
Stem fly	Dsb 25, Himso 1685, JS 20-89, MACS 1370, MACS 1410, NRC 97, JS 20-53,PS 1543, SL 983, Dsb 23-2
Girdle beetle	MACS 1410, Dsb 23-2, Himso 1685, JS 20-89, KDS 726
Defoliators	Dsb 23-2, KDS 726, PS 1543, PS 1569
Pod borer	Dsb 25, SL 683, NRC 97, MACS 1370, JS 20-89
Leaf miner	MACS 1370, Himso 1685, MACS 1370, MACS 1410
Pest complex	DS 2708, Dsb 23-2, Dsb 25, Himso 1685, JS 20-53, JS 20-79, JS 20-89, KDS 726, MACS 1370, MACS 1410, NRC 97, SL 983, PS 1543

Mechanical Control: Reduction of insect pest population by means of manual devices or labour is called mechanical control. The following measures are recommended for mechanical practices for soybean insect pests.

1. Collection and destruction of girdle beetle infested plant parts, egg masses and gregariously feeding larvae of Bihar hairy caterpillar and tobacco caterpillar.
2. Hand picking and mechanical destruction of matured pod borer larvae.
3. Erection of bird perches @ 10-12/ha to attract predatory birds for preying on defoliator larvae.

Physical control: Reduction of pest population by using device which affect them physically or alter their physical environment. Manipulation of temperature, humidity, light is used for this purpose. This includes the following:

1. Light traps should be placed at ground level early in the season for collection and destruction of the leafminer moths.
2. Installation of light traps in the field for monitoring and collection of adult moths.

Biological Control: The successful management of a pest by means of another living organism (parasitoids, predators and pathogens) is called biological control. The following biological control agents are used in IPM of soybean.

1. Release of *Tricogramma chilonis* @ 50,000/ ha four times at weekly interval against *S. litura*.
2. Spraying of *Bacillus thuringiensis* var. kurstaki @ 0.75 to 1.0 kg/ha for the management of defoliators.
3. Foliar application of HaNPV (*Helicoverpa armigera* Nuclear Polyhedrosis Virus) for *H. armigera* @ 250 LE/ha.
4. The major predators of soybean insect pests are given in the table 2.

Table 2: Major predators of insect pests of soybean

Insect pests attacked	Predator
Whiteflies	Lady bird beetles: *Coccinella septumpunctata* *Coccinella transversalis*
Lepidopterous caterpillars	Pentatomid bug *Eocanthecona furcellata*
Lepidopterous caterpillars and Whiteflies	Spiders: *Lynx* spider and Orb weaver spider

Chemical Control: The control of insects with pesticides/insecticides is known is chemical

control. The insecticides are applied only when the population of insect pests crossed the Economic Threshold Level (ETL) (Table 3). The list of insecticides recommended for soybean insect pests are given in table 4.

Table 3: Economic Threshold Level (ETL) of soybean insect pests

Insect Pest	Crop stage	Population/ meter
Green semilooper	Flowering	2 larvae
Tobacco caterpillar	Flowering	4 larvae
Girdle beetle	Flowering	10 % infestation
Pod borer	Podding	3 larvae

Table 4: List of insecticides recommended for soybean insect pests

Insect pest	Insecticide	Dosage
Sucking pests, stem fly	Thiamethoxam 30 FS (Seed treatment)	10ml/kg seed
Sucking pests	Acetamiprid 20 SP	100 ml/ha
Sucking pests	Spiromesifen 22.9 SC	600ml/ha
Sucking pests	Imidacloprid 17.8 SL	500 ml//ha
Sucking pests and girdle beetle	Triazophos 40 EC	800ml/ha
Defoliators	Dichlorovos 76EC	500 ml/ha
Defoliators and pod borer	Quinalphos 25 EC	1500 ml/ha
Sucking pests and defoliators	Monocrotophos 36 SL	800 ml/ha
Pod borer	Indoxacarb 15.8EC	333 ml/ha
Defoliators, stem fly and girdle beetle	Chlorantraniliprole 18.5 SC	150 ml/ha
Leaf miner	Carbaryl 50WP	2.0 kg/ha
Leaf miner and sucking pests	Oxydemeton methyl 25EC	350 ml/ha
Girdle beetle	Phorate 10 G	10 kg/ha
Stemfly and girdle beetle	Carbofuran 3 G	30 kg/ha

Bio-insecticides

Tobacco caterpillar (*Spodoptera litura*)

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750	

***Hairy caterpillar* (*Spilosoma obliqua*)**

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750	

Semilooper (*Chrysodeixis acuta*)

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750	

Soyabean leaf miner (*Odontota horni*)

Name of the Bio-insecticides	(gm/ml) /ha	Waiting period (days)
Bacillus thuringiensis var. kurstaki Serotype H-3a,3b, Strain Z-52	750	

vii. Major disease associated with crop: YMV, leaf spot, blight, Collar rot, rust

viii. IPM Module for management of disease:

Rust: *Phakopsora pachyrhizi*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Hexaconazole 5% SC	500	30
Propiconazole 25% EC	500	26

Collar rot: *Sclerotium rolfsii*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Carboxin 37.5%+ Thiram 37.5% DAS	3.0/Kg	Seed Treatment

ix. Major weeds associated with crop : *Oxalis latifolia, Phyllanthus niruri ,Amaranthus viridis, Euphorbia hirata, Solanum* sp., *Tribulus* sp*, Cypurus* sp

x. Production constraints in agro-ecological region:

1. Apply Trifluralin 48%EC @ 1.0 kg a.i/ha as pre plant incorporation.
2. Apply Alachlor 50%EC @ 2-2.5 kg a.i/ha or Pendimethalin 30%EC @ 0.75-1.0 kg a.i/ha or Pendimethalin 30% EC + Imazethapyr 2% EC @ 0.75+0.05 kg a.i/ha or Metribuzin 70%WP @ 0.35-0.525 kg a.i/ha or Diclosulam 84% WDG @ 22-26 g a.i/ha within 3 days after sowing.
3. Apply Quizalofop- ethyl 5%EC @ 0.0375-0.05 kg a.i/ha or Fenoxaprop-p-ethy l 9.3% EC 0.1 kg a.i/ha or Haloxyfop 10.5% EC 108-135 g a.i/ha at 20-25 days after sowing to control grassy weeds.
4. Apply Imazethapyr 10%SL @ 0.1 kg a.i/ha or Imazamox 35%+ Imazethapyr 35% @ 0.07 kg a.i/ha at 20-25 days after sowing to control grassy and non grassy weeds.
5. Apply any pre emergence herbicide followed by one hand weeding at 30-35 days after sowing.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Organic cultivation,
2. Adoption of low-cost based cultivation practices,
3. Soybean- Wheat/Lentil/Barley/oat (fodder) (rainfed),
4. Timely Sowing, Seed treatment,
5. Use of HYV,
6. Contour cultivation and care soil & water conservation measures
7. Maximum use of value added compost/FYM
8. INM and soluble fertiliser
9. Integrated weed management
10. IPM
11. Good storage condition
12. Sale of value added products

xii. Production constraints in agro-ecological region:

1. Less availability of agriculture inputs,
2. Use of imbalance and un decomposed FYM,
3. Climate changing,
4. Wild animal damages
5. Migration,

6. Poor Irrigation facilities

8A. Name of Fruit crop: Apple

i. **Existing varieties being used:** Royal Delicious, Red Delicious, Red Chief, Walspur, Oregoen spur, Red spur, Rymer, Sweet Banana, Kings Orange Pippins etc

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** Need to introduce low chill or colour mutants and spur varieties suitable for different agro ecological situations viz. Early Red one, Washington spur Pink Lady, Oregon spur, Super chief and other new stains.

iii. **Existing package of practices being used:**

1. Use of old and traditional varieties
2. Less use of pollinizer cultivars
3. Use of high density plantation system without irrigation
4. Less or no use of mulch for water conservation
5. High incidence of wooly aphis
6. Use of organic manures
7. High stem and barky cankers
8. No use of IPM
9. No Grading or packing system or facilities
10. No facilities for under sized or cull fruits

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:** Use of low chill cultivars like Red Velox, Washimgton spur, Pink Lady, Super chief, Red spur, walspur with suitable pollizers arrangement for apple.

v. **Major insect pests associated with crop:** Wooly aphis is a serious problem San Jose Scale, Woolly Apple Aphid, Tent Caterpillar, Codling Moth/ Fruit borer.

vi. **IPM Module for management of insect pests :**

San Jose Scale:

1. Collection and destruction of infected pruned material.
2. Adult emergence monitoring with special sex pheromone
3. TrapsParasite, Encarsia perniciasi with Aphytis diaspidis may give upto 86.5 per cent parasitism.
4. Conserve Coccinellid predators,Chilocorus bijugus Mulsant,Chilocorus rubidus Hope Pharoscymnus flexibilies Mulsant
5. Spray trees with Thiamethoxam (0.05%) or melathion (0.05%) or oxy demeton methyl (0.07%) and use Imidacloprid (0.007%) or Chlorpyriphos (0.05%) or around tree basin

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Malathion 50% EC	0.05%	1500-2000
Oxydemetonmethyl 25% EC	0.07%	4200-5600

Tent Caterpillar:

1. Pruning and burning of twigs containing egg mass (Dec-Jan).
2. Mopping up the tent with pole and some rags dipped in kerosene tied on its end (at 12.00-3.00 pm).
3. Ues parasitoid Tachnid fly, virus also causes diseases to caterpillar.
4. Spraying with melathion @ 2ml/l or Carbaryl 50 WP @ 2 Kg per 500 lit of water per hac.
5. Spray 0.05% nimbecidine or B.t. based Halt 0.02%.

Codling Moth/ Fruit borer:

1. Thorough clean up of orchard.
2. Scrapping lose bark from old trees.
3. Collection and destruction of fallen fruits.
4. Mating disruption dispenser, moth pheromone trap can be used
5. Birds; Parus major and Passer domesticus prey upon overwintering larvae.

6. Predators, such as ground beetles (Carabidae), ants and crickets, and parasitic wasps, attack larvae as they leave fruit and crawl towards tree trunks
7. Spray of Carpovirusine (GV of moth) at fortnightly interval.
8. Release of Trichogramma embryophagum within the first appearance of moth and subsequent release at weekly interval.
9. Spraying (before caterpillar enter into fruit), monocrotophos @ 2ml/l or quinolphos @ 2ml/l or 2.0 kg carbaryl 50 WP in 500 l of water/ha.
10. In case of high abundance, tree should be banded with chemically treated bands.

Apple wolly aphid: *Eriosoma lanigerum*

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Phorate 10% CG (per tree)	10-15	100-150
Carbosulfon CG (per tree)	5	166
Chlorpyriphos 20% EC	0.05%	3750-5000
Oxydemetonmethyl 25% EC	0.025%	1500-2000
Quinalphos 25% EC	0.05%	3000-4000

vii. Major disease associated with crop: Stem and barky canker is a serious problem

viii. IPM Module for management of disease:-

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: Use of high yielding cultivars with and suitable placement of pollinizer in high density planations with sufficient irrigation facility as drip for establishment of model and commercial orchards.

xii. Production constraints in agro-ecological region:

1. Availability of elite planting material
2. Lack of technical knowhow in apple cultivation

8B. Name of fruit Crop: Peach

i. Existing varieties being used: Paradelux, July Elberta, Red June

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:
Alxander, Red Globe, Crest heaven, Glo Heaven etc
Nectarine- Snow Queen

iii. Existing package of practices being used:

1. Use of old and traditional Varieties
2. Poor knowledge of canopy management practices
3. Organic inputs for crop production
4. No knowledge of high density orcharding
5. Irrigation facilities are rarely used
6. Lack of grading and packing facilities
7. No canning or processing unit
8. No availability of waste management of crop residue

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Need to introduce non-clingstone varieties with maturity indices on or before June.
2. Use of High density plantation with mulch and supplementation of drip irrigation.

v. Major insect pests associated with crop: Leaf curl aphid, Peach Fruit Fly.

vi. IPM Module for management of insect pests :

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause

succulent tissue that is very susceptible to infection.

3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Carbosulfan 3% CG	1000	33300
Oxydemetonmethyl 25% EC	0.025%	1500-2000

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Bury the infested fruits at 60 cm deep in the soil.
4. Use Methyl eugenol trap
5. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting

vii. Major disease associated with crop: Gummosis is major problem

viii. IPM Module for management of disease:

1. Use of proper cultural or field operation with minimum damage to the crop
2. Use of antibiotic as prophylatic spray.

Name of the Fungicides	(gm/ml) /ha
Lime sulphur 22% SC	1%

ix. Major weeds associated with crop: Nothing special

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: High density plantation with (3x3mts) supplemented with drip irrigation system.

xii. Production constraints in agro-ecological region:

1. Availability of Quality planting material
2. Need to delineate the table and canning type varieties.

8C. Name of the fruit crop: Plum

i. Existing varieties being used: Santa rosa, Beauty, Burbank

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Italian plum, Prunes viz Frontier, for mid and high hills.

iii. Existing package of practices being used:

1. Use of old and traditional varieties
2. Less or no use of pollinizer varieties in plum especially in Japanese type varieties
3. Less or no use of mulch for water conservation
4. Canopy management is poor
5. Recommended cultural practices are rarely applied
6. Maturity indices are rarely use
7. Processing industries are not established for plum.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region: High density plantation with drip irrigation system.

v. Major insect pests associated with crop: San Jose Scale, Woolly Apple Aphid, Codling Moth/ Fruit borer,Tent Caterpillar, Peach Leaf Curl Aphid,Peach Fruit Fly

vi. IPM Module for management of insect pests :

San Jose Scale:

1. Collection and destruction of infected pruned material.

2. Adult emergence monitoring with special sex pheromone
3. TrapsParasite, *Encarsia perniciasi* with *Aphytis diaspidis* may give upto 86.5 per cent parasitism.
4. Conserve Coccinellid predators,*Chilocorus bijugus* Mulsant,*Chilocorus rubidus* Hope *Pharoscymnus flexibilies* Mulsant
5. Spray trees with Thiamethoxam (0.05%) or melathion (0.05%) or oxy demeton methyl (0.07%) and use Imidacloprid (0.007%) or Chlorpyriphos (0.05%) or around tree basin.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Malathion 50% EC	0.05%	1500-2000
Oxydemetonmethyl 25% EC	0.07%	4200-5600

Woolly Apple Aphid:

1. Aphids usually spread through infested stocks, avoid planting infested stocks.
2. Use of resistant stocks Golden Delicius, Northern Spy and Morton Stocks 778, 779, 789 and 793.*Parasitoid, Aphelinus mali*
3. Conserve and utilize Predators *Coccinella septempunctata* ,*Chrysoperla carnea* , *Menochilus sexmaculus* ,*Syrphus confactor*
4. Treat nursery plant with chlorpyriphos or fenitrothion 0.05% or carbofuron (5ml/tree) or phorate10% (10-15g/tree)
5. For root forms: Methyl oxydemeton 25 EC in 500 lt of water/ha during winter.
6. Spray tree with thiamethoxam (0.05%) or quinolphos (0.05%).
7. Root fumigation: Paradichlorobenzene granules in 15 cm deep trench dug around infested tree.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Phorate 10% CG (per tree)	10-15	100-150
Carbosulfon CG (per tree)	5	166
Chlorpyriphos 20% EC	0.05%	3750-5000
Oxydemetonmethyl 25% EC	0.025%	1500-2000
Quinalphos 25% EC	0.05%	3000-4000

Tent Caterpillar:

1. Pruning and burning of twigs containing egg mass (Dec-Jan).
2. Mopping up the tent with pole and some rags dipped in kerosene tied on its end (at 12.00-3.00 pm).
3. Ues parasitoid Tachnid fly, virus also causes diseases to caterpillar.
4. Spraying with melathion @ 2ml/l or Carbaryl 50 WP @ 2 Kg per 500 lit of water per hac.
5. Spray 0.05% nimbecidine or *B.t.* based Halt 0.02%.

Codling Moth/ Fruit borer:

1. Thorough clean up of orchard.
2. Scrapping lose bark from old trees.
3. Collection and destruction of fallen fruits.
4. Mating disruption dispenser, moth pheromone trap can be used
5. Birds; *Parus major* and *Passer domesticus* prey upon overwintering larvae.
6. Predators, such as ground beetles (Carabidae), ants and crickets, and parasitic wasps, attack larvae as they leave fruit and crawl towards tree trunks
7. Spray of Carpovirusine (GV of moth) at fortnightly interval.
8. Release of *Trichogramma embryophagum* within the first appearance of moth and subsequent release at weekly interval.
9. Spraying (before caterpillar enter into fruit), monocrotophos @ 2ml/l or quinolphos @ 2ml/l or 2.0 kg carbaryl 50 WP in 500 l of water/ha.
10. In case of high abundance, tree should be banded with chemically treated bands

Peach Leaf Curl Aphid:

1. Keep plant healthy — avoid excess fertilization.
2. A healthy plant can better withstand the loss of leaves, but excess fertilization can cause succulent tissue that is very susceptible to infection.
3. Monitoring should be done during spring
4. Removal and destruction of alternate host
5. Biological controlling agent like *Coccinella sp.* Green lacewing larvae *(Chrysoperla carnea) Aphelinus matricarinae*.
6. Inspect fruit and foliage for honeydew secretion
7. Two sprays at pre bloom and post bloom stage at 10 days interval with Imidacloprid @ 0.5ml/lit Or Dimethoate (0.03%) or Thiometon (0.25%) or oxydemeton- methyl (0.025%)

Peach Fruit Fly:

1. Use early maturing varities like 16-33 and Flordasum, Shan-e -Punjab, Pratap.
2. Hoe the orchard (May- June) 4-6 cm deep.
3. Use Methyl eugenol trap
4. Use Bait spray with yeast hydrolyate-250g, crude sugar, 2.5 kg Malathion 50EC – 250ml in 250 l of water and spraying two weeks before harvesting.
5. Bury the infested fruits at 60 cm deep in the soil

vii. Major disease associated with crop:-

viii. IPM Module for management of disease:-

ix. Major weeds associated with crop:-

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. High density plantation (3x3 mts) with drip irrigation
2. Intercropping of soybean or gahat or lentil in rabi season
3. Mulch technology
4. Post harvest management of perishable with refrigeration system and development of fruit wines factories in the state.

xii. Production constraints in agro-ecological region:

1. Non-availability of reliable and elite planting material
2. Poor technical knowledge

9A. Name of the Vegetable crop: Cabbage

i. Existing varieties being used: Pride of India, Golden acre as open pollinated varieties and Varun, Pragati as hybrid varieties

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: All hybrid varieties. Seeds are available in Multinational companies. T-621, Pragati, Indica,, Pusa Mukta , Sri Ganesh Gole

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
7. Cultivars-In cabbage, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be head formation.
8. Transplanting- Farmers practices improper planting distance.
9. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.

10. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
12. Harvesting- The harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should test their soils before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to go for deep ploughing before sowing the crop particularly during the hot season or before the snowfall
3. Seed- Farmers should adopt improved varieties/ hybrids
4. Soil solarisation practice should follow in nursery beds
5. Seed Treatment- To combat the different seed borne diseases to treat the seed by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or T*richoderma viride* 4g/kg before sowing
6. Seed Rate- It is recommended to use the seed quantity for different as follows-
   (Early)-600-700g/ ha open pollinated
   (Mid and Late)- 500-550g/ha open pollinated
   (Hybrid)-350-400g/ha
7. Optimum sowing time -June, July (Rainfed)
8. Transplanting- Farmers should transplant seedlings properly as for early (40x45cm), medium (40x45cm),
9. Manures and fertilizers- Farmers should incorporate well rotten cow dung (20-25tonnes/ha) and NPK (120:60:60) in irrigated, half dose of NPK in unirrigated condition.
10. Irrigation- As per requirements. At critical stages such as head initiation and head development
11. Weed control- Farmers must know about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically.
12. Harvesting- The farmer must aware about the maturity stage of a particular crop variety so he can harvest the crop as per their object. In general the heads should be harvested when they attempt the size in between 500-750 gms.

v. Major insect pests associated with crop: Butterflies , Aphids, *Plutell*a and Painted bugs

vi. IPM Module for management of insect pests :

Diamond black moth- plantation of mustard crop as trap crop at margins of cabbage field to attract the adults for egg laying,spray of *Bacillus thurengnsis* @ 1.0 kg /ha or
Cabbage butterfly - mechanically destroy the cluster of eggs,*Helicoverpa* - release of *Tricogramma* spp insect eggs @ 50000 / ha at the time of initation of flowering to 7- 10 days,

Before Planting

4. Deep ploughing in the month of summer to expose immature stages.
5. Hand picking and destruction of cabbage butterflyeggs and larvae in nursery as well as main crop to reduce the pest multiplication.
6. Growing of African bold seeded mustard as trap crop at 22:2 ratio (Cabbage: Mustard) to attract DBM for oviposition at least 10 days ahead of planting of main crop may reduce the infestation.

After Planting

5. Regular Monitoring of the plants randomly for the presence of pests on both the leaf surface as well as between the leaves.
6. Hand picking and destruction of leaf webber and egg masses and early instar larvae to

reduce further multiplication of pests in the field.

7. Hook out the head borer and destroy mechanically. Spray Neem seed powder extract 4% @ every 10 days interval starting from 30 days after planting (DAT) and alternate spray with Neem cake (5%) to keep the pest in check.
8. Spray Neem soap 1% to manage the sucking pests at 10 days interval from 30 to 90 DAT.

Dimond back moth: *Plutella Xyllostella*

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 18.5% SC	50	3
Cyantraniliprole 10.26% OD	600	5
Indoxacarb 14.5% SC	200-266	7
Indoxacarb 15.8% EC	266	5
Spinosad 2.5% SC	600-700	3
Chhlorfenapyr 10% SC	750-1000	7
Emamectin benzoate 5% SG	150-200	3
Flubendamide 480% SC	45-60	7
Flubendamide 20% WG	90-120	7
Chlofluazuron 5.4% EC	1500	7
Diafenthiuron 50% WP	600	7
Lufenuron 5.4% EC	600	14
Novaluron 10% EC	750	5
Metaflumizone 22% SC	750-1000	3
Tolefenpyrad 15% EC	1000	5
Thiodicarb 75% WP	1000-1330	7
Fipronil 5% SC	800-1000	7
Cypermethrin 10% EC	650-760	7

Bioinsecticides

Name of the Bio-Insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7
Bacillus thuringiensis var. galleriae 1593 M sero type H 59 5b, 1.3% FC	600-1000	
Bacillus thuringiensis serovar kurstaki (3a,3b,3c) 5% WP	500-1000	
Bacillus thuringiensis serovar kurstaki serotype 3a,3b, SA II WG	500	

Cabbage/cauliflower Aphid

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7
Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Bio-Insecticides	(gm/ml) /ha	Waiting period (days)
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

Painted bug

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Dimethoate 30% EC	200	660

vii. Major disease associated with crop: Black rot

viii. IPM Module for management of disease:-

ix. Major weeds associated with crop:-

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region: Use of hybrid varieties suitable for year round production system for mid or high hills.

xii. Production constraints in agro-ecological region:

1. Less heading in open pollinated cabbage
2. Boron deficiency is becoming serious.
3. Less availability of high quality seeds
4. High prices of hybrid seeds
5. Post-harvest losses are more due to non availability of
6. storage facility
7. High prices of fertilizers
8. Low prices of farm produce
9. Lack of knowledge about the cultivation practices
10. Lack of processing facilities
11. So far no minimum support price is fixed for the crop.

9B. Name of the Vegetable crop: Cauliflower

i. Existing varieties being used: Pusa Snowball 16, PSB-35 as open pollinated. Snow Queen and Snow King, Sweta and late group hybrids.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: A large number of hybrids are used in the distt. There is no specific hybrid available for farmers in the state (Rainfed or partially irrigated)

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil.
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed – Most of the farmers are in practices to use the local low yielding seed materials.
4. Nursery- Nursery soil generally not sterilize by the farmers.
5. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
6. Seed Rate- Farmers practices to use uncounter/ un amounted seed quantity.
7. Optimum sowing time -June-July (Rainfed)
8. Cultivars-In cauliflower, there are three group of varieties as early, medium and late. Due to unawareness farmers sow the seeds of early variety in late and late in early season so as a result there will not be curd formation.
9. Transplanting- Farmers practices improper planting distance.
10. Manures and fertilizers- Farmers incorporated cow dung in immature stages in the field.
11. Irrigation- Farmers do not apply water in the field at proper stage of the crop.
12. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field as well as losses takes place in the crop.
13. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Seed- Farmers should use improved varieties/ hybrids
4. Soil solarisation practice in nursery must be followed by the farmers because it is easy

method of sterilization at low cast.

5. Seed Treatment- For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or *Trichoderma viride* 4g/kg before sowing.
6. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Cauliflower (Early)-500-750g/ ha open pollinated.
   Cauliflower (Mid and Late)- 300-350g/ha open pollinated.
   Cauliflower (Hybrid)-250-300g/ha.
7. Varieties- Farmers should select proper variety for suitable sowing time as per maturity group.
8. For early crop- Early Kunwari, Pusa Kartiki, Pusa Early Synthetic; Mid- Pusa Synthetic, Pusa Shubhra, Pant Shubhra, Hisar No.1 and Late- Pusa Snowball-16, Pusa Snowball Kt-1, Pusa Hybrid-2.
9. Transplanting- Farmers should transplant seedlings properly as for early (30x30cm), medium (45x30cm), and late (60 x 45 cm).
10. Manures and fertilizers- Farmers should incorporate well rotten cow dung (15-20tonnes/ha) and NPK (150:80:60) in irrigated, half dose of NPK in un irrigated condition.
11. Irrigation- Farmers should apply water in the field at proper stage of the crop. As critical growing stage such as proper growing stage, curd formation and maturity stages.
12. Weed control- Farmers must know about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically.
13. Harvesting- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. Major insect pests associated with crop: Aphids are serious problem

vi. IPM Module for management of insect pests :

Cabbage/cauliflower Aphid

Name of the Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Cyantraniliprole 10.26% OD	600	5
Tolefenpyrad 15% EC	1000	5
Acetamiprid 20% SP	75	7
Fenvalerate 20% EC	300-375	7

Bioinsecticides

Name of the Bio-Insecticides	**(gm/ml) /ha**	**Waiting period (days)**
Azadirachtin 0.03% WSP (Neem oil based)	2500-5000	7

vii. Major disease associated with crop: Black rot and stalk rot are serious problem

viii. IPM Module for management of disease:

***Xanthomonas* Black rot:**

Seed treatment with Streptocyclin @ 100 mg/kg seed and two spray of Streptocyclin 1.0 gm / 10 litre of water after 10-12 days interval.

ix. Major weeds associated with crop: All common weeds

x. IPM Module for management of weeds:

1. Use of plastic mulch,
2. Timely manual weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yieldind and disease tolarent varieties,
2. Use of well decomposed FYM,
3. Use of black polythine mulch
4. Drip irrigation system

xii. Production constraints in agro-ecological region:

1. Non availability of suitable varieties as per agro-ecological situation.
2. Buttoning and leafiness are common problem
3. Lack of technical knowledge
4. Less availability of high quality seeds
5. High prices of hybrid seeds
6. Post-harvest losses are more due to non availability ofstorage facility
7. High prices of fertilizers
8. Low prices of farm produce
9. Lack of knowledge about the cultivation practices
10. Lack of processing facilities
11. So far no minimum support price is fixed for the crop

9C. Name of the Vegetable crop: Radish

i. Existing varieties being used: Dunagiri, Chinese Pink and Pusa Himani

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Early Mino, Japnese white Japanese White, Pusa Himani, Mino early, Ankur Naveen, Century -11

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
4. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
5. Sowing time- June-Aug
6. Planting distance- Farmers practices improper planting distance and sown through broadcast.
7. Manures- Farmers incorporated cow dung in undecomposed stages in the field.
8. Fertilizers: Farmer use imbalance fertilizer
9. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method..
10. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
11. Harvesting- The root harvesting should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. **Soil Testing-** Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. **Land Preparation-** The farmers are recommended to open the land before sowing the crop for sterilization.
3. **Seed Treatment-** For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or T*richoderma viride* 4g/kg before sowing
4. **Seed Rate**- The recommended seed rate of Asiatic type radish 10 Kg/ha and European type 12-14 Kg/ha
5. **Planting distance**- Farmers should be sown the seed Asiatic type line to line 45 cm and plant to plant 8cm and European type line to line 30 cm and plant to plant 8 cm
6. **Manures and fertilizers**- should be used as per soil testing , General recommendation are **FYM**-250q/ha **Nitrogen**: 60 kg/ **Phosphorus**: 100 kg/ha and **Potassium:** 50kg/ha **Micronutrient:** should be used as per soil testing,
7. **Irrigation**- Farmers should apply water in the field at proper stage of the crop. Irrigate

the crop in winter at7-8 days interval and in summer 3-4 days interval

8. **Harvesting-** Depending upon the cultivars, the roots become ready for harvesting in about 25-35 days after sowing. Early and rapid maturing European cultivars reach harvest maturity in 25-30 days after sowing. They become bitter and pithy if the harvesting is delayed. In India, harvesting is done manually. A light irrigation may be given before harvesting to facilitate lifting of roots. In advanced f countries, commercial radish growers use a single row harvester that pulls the plants from the soil, cuts the roots from the tops, and then places them in bags for transportation to a picking shed.

v. Major insect pests associated with crop: Aphids

vi. IPM Module for management of insect pests :

Aphid; *Aphis gossypii* Glover and *Myzus persicae* (Sulzer)

1. Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.
2. Yellow sticky trap is effective for controlling aphid population.

Imidacloprid 17.8 SL @ 0.25ml/l or Acetamiprid 20%SP @100g/ha or Thiamethoxam 25%WG@ 100g/ha if needed

vii. Major disease associated with crop: White rust, Nematodes

viii. IPM Module for management of disease:

1. Crop rotation
2. Use of FYM treated with *Trichoderma* @500gm per 100 kg

ix. Major weeds associated with crop: Not serious

x. IPM Module for management of weeds: Not applied

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of short duration,
2. Non pithy,
3. Coloured varieties for year round production.
4. Farmers should be adopted intensification of the crop such as he should grow at least 3-4 crops in a year such as Cauliflower early- Radish- Bottlegourd

Brinjal-Radish –Chilli

Bottle bourd-radish-French bean

xii. Production constraints in agro-ecological region:

1. Pithiness problem in low hills
2. Less availability of high quality seeds
3. High prices of hybrid seeds
4. Post-harvest losses are more due to non availability of storage facility
5. High prices of fertilizers
6. Low prices of farm produce
7. Lack of knowledge about the cultivation practices
8. Lack of processing facilities
9. So far no minimum support price is fixed for the crop

9D. Name of the Vegetable crop: Tomato

i. Existing varieties being used: Pant T3, Non descriptive varieties as open pollinated, Naveen 2000, Manisha, etc. Private company varieties like Himsona, Rakshhak etc.in all zones

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

Indeterminate hybrid varieties, Avinash (A-2), Himsona and various types of hybrids avalable in the marketAvailable good yielding varieties like Naveen2000+, Himsona etc should be used from private sector and varieties like Pusa Sheetal, Pusa Gaurave, Pant T-3

should be used from Government sector for and B Zone

iii. Existing package of practices being used:

1. Without soil and seed treatment,
2. Poorly managed nurseries,
3. Subterranean staking,
4. Non- judicious use of fertilizers,
5. Generally crop grown in open field condition
6. Sowing time- Oct-Nov and Jan-Feb
7. Sowing space-75x60 cm and 75x45 cm

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of indeterminate, round, optimal fruits weight (+_120) g weight hybrids, use of organic manures, special training and pruning techniques, Upright stacking and earthling up operation, with standard harvesting techniques and stages.
2. Use Inderminate tomato varieties like Naveen 2000+ under protected cultivation to promote vertical cultivation of tomato in marginal holdings under polyhouse condition. Use Zn in deficient soil.
3. Use micronutrient including Ca, B and Mo
4. Crop rotation Tomato-cowpea-Early cauliflower.

v. Major insect pests associated with crop: Fruit borer and white flies

vi. IPM Module for management of insect pests :

Fruit borer

1. Growing trap crop of African tall marigold as border row before 15 days of transplanting is beneficial in reducing egg laying in main crop.
2. Field sanitation and clean cultivation is effective tool to suppress the pest population.
3. Setting of sex pheromone traps @ 5 trap/acre for monitoring is effective.
4. Spray of Ha NPV @ 500 LE/ha mixed with 0.1 per cent UV retardant (Tinopol) and 0.5 per cent jiggery is effective.
5. Use of Bt @ 0.50kg/acre and NSKE 5 per cent to kill early stage larvae. Release of the egg parasitoid, *Trichogramma chilonis* or *T. brasiliensis* @ 1Lakh/ha coinciding with flower initiation at 15 days interval may reduce the pest population.
6. Development of pyridalyl nanocapsule suspension for efficient management of tomato fruit and shoot borer (*Helicoverpa armigera*) is an efficient approach for frequent delivery and effective management.

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Indoxacarb 14.5% SC	400-500	5
Chlorantraniliprole 18.5% SC	150	3
Cyantraniliprole 10.26% OD	900	3
Flubendamide 480% SC	120	5
Flubendamide 20% WG	240	5
Novaluron 10% EC	750	1-3
Novaluron 5.25%+ Indoxacarb 4.5% SC	1700	5
Methomil 40% SP	750-1125	5-6
Lambda cyhalothrin 5% CS	300	5

Management strategies(white fly and other sucking pests)

A. Crop Hygiene

Field hygiene should be a high priority and should be included as an integral part of the overall strategy for managing whitefly populations, Tomato yellow leaf curl virus (TYLCV) incidence, and insecticide resistance. These practices will help reduce the onset of the initial infestation of whitefly, regardless of biotype, and lower the initial infestation level during the

cropping period.

B. Other Cultural Control Practices

1. Use proper pre-planting practices.
2. Vegetative propagated ornamental plants (i.e. *Hibiscus, Poinsettia*, etc.) should not be grown at the same location, especially if bringing in plant materials from other areas.
3. Avoid yellow clothing or utensils as these attract whitefly adults.
4. Delay planting new fall crops as long as possible.
5. Do not plant new crops near or adjacent to old, infested crops.
6. Use proper post-planting practices.
7. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc. Rogue tomato plants with symptoms of TYLCV.
8. Plants should be treated for whitefly adults prior to rouging and, if nymphs are present, should be removed from the field, preferably in plastic bags, and disposed of as far from production fields as possible.
9. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
10. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

C. Insecticidal Control Practices.

1. Restricted the use of neonicotinoids (imidacloprid or acetamiprid) in the field only during the first six weeks of the crop thus leaving a neonicotinoid-free period at the end of the crops.
2. Use selective rather than broad-spectrum control products where possible to conserve natural enemies and enhance biological control.
3. Do not apply insecticides on weeds on field perameters. These could kill whitefly natural enemies and, thus, interfere with biological control.
4. Crop rotation is effective tool to prevent pest population.
5. Avoiding of same group of crop in same field for a long time is beneficial.
6. Sticky trap is effective to control whitefly population.

White fly

Name of the Insecticides	(gm/ml) /ha	Waiting period (days)
Cyantraniliprole 10.26% OD	900	3
Spiromesifen 240% SC	625	3
Thiamethoxam 25% WSG	200	5
Imidacloprid 17.8% SL	150-175	3

vii. Major disease associated with crop: Buckeye fruit rot is a major serious disease.

viii. IPM Module for management of disease:

Buck eye rot:

1. Burn the infected fruit, leaves etc. and staking of plants,
2. Remove the leaves upto 9 inches from ground.

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Mancozeb 75% WP	1500-2000	
Propeneb 70% WP	1500	10

ix. Major weeds associated with crop: *Trifolium alaxenderum, Cyperus rotundus*

x. IPM Module for management of weeds:

1. Cultural practices.
2. Through recommended chemicals.

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of high yielding varieties grown under ventilated polyhouses using standardized

technology with fertigation technology in tomato can enhance the productivity of tomato manifold.
2. Polyhouse technology is a boon for small and marginal farmers with fragmented holdings.

xii. Production constraints in agro-ecological region:

1. Non-availability of reliable hybrid cultivars for continuous cultivation.
2. Poor nursery management in the crop
3. Poor staking and pruning techniques.
4. Poor technical knowhow

9E. Name of the Vegetable crop: Potato

i. Existing varieties being used: Up-to-date, Kufri Jyoti, Kufri chandramukhi, Tumari Local and Kufri Jyoti

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Kufri Girriraj, Kufri Chipsona 1, Kufri chipsona 3,K Girdhari, K Himalini and K. Shailja

iii. Existing package of practices being used:

1. Use of big sized tuber or divion of tuber (50-60 g)
2. No Tuber treatment
3. Use of organic maures, sowing in flat bed.
4. Sowing time is March-April.
5. Limited or no IPM practices
6. Planting time:
7. Region C (1500-2400): March-April
8. Spacing: 50-60 x 15-20 cm
9. Seed rate: 25-30 qtl/ha
10. Farmers are only using FYM along with urea at hills but the farmers in plains are using FYM + 160:100:120kg/ha NPK

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of HYV variety with proper seed size (with 3 sprouted eyes, sown in line with application of organic manures.
2. Late blight resistant variety such as K Girdhari, K.Himalini and K. Shailja should be selected for planting. Fertilizer should be used on soil test basis. Dehaulming practise should be adopted for long duration storage of tubers.
3. Suitable fungicides should be used for control of Late blight disease e.g. mancozeb, cardendazim alone and in combination.

v. Major insect pests associated with crop: Potato tuber moth, Epilachna beetle, aphids, white grub

vi. IPM Module for management of insect pests :

Potato tuber moth: *Phthorimaea operculella*

1. Heaps of green grasses may be kept at suitable interval in infested field during evening and next day early in the morning along with caterpillars to destroy.
2. Clean cultivation and mechanical destruction of caterpillars also help in reducing pest infestation.
3. Irrigation also brings them on the surface and birds shall predate them.
4. Apply chlorpyriphos 20EC at the rate of 2.5ml/l in the soil before seed sowing.

2.Epilachna beetle: *Epilachna viginatioctopunctata*

1. Hand packing of grubs and collection of beetles by hand nets during early stages of attack, helps in reducing the intensity of infestation.
2. Conservation and augmentation of natural parasitoids viz.*Pediobius foveolatus, Pleunotrogrus faveolatus* and*Tetrastichus* sp.

3. Application of Neem, Mahua, ground nut cakes are efficient in suppressing the pest population.Spray of Malathion 50 EC in 200 liters of water per acre provides effective control of this pest

Aphids: ***Myzus persicae***

1. Conservation of the coccinellids and syrphids that are found to feed on the aphids will reduce the numbers considerably without any insecticidal spray.
2. Yellow sticky trap is effective for controlling aphid population.
3. Imidacloprid 17.8 SL @ 0.25ml/l or Acetamiprid 20%SP @100g/ha or Thiamethoxam 25%WG@ 100g/ha.

vii. Major disease associated with crop: Late blight andcommon scab disease in the crop and tuber.

viii. IPM Module for management of disease:

1. Cultural practices are used.
2. Use Certified seed / disease free seed.
3. Plant imroved/ resistant cultivars like Kufri giriraj, K. Himalini, K. Girdhari, K. Himgiri and K. Himsona.
4. Regularly monitor the field and rouge the virus affected plants. Need based spraying of systemic insecticides shuld be done to check the vector population.
5. Destroy the crop residues and left over tubers after harvest.

Late blight of potato: ***Phytophthora infestans***

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Cyazafamid 34.5% SC	200	27
Chlorothaonil 75% WP (per lit. water)	0.875-1.250	14
Azoxystrobin 23% SC	500	12
Mandipropamid 23.4% SC (per lit. water)	0.8	40
Propineb 70% WP	0.30%	15
Captan 50% WG	1500	21
Captan 75% WP	1667	8
Copperoxychloride 50% WP	1250	
Copperhydroxide 53.8% DF	1500	22
Dimethomorph 50% WP	1000	16
Hexaconazole 2% SC	3000	21
Mancozeb 75% WP	1500-2000	
Zineb 75% WP	1500-2000	
Metalaxyl 8%+ Mancozeb 64%WP	2500	49
Metalaxyl 4%+ Mancozeb 64%WP	2500	24
Capatan70%+ Hexaconazole 5% WP	500-1000	21
Carbendazim 25%+ Mancozeb 50%WS	0.6-0.7/Kg	Seed Treatment
Cymoxanil 8%8% +Mancozeb 64%WP	1500	10
Famoxadone 16.6%+Cymoxamil 22.1% SC	500	40
Fenamidone 10%+ Mancozeb 50% WG	1250-1500	30
Metiram 55%+ Pyraclostrobin 5% WG	1500-1750	15
Metalaxyl 3.3%+ Chlorothanil 33.1% SC	0.02%	34

Potato scab: ***Streptomyces scabiei***

Name of the Fungicides	**(gm/ml) /ha**	**Waiting period (days)**
Thiram 75% WS (Seed Treatment/ Kg)	2.5-3.0	7-10

ix. Major weeds associated with crop: *Ranunculus, Cyperus* sp and *Chenopodium* etc.

x. IPM Module for management of weeds: Mechanical and cultural method.

1. Proper crop rotation
2. Timely hand weeding
3. Winter/ summer ploughing

Bathua, Pigweed*: Chenopodium album* (annual, dicot, broad leaves, leafy)

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
2,4 D Dimethyl amine salt 58% SL	2000	3440
Oxyflourfen 23.5% EC	100-200	425-850

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Early maturing varieties.
2. Use of Kufri Girriraj and Kufri Jyoti varieties supplementation with use of optimal tuber size,
3. Selection of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja.
4. Seed treatment should be followed.
5. Planting of pre-sprouted tubers should be done.
6. Proper crop rotation to should be followed.
7. Winter/ summer ploughing of fields.
8. Use of organic mulching material in appropriate thickness especially under rain fed mid hills agro climatic conditions.
9. Dehaulming practise should be adopted by the farmers for long duration storage of tubers.
10. Medium size whole tuber should be used as planting material.

xii. Production constraints in agro-ecological region:

1. Timely and adequate seed supply.
2. Facility of poor seed storage in the distt.
3. The seed of early maturing disease resistant varieties like K Girdhari, K Himalini and K. Shailja is not available in sufficient quantity. Use of infected planting material by the farmers.
4. Use of un sprouted seed (newly dug tubers)
5. Proper crop rotation is not followed.
6. Cultivation on sloppy land.
7. In situ moisture conservation techniques such as mulching technology are not followed.
8. Dehaulming technique is not followed.
9. Imbalance use of fertilizers.
10. Use of unrecompensed FYM.
11. Lack of storage facilities.
12. Seed production is not done by the farmers.

9F. Name of the vegetable crop: Brinjal

i. Existing varieties being used: Non descriptive or non identified varieties, PPL 74

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Navkiran, Brinjal 704 (SunGro Seed), Navina, VNR212 (VNR Seed), IndameSupriya (Indo-American), Pant Rituraj, Pant Samrat (Pantnagar), Kashi Taru, Kashi Sandesh (IIVR)

iii. Existing package of practices being used:

1. Soil Testing-Farmers do not test their soil
2. Land Preparation- Farmers do not open the land before sowing for sterilization of the soil.
3. Nursery- Nursery soil generally not sterilize by the farmers.
4. Seed Treatment- Mostly farmers of the state do not treat the seed materials.
5. Seed Rate- Farmers practices to use uncounted/ un amounted seed quantity.
6. Sowing time: Feb- March

7. Transplanting- Farmers practices improper planting distance.
8. Manures- Farmers incorporated cow dung in undecomposed stages in the field.
9. Fertilizers: Farmer use imbalance fertilizer
10. Irrigation- Farmers do not apply water in the field at proper stage of the crop and by proper irrigation method.
11. Weed control- Farmer generally not aware about the proper stage of weed elimination from the field and chemical method of weed control
12. Harvesting- The harvesting/ picking should not follow as per maturity standards or as per object.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Soil Testing- Farmers should practice for soil test before sowing the crop for proper recommendation of fertilizers.
2. Land Preparation- The farmers are recommended to open the land before sowing the crop for sterilization.
3. Soil solarisation practice in nursery must be followed by the farmers because it is easy method of sterilization at low cast.
4. Seed Treatment- For minimal attack of the different diseases farmers must treat the seed materials by Captan @ 2g/kg of seed orCarbandazim @2g/kg of seed orTrichoderma viride 4g/kg before sowing
5. Seed Rate- The recommended seed rate of brinjal: Hybrid-250g/ha, Open pollinated-500-600g/ha
6. Transplanting- Farmers should transplant seedlings properly as for non spreading type varieties- 60cm x 60cm, spreading type varieties - 75cm x 60cm.
7. Manures and fertilizers- should be used as per soil testing , General recommendation are FYM-250q/ha Nitrogen: (Hybrid-200kg/ha, Open pollinated-100-120kg/ha) Phosphorus: (Hybrid-100kg/ha, Open pollinated-80kg/ha Potassium: (Hybrid-80/ha, Open pollinated-60kg/h), Micronutrient: should be used as per soil testing,
8. Irrigation- Farmers should apply water in the field at proper stage of the crop. Irrigate the crop in winter at7-8days interval and in summer3-4 days interval
9. Weed control- Farmers must know the about the losses in the production of the crop by weeds, they should adopt proper weed control management practices either manually or chemically. Farmer can control the weeds by hand weeding along with pre-planting surface application @ of 1.0-1.5 kg/ha Alachlor.
10. Growth substances: Use 2,4-D @ 2ppm at flowering stage
11. Harvesting- The farmer must aware about the maturity stage of a particular crop so he can harvest the crop as per their object.

v. Major insect pests associated with crop: Shoot and fruit borers

vi. IPM Module for management of insect pests:

Brinjal fruit & shoot borer: *Leucinodes orbonalis*

Only cultural practices can be used.

Brinjal fruit & shoot borer: *Leucinodes orbonalis*

1. The damaged portions of the plants and fruits should be removed and destroyed.
2. Early removal of drooping shoots will reduce the fruit infestation.
3. Proper collection of all the infested flower buds, fruits during harvest.
4. Continuous cultivation of brinjal also favors the pest infestation.
5. Varieties like Punjab Barsati, (moderate resistant cultivar) Pusa purple round, Punjab Neelam found to be resistant to brinjal fruit borer.
6. Biological method recommended by IIHR, Bengaluru involving release of *Trichogramma chilonis* @10 to 15 lakh parasites/ha/season along with 2 sprays of *Bt* formulation found

to be economically effective.

7. Installation of BSFB (brinjal shoot and fruit borer) pheromone traps Lucinure @3/ha to monitor and mass trap the male moths is effective.
8. Neem Seed Kernal Extract(NSKE)5 % per cent at the time of flowering is effective.
9. Prevent continuous growing of same group of crop at same field.
10. Rotate brinjal with cabbage or other crops

Name of the insecticides	(gm/ml) /ha	Waiting period (days)
Chlorantraniliprole 18.5% SC -	200	22
Emamectin Benzoate 5% SG	200	3
Thiacloprid 21.7% SC	750	5
Thiodicarb 75% WP	625-1000	6
Lambda cyhalothrin 5% CS	300	5
Cypermethrin 25% EC	150-200	1
Betacyfluthrin 8.49%+ Imidacloprid 19.81% OD	200	7
Triazophos 35% + Deltamethrin 1% EC	1250	3
Pyriproxyfen 5%+ Fenpropathrin15% EC	750	7

vii. Major disease associated with crop: Phomopsis blight and rot (*Phomopsis vexan*) is a serious problem in the hills.

viii. IPM Module for management of disease:

1. Use healthy seed materials for sowing.
2. Seed should be extracted only from disease free fruits.
3. After extraction of seeds it should be dried for a week and then stored.
4. Avoid continuous cultivation of brinjal. A rotation of brinjal - paddy - gingelly will helps to check the disease development.
5. In the fields the affected plants and debris should be collected and burnt
6. During summer deep ploughing should be given.
7. Spray following insecticides

Blight

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: *Euphobia hirta, Cynadon dactylon , Oxalis, Cyperus rotundus, Panicum repens, Cyanodon dactylon, Amaranthus virdis, Parthenium hysterophorus*

x. IPM Module for management of weeds:

1. Hand weeding.
2. The field should be kept weed-free, especially in the initial stage of plant growth, as weeds compete with the crop and reduce the yield drastically.
3. Frequent shallow cultivation should be done at regular interval so as to keep the field free from weeds and to facilitate soil aeration and proper root development.
4. Deep cultivation is injurious because of the damage of roots and exposure of moist soil to the surface.
5. Two-three hoeing and the earthing up are required to keep the crop free of weeds.
6. Preemergence application of Fluchloralin (1.5 kg a.i./ha) coupled with one hand weeding 30 days after transplanting is effective for control of weeds

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Use of hybrids can increase productivity 2to 3 times higher.

2. Use of mulch in rainy season.
3. Farmers should be adopted intensification of the crop such as he should grow at least 3-4 crops in a year such as Brinjal- Radish-Bottle gourd, Brinjal- spinach-cowpea, Brinjal-Turnip-Amaranthus, Brinjal- Spinach-Bitter gourd etc.

xii. Production constraints in agro-ecological region:

1. Non-availability of suitable hybrids
2. Wild animals problems
3. Poor technical knowhow
4. Marketing problem in rainy season
5. Less availability of high quality seeds
6. High prices of hybrid seeds
7. Post-harvest losses are more due to non availability of storage facility
8. High prices of fertilizers
9. Low prices of farm produce
10. Lack of knowledge about the cultivation practices
11. Lack of processing facilities
12. So far no minimum support price is fixed for the crop

9G. Name of the vegetable crop: Cucumber

i. Existing varieties being used: Local and traditional varieties Kalyanpur Green, Japanese Long Green, Poona Khira, Pant Khira-1, Poinsette, Japanese Long Green, Straight Eight, Swarna Sheetal, Swarna Poorna, Swarna Ageti etc.

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

For open field condition: Pusa Udhay, Pusa Barkha,Shubhangi, Himangi, Punjab Naveen, Tasty, Ruchi, Mandakini, Kumud, Noori, Alamgir, Rani, Don etc,

For protected condition: Pant Parthenocarpic Cucumber-2 & 3, Hilton, Kian, Isatis, Malini etc.

iii. Existing package of practices being used:

1. Use of traditional seeds,
2. Planting in rainy season,
3. Traditional stacking method,
4. Long harvest duration season,
5. Sale at local market, absence of crop rotation.
6. Random selection of variety (May or may not be suited to Agroeco-region).
7. Untimely sowing / planting of crop.
8. Use of untreated seed.
9. Unbalanced use of fertilizers.
10. Use of plant protection chemicals having long wetting period.
11. Use of traditional irrigation system.
12. No soil solarisation/ treatment during lean period.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Glasshouse or polyhouse technology
2. Use of Hybrids or/and Pathenocarpic varieties
3. Management of crop geometry.
4. Use of organic manure or fertigation inside polyhouse.
5. Management of Dacus and other flies, Use of protected cultivation.
6. Adoption of crop/ soil health related crop rotations.
7. Recommended/suitable variety for Agroeco-region.
8. Use recommended spacing eg. 60-200 × 50-100 cm

9. Treating seed before sowing.
10. Balanced use of fertilizers (125: 155: 125 Kg N: P: K/ha, respectively) with water soluble fertilizers (fertigation).
11. Selection of eco-friendly plant protection chemicals having short wetting period, recommended for protected cultivation.
12. Selection of optimum planting period.
13. Sowing time: Feb- March
14. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
15. Adoption of micro irrigation technologies for efficient use of available water.
16. Adoption of fertigation system for efficient use of fertilizers

v. Major insect pests associated with crop: Fruit flies

vi. IPM Module for management of insect pests:

Fruitflies, *Bactrocera cucurbitae* Coq. and *B. ciliatus* Loew (Tephritidae : Diptera)

1. To avoid infestation by fruit flies, growing of resistant or early maturing varieties has been recommended.
2. To check the damage by these flies, fruits should be harvested before they start ripening.
3. All the fallen and infested fruits should be collected and destroyed to prevent the carryover of the pest.
4. Frequent raking of the soil under the vines or ploughing the infested fields after the crop is harvested can help in killing the pupae.
5. Baits prepared with 10% ripe banana, 10% jaggery mixed with 0.1% malathion or 1g carbofuran used in bait traps was found effective or this bait mixture is to be applied as 200 spot splashes per hectare on the undersurface of cucurbit leaves.
6. Use of 0.4 ml methyl engenol with 1ml of dichlorvos in bait traps was also found effective

vii. Major disease associated with crop:

Powdery mildew and downy mildew, anthracnose

viii. IPM Module for management of disease:

Downy mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Zineb 75% WP	1500-2000	
Cymoxanil 8%+ Mancozeb 64% WP	1500	10
Azoxystrobin 23% SC	500	7
Amectoctradin+ Dimethomorph 20.27% SC	800-1000	3

Powdery mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300

Anthracnose

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300
Zineb 75% WP	1125-1500	1500-2000

ix. Major weeds associated with crop: Various weeds

x. IPM Module for management of weeds:

1. Use of black Poly mulch,
2. Timely weeding
3. Crop rotation

xi. Specific workable and sustainable intensification capable of doubling agricultural

income in specific agro-ecological region:

1. Polyhouse technology and hybrid cultivars can increase productivity 3-4 times in mid and high hills.
2. Use of protected cultivation.
3. Adoption of crop/ soil health related crop rotations.
4. Recommended/suitable variety for Agroeco-region.
5. Use recommended spacing eg. 60-200 × 50-100 cm
6. Treating seed before sowing.
7. Balanced use of fertilizers (125: 155: 125 Kg N: P: K/ha, respectively) with water soluble fertilizers (fertigation).
8. Selection of eco-friendly plant protection chemicals having short wetting period, recommended for protected cultivation.
9. Selection of optimum planting period.
   (Protected cultivation): Feb- March
10. Use of different protected systems/materials eg. Mulch, agro shed net house, insect proof net house, water harvesting tank etc.
11. Adoption of micro irrigation technologies for efficient use of available water.
12. Adoption of fertigation system for efficient use of fertilizers

xii. Production constraints in agro-ecological region:

1. Lack of plant growing structures.
2. Monkey, baboon, wild pigs are serious threats.
3. Good quality seed is inaccessible.
4. High cost of seed & poor purchasing power of farmers.
5. Water scarcity.
6. Protected cultivation is cost involving technologies.
7. Repair of the poly houses/ micro irrigation structures is a tedious task.
8. Damage of crop / poly houses /micro irrigation structure by wild animals.
9. Unawareness about scientific technologies.
10. Involvement of middle men in marketing.
11. Availability of agriculture inputs is not easy.
12. Use of unsafe agro chemicals.
13. Difficult labour availability.
14. Different biotic and abiotic stresses.

9H. Name of the fruit crop: Vegetable Pea

i. Existing varieties being used: Traditional field pea , Arkel and Azad pea 3

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Vivek Matar 11 for main season & VL Ageti Matar 7 for August sown

iii. Existing package of practices being used:

1. Sowing in of Autumn month
2. Broadcasting method,
3. No line sowing,
4. High seed rate,
5. Mature more than 120 days,
6. Stacking is done for tall varieties,
7. Dual purpose varieties
8. Sowing by broadcasting method, no seed treatment, using own saved seeds to grow crop.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Use of tall varieties sown in line with effective stacking methods. Management of

powdery mildew, Aschochyta blight and other diseases and Fusarium wilt in autumn season Sowing early maturing varieties at closer spacing (30 cm plant to plant and about 5-10 cm between plants) and higher seed rate (120 kg/ha).

2. Sowing time: Mid Aug
3. Seed rate: 100 Kg/ ha
4. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time.
5. If available, at least one ton of farmyard manure per ha should be incorporated in the soil at the time of land preparation. Add fertilizers containing NPK as 30: 70: 50 kg/ha all apply as basal dose.
6. Water the crop as per need especially during flowering and pod setting.

v. Major insect pests associated with crop: Leaf miner , borer

vi. IPM Module for management of insect pests: Spray of Dimethoate 0.01% or Imidachlorprid 1 ml/lit.

vii. Major disease associated with crop:

1. Powdery mildew in all agro ecological situations
2. Fusarium wilt in autumn sown crop
3. Aschochya blight in rainy season in high hills.

viii. IPM Module for management of disease:

1. Use of organic inputs only
2. Use of rust and powdery mildew resistant strains.

Powdery mildew

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Benomil 50% WP	100	200
Carbendazim 50% WP	150	300

ix. Major weeds associated with crop: All seasonal weeds

x. IPM Module for management of weeds:-

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1. Increasing crop intensity, Line spacing
2. Use of tall cultivars in cropping system
3. Standardization of time for seed sowing in pea viz. September sowing in high hills, Mid Nov sowing time for Mid hills can enhance productivity.

xii. Production constraints in agro-ecological region:

1. Monkey Menace
2. Need to increase seed production program in distt.

9I. Name of the Vegetable crop: Leafy vegetables

i. Existing varieties being used: Locally available varieties of palak, methi and amaranthus

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:

Palak- All Green, Pusa Harit
Methi- Pant Ragini, Pusa Early Bunching and Kasuri Selection
Amaranth- Chhoti Chaulai, Badi Chaulai, Pusa Kiriti,
Pusa Kiran and Pusa Lal Chaulai.

iii. Existing package of practices being used:

1. Varieties- – farmers are using the local varieties of leafy vegetable
2. Sowing methods: Broadcasting method of sowing is used by farmers.
3. seed Treatment- farmers of the state do not treat the seed materials
4. Manures and fertilizers- Farmers incorporated undecomposed cow dung in the field.
5. Weed control- Farmer generally not aware about the proper stage of weed elimination

from the field as well as losses takes place in the crop.

6. Cuttings- The leaves are not picked as per recommended practices as per variety.

iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:

1. Seed- Farmers should use improved varieties/ hybrids of leafy vegetables
2. Seed Treatment- to protect crops from different diseases, farmers must treat the seed by Captan @ 2g/kg of seed or Carbandazim @2g/kg of seed or *Trichoderma viride* 4g/kg before sowing of seeds.
3. Seed sowing: Seed is sown by line sowing method
4. Seed Rate- It is recommended to use the seed quantity for different as follows-
   Palak- winter crop-10-15 kg seeds/ha
   Summer crop-25-30 kg/ha
   Methi- direct sowing -20-30 kg/ha
   Amaranthus
   direct sowing-2kg/ha
   Transplanting- 1kg/ha
4. Spacing: sowing of seed should be done at proper spacing
   Palak: Row to Row- 20cm and plant to plant -5cm
   Methi: Row to Row-20-30 cm and plant to plant 10-15cm Amaranth: Row to Row-20-30 cm and plant to plant-10 cm
5. Manures and fertilizers- Farmers should incorporate well rotten cow dung (10-15 tonnes/ha) and NPK (50: 50:20). On the basis of soil testing. Top dressing of nitrogen after each cutting.
6. Application of Vermicompost @ 5qt/ha in the field is beneficial for leafy vegetables.
7. Cutting: cutting should be done at proper stage at 25-30 days after sowing.

v. Major insect pests associated with crop: Aphid, white fly, gross hopper

vi. IPM Module for management of insect pests : Foliar spray of quinalphos 25ec @0.2%

vii. Major disease associated with crop: Powder mildew

viii. IPM Module for management of disease: Spray of wettable sulphur @ 0.2%

ix. Major weeds associated with crop:

Palak- jangli palak(Rumex acutus)
Methi- bathua, senji(*Melilotus alba)*
Amaranthus- Jungli Chauli(*A. viridis*) kataili chauli, Bathua

x. IPM Module for management of weeds: Timely weeding

xi. Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:

1.Follow deep summer / winter ploughing
2.Line sowing should be prefer
3.Follow proper crop rotation
4.Use of improve varieties of leafy vegetable
5.Timely weeding and hoeing should be done
6. Timely cuttings of leaves

xii. Production constraints in agro-ecological region:

1. Unavailability of quality seed
2. Farmers are not aware about improved varieties of leafy vegetables
3. Seed treatment is not being followed
4. Proper method of sowing is not followed
5. Imbalance use of fertilizers.
6. Disease and insect pest problem. They do not know how protect leafy vegetable from biotic stress.

10A. Name of the Fodder crop: Berseem

i. **Existing varieties being used:** Mescavi, Vardan

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** JB-1, BL-1,Hybrid multi cut, Pusa Gaint & Bundel Berseem 243

iii. **Existing package of practices being used:** Sowing after Puddiling

iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**

1. Soil : loam to clay soil
2. Field preparation: 3-4 Harrowing + leveling the field.
3. HYVS. – Mescavi, Vardan. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
4. Seed rate: 25-30 kg/ha
5. Sowing method: a. Wet method-like rice in puddled field
6. Dry method: Without puddled.
7. Sowing time: First an week of October
8. Fertilizer: 30:60:70:: N:P_2O_5 K_2O kg/ha
9. Irrigation: Field should remain at field capacity throughout the crop period after germination.
10. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
11. Cutting management: First cut -45-50 DAS
12. Other cutting at 25-30 days interval- total 5-6 cutting are taken
13. Yield: 800-1000g/ha. Green forage.

v. **Major insect pests associated with crop:** Not reported

vi. **IPM Module for management of insect pests :** Mechanical control

vii. **Major disease associated with crop:** Not reported

viii. **IPM Module for management of disease:** Seed treatment

ix. **Major weeds associated with crop:** Not reported

x. **IPM Module for management of weeds:** Not available

xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:** Use multicut Varieties

xii. **Production constraints in agro-ecological region:** Not sowing in hill areas

C1. Livestock: Buffalo

1.A Existing breeds available: Mostly non-descript, Neeli-Ravi cross, Murraha cross

1.B Specific breeds to be introduced: Murraha, Neeli-ravi,

2.A Existing feeds being used: Wild grasses, paddy straw, wheat straw, wild dried grasses, Leaves of trees such as silver oak, bhemal, khadeek, mulberry

2.B Specific feeds to be introduced / advised:

1. UMBB, Feed blocks, Fodder maize, multi cut chari, multi Barseem, Hybrid napier, tall fascue, Italian rai, cox foot, orchard grass fodder trees etc
2. Fortification of local Fodder, use of Chaff cutter and mangers etc

3.A Existing health services:

1. State animal husbandry department (Vet. Hospital, LEO Centers)
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

Village level workers for first aid, vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder

4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction,
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds,
2. Shortage of feed and fodder,
3. Improper feeding, poor housing and management of animals,
4. Improper health services,
5. Mostly unproductive animals

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed
3. Low cost of milk

C2. Livestock: Cattle

1.A Existing breeds available: Mostly non-descript, Badri, Cross bred of Jursey, HF, Sahiwal

1.B Specific breeds to be introduced: Jersey, HF, Sahiwal

2.A Existing feeds being used: Wild grasses, paddy straw, wheat straw, dry grasses, Leaves of trees as silver oak, bhemal, khadeek, mostly rearing on grazing

2.B Specific feeds to be introduced / advised:

1. Fodder maize, multi cut sorgam (chari), Bar seem, Hybrid Napier, fodder trees etc

2. Fodder treatment, Chaff cutter, mangers etc

3.A Existing health services:

1. State animal husbandry department
2. BAIF, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

Village level workers for first aid, vaccination and AI

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder,
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Proper scientific housing,
2. Scientific feeding management,
3. Manger and chaff cutter introduction,
4. Proper and timely vaccination and deworming, timely health and breeding facilities

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

1. Poor breeds,
2. Shortage of feed and fodder,
3. Improper feeding,
4. Poor housing and management of animals,
5. Improper health services
6. Mostly unproductive animals

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Feed and fodder shortage,
2. Local breed
3. Low cost of milk

C4. Livestock: Goatry

1.A Existing breeds available: Mostly non-descript,Chaugarkha, Udaipuri

1.B Specific breeds to be introduced: Barbari, Jamunapari,

2.A Existing feeds being used: Grazing

2.B Specific feeds to be introduced / advised: Grazing

3.A Existing health services: State animal husbandry department,

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region: Village level workers for first aid, vaccination

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district: Development of pasture land, scientific management

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Lack of range land management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

1. Lack of range land management,
2. Managemantal problems as proper vaccination
3. Ecto and endo parasite control, breed improvement

C4. Livestock: Sheep

1.A Existing breeds available: Mostly non-descript,gaddi, black sheep

1.B Specific breeds to be introduced: Gaddi, selective breeding of local breed

2.A Existing feeds being used: Grazing

2.B Specific feeds to be introduced / advised: Grazing

3.A Existing health services:

State animal husbandry department,

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:

1. Village level workers for first aid
2. Vaccination

4.A Existing management practices:

1. Improper and unhygienic housing,
2. Improper and inadequate feeding management,
3. Shortage of feed and fodder,
4. Improper vaccination, long calving interval, inbreeding

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. Development of pasture land
2. Scientific management

5.A Problems of Livestock system- Goatary, Poultry, Fisheries: Lack of range land management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which

income is not increasing:

1. Lack of range land management,
2. Managemantal problems as proper vaccination
3. Ecto and endo parasite control, breed improvement

C5. Livestock: Poultry

1.A Existing breeds available: Poultry: Local, Croiler, RIR, uttara fowl

1.B Specific breeds to be introduced: Poultry: Croiler, Kadaknath, Cob, Cari-davendra, cari-nirbheek

2.A Existing feeds being used: Kitchen waste

2.B Specific feeds to be introduced / advised: Starter, grower, finisher feed according to age

3.A Existing health services: State animal husbandry department, KVK

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region: Specific poultry management services

4.A Existing management practices:

Mostly backyard

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:

1. High yielding breeds
2. Proper feeding and management practices

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:

Poor breed and management

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing:

Poor breed and management

C6. Livestock: Fisheries

1.A Existing breeds available: Local, Silver carp, grass carp and common carp

1.B Specific breeds to be introduced: Silver carp, grass carp and common carp

2.A Existing feeds being used: House hold waste

2.B Specific feeds to be introduced / advised: pelleted fish feed having 25-30% protein

3.A Existing health services: State fisheries deptt. (fisheries inspector at district level)

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:-

4.A Existing management practices:-

4.B Specific management practices to be advised for doubling income in specific agro-ecological region of district:-

5.A Problems of Livestock system- Goatary, Poultry, Fisheries:-

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which income is not increasing: Non availability of quality fish seed is major problem

Vet. Health services

Resouces		**Manpower**							**Infrastructure**		
		No.	V. O.	LEO	Pharmacist	Lab. Tech.	Livestock Assistant	Para vets	Buildings	Equipments	Others
Vety. Hospitals	Existing	13	13	-	15	-	31	1	12	Available	-
	Proposed	3	3	-	3	-	6	-	3	-	-
Mobile Vety. Unit	Existing	1	1	-	1	-	2	-	No	Not Available	-
	Proposed	1/ block+1	05	-	05	05	5	-	-	Needs to be procured	
Vety. Dispen.	Existing	23	-	23 (vacant-09)	-	-	-	-	9	-	-
	Proposed	2	-	2	-	-	-	-	2	-	-

AI centres	Existing	28	13	15	-	-	-	-	-	Available	-
	Proposed	2	-	2	-	-	-	-	-	-	-
Disease Diag. Labs	Existing	Nil	1	-	-	Vacant	1	-	1	Available	-
	Proposed	1	1	-	1	1	1	-	-	-	-
Polyclinic	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	1	-	-	-	-	-	-	Required	Required	-
Ambu. Clinics	Existing	-	-	-	-	-	-	-	-	-	-
	Proposed	-	-	-	-	-	-	-	-	-	-

Availability of Medicines/ Vaccines: Adequate

Specific health services to be required/ advised for doubling income in specific agro-ecological zone:

Nutritional gap needs to be filled. Farmers should be provided feed & fodder supplements at subsidised rates. Minimum support prize should be fixed for the farm products, improved market infrastrusture and market scope.

Any other suggestions to improve the quality of Vety. Health services:

1. Need restructuring of the department especially for the hilly areas so as to fulfil the staff requirement.
2. Refresher course should be organised for the doctors.

Problems of Animal Husbandry

Specific problems due to which income is not increasing	Poor accessibility	Yes (some remote hilly area)
	Water scarcity	Almost in the whole district
	Natural disasters	Frequency is low
	Wild life conflicts	Yes, frequency is very high due to which farming intensity is decreased to a significant level in both the zones
	Marketing of animals	No availability of structured market
	Marketing of products	Due to Low cost of milk and milk product marketing is not upto the mark, transportation cost is also very high thus making is not feasible, need chilling plants at regular distance.
	Budget	Allocation is low
	Manpower shortage	Yes. Monopoly gender role in livestock activity
	Capacity building	Para veterinary staff and refresher courses of vetenarians is required
	Equipment & Implements (old/ shortage, etc.)	Adequate
	Mobility	Huge Problem. Dependence on the public vehicle is very high. Difficult terrain. Difficult road connectivity.
	Risk cover (Insurance)	Is must, though inappropriate action by insuarance companies

		in settlement of claims discourage farmers
	Relook to policies	-

D. Integrating Farming system

1.A Existing farming system: Animal husbandry +crop/Vegetable

1.B Specific farming system for doubling income in specific agro-ecological region:

Agri-Hort-Animal based farming system

Activity **Area**

Cropping system: 8 nali

Paddy-Cabbage/Pea

Capsicum-radish-cauliflower

Paddy-Radish-garden pea-Frenchbean

Horticulture 8 nali

Peach, plum apricot and walnut

Livestock 2 nali

Cow/buffalo

Backyard poultry

Gottary

Fishery

Beekeeping

Processing2 nali

Washing and cleaning of season vegetables, biogas/vermicompost/biopesticides

Total cost : 50,000.0

Total income : 1.5 lakhs

Net income : 1.00 lakh (Approx.)

E. Reducing post harvest losses and value addition

1.A Existing grading facilities: Not available in area

1.B Grading facilities to be advised/ setup for doubling income in the agro-ecological region of district:

Establishment of minimal processing plants in various location based on crop and area specific.

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.A Existing processing facilities:

Food processing units of Deptt of Horticulture.

Units of some NGOs

2.B Processing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

Establishment of small or cottage level processing units for market surplus in Gola nashpati, Chullu, malta for food products.

Establishment of wine factories for gola, chullu, plum and other forest products.

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular commodity
6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

3.A Existing packing facilities: Not available

3.B Packing facilities to be advised/ setup for doubling income in the agro-ecological region of district:

A factory based on plastic cartoon, *Kilta*, *Dalia* of various grade and size based on weight of the fruit is needed at least at distt level to meet the requirement of apple and seasonal vegetables.

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)
4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxesfor particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed
8. Litchi peeling and shredding unit

4.A Existing storage facilities: At present no storage facilities are available in the distt.

4.B Storage facilities to be advised/ setup for doubling income in the agro-ecological region of district:

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo

3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chambers
7. Jaggery storage bin

F. Waste land development and waste water

1.A Existing practices of soil water conservation:

1. Using indigenous technology use for water conservation includes formations of bund, growing of Napier and other perennial grasses,
2. Multiple forest species as per need are requirement.

1.B Package of practices to be advised/ developed for management of wasteland and wastewater in the agro-ecological region of district:

1. Storage of wastewater by using low cost water harvesting technology as *kuchha* and *Pucca* tank.
2. Polytank can be constructed as (5x3x2m) capacity to meet the lean season demand of seasonal vegetables and for non agricultural use also.
3. In wasteland, a wide scope of fodder plantation of Morus, Chhanchru, and Melilotus sp can be utilized.
4. In dry and un-irrigated situation there is scope of bael, amla can be included. There is need to put fodder crops in wasteland.

2.A Existing plantation: Tun, shirish, Bheemal, Kachnar, Kharik, shisham in low and mid hills Utis, banj,chhanchru, leucinia, Mulberry

2.B Plantation suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of district: Morus, Shirish, Kharik, Utis, Oak, Bheemal, Kachnar, Vilyati khair etc are useful as dual purpose species to meet fodder, fire wood and other requirement of the farmers. Sufficient plants are available at forest nurseries for plantations.

3.A Existing fodder production: Crop stobbers, wild grasses, Forest leaves etc.

3.B Fodder suggested and Package of practices to be advised/ developed for waste land development and waste water management in the agro-ecological region of district: Napier grass, Tall fescue, Perennial rye, Pongola grass, Clovers

4.A Type of waste water: Home and kitchen waste

4.B Existing treatment facilities: Not available

4.CTreatment facilities to be advised/ developed for waste water treatment and utilization in the agro-ecological region of district: Multistage filtration unit should be established to recycle the waste water for multiple uses.

G. Reduced cultivation cost

1.A Existing inputs being given:

1. Traditional and unprocessed inputs are used in agricultural practices.
2. Drudgery prone implements/tools are in practice for various operations.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district: Application of nutrients based on soil test basis as major and micro elements.

2.A Existing mechanization:

Limited use of power driven implements in land preparation. Small tools like sickle, hand hoe etc are being adopted by progressive farmers.

Wheat

1. Conventional tillage by offset disc harrow/ rotavator followed by Planker
2. Conventional seed-cum-fertilizer drill/manual broadcasting for sowing
3. Manually operated sprayers for plant protection/tractor operated high pressure sprayers.
4. Manual and chemical weed control
5. Combine harvester/manual harvesting
6. Multi-crop/wheat thresher
7. *Bhusa* combine/straw reaper in combine harvested field.

Paddy

1. Conventional method of nursery rising.
2. Conventional tillage using disc harrow.
3. Puddling by paddy disc harrow/rotavator/ cultivator/peg type puddler.
4. Manual transplanting.
5. Manual/chemical weed control.
6. Manual top dressing of urea and zinc.
7. Manual/combine harvesting.
8. Threshing by axial flow power thresher.

Soybean

1. Seedbed preparation using disc harrow followed by planker.
2. Manual sowing.
3. Manual interculture and earthing-up of plants.
4. Manually operated sprayers for weed control and plant protection.
5. Manual harvesting.
6. Manual threshing/multi-crop power threshers

Pea

1. Seedbed preparation using disc harrow followed by planker.
2. Sowing by conventional tractor drawn seed drill.
3. Chemical weed control and plant protection using high pressure tractor operated sprayers.
4. Manual picking of vegetable pea.
5. Manual harvesting for seed production.
6. Threshing by multi-crop thresher

Management of Orchards

1. Manual digging of holes for sapling planting.
2. Manual watering of plants.
3. Manual interculture operations.
4. Manual pruning of branches.
5. Manual plant protection.
6. Manual picking of fruits.
7. Manual grading.

2.B Mechanization required for reducing cost of cultivation in the specific agro-ecological region of district:

Power tiller, power weeder, and shrub cutter, Multiple crops threshers are becoming popular and are available in pockets. Old wooden based implements are being replaced with iron/alloy (Plough, danalla,) based tools are available. **Wheat**

1. Seedbed preparation by rotary plough /rotavator
2. Sowing by zero-till drill / roto –till drill / happy seeder
3. Tractor operated high capacity power sprayers/ power operated ULV sprayers for plant protection.
4. Combine harvesting and *bhusa* making using *bhusa* combine.

5. Self-propelled reaper binder / tractor drawn vertical conveyor reaper windrower.
6. High capacity power wheat thresher.
7. To avoid wheat straw burning and its useful application recovery of wheat straw using tractor drawn baler.

Paddy

1. Transplanting by self-propelled transplanter and mat type nursery raising.
2. Seedbed preparation by rotavator / conventional disc harrow.
3. Puddling by rotavator / peg type puddler.
4. Cono-weeder / powered paddy weeder for weed control.
5. *Promotion of Direct Seeded Rice using DSR Seed drill.*
6. *Promotionof rice drums seeder for sowing of pre-germinated rice.*
7. Chemical weed control using high capacity power sprayers in DSR / drum seeded rice.
8. Harvesting by self-propelled combine harvester.
9. Harvesting by tractor / power tiller operated vertical conveyer reaper windrower.
10. Threshing by axial flow thresher.
11. To avoid paddy straw burning and its useful application recovery of paddy straw using tractor drawn baler.

Soybean

1. Seedbed preparation using rotary plough / rotavator / disc harrow followed by planker.
2. Sowing by FIRB planter.
3. Weed control by powered rotary weeder.
4. Harvesting and threshing by soybean combine.
5. Harvesting by tractor drawn soybean reaper.
6. Threshing by multi-crop thresher.

Pea

1. Seedbed preparation by rotary plough.
2. Sowing by tractor drawn inclined plate planter.
3. Plant protection using ULV sprayer.
4. Chemical weed control.
5. Manual picking for vegetable pea.
6. Harvesting by self-propelled combine harvester for seed production.

Management of Orchards

1. Digging of holes by light weight power tiller operated post hole digger.
2. Watering by fertigation using drip method.
3. Pruning by power chain saw / mechanical pruners.
4. Fruit picking by mechanical hand held pickers.
5. Plant protection by aero blast sprayer.
6. Grading by mechanical graders.

3.A Existing collective inputs: Community pasture land, Service bulls, Irrigation channel and source, Irrigation tanks,

3.B Collective inputs suggested for reducing cost of cultivation in the specific agro-ecological region of district:

Custom hiring energy based implements viz. Small tractor, tiller, Power sprayers, Mandau thresher, Hydrum irrigation can reduce the cost of cultivation along with reduction of farm labour.

Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district:

1. Labour cost
2. High hybrid seed cost
3. No storage facilities for perishable product

4. No chilling plant for milk

H. off-farm income

1.A Existing SHGS operative in specific agro-ecological region of district: ATMA, AAJIVIKA, GRASS, SAMBANDH, NIDHI, BAIF, KAGAS

1.B SHGS to be created/ encouraged in the specific agro-ecological region of district for doubling agricultural income:

1. Milk collection and chilling group
2. Honey collection and production group
3. Mango and Litchi collection centres
4. Crop collection centre
5. There is need to have regular monitoring and follow up of SHG's by the forming agencies and time to time evaluation of the group.
6. Regular monitoring by the concerned agency must be ensured like ensuring regular meeting of the SHG, checking their register, regular collection of the money, help during conflicts, solving problems occurring during banking etc. and submitting the monitoring report to their concerned officials so that steps can be taken by the high officials to ensure regular continuity of the SHG.
7. Imparting the information to the groups about various govt. schemes regarding loan, trainings and marketing of the product.
8. A large number of groups discontinued as they were not having knowledge regarding income generating activities that can be started (what activities can be taken up, how to operate it, where to market the produce etc.) So there is need of encouragement, motivation along with imparting knowledge, skills and linking them to market.
9. Trainings should be provided to the rural women on income generating activities as per the need of rural women, marketing potential and availability of locally available resources.
10. Loan procedure should be made more flexible with less interest rate.
11. As there were problems like non-cooperation among members, confusion regarding money matter, lack of confidence on office bearers with respect to group money etc., there is need of organizing training on good governance, democratic election and how to solve financial and administrative issues.
12. SHG's formed should be grouped into clusters, federations and registered cooperatives so as to converge with govt. schemes, facilitate collective purchase of input and marketing of products.
13. To encourage people to form and sustain SHG's so that new enterprise developed, intensive work needs to be done with them in sustainable manner.
14. Enterprises need to be identified depending upon local resources- human and material.
15. Market linkages need to be developed so that people can sell their produce gainfully.
16. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
17. Target should not be only to form large number of SHGs but care should be taken that formed SHG may be in less number are functioning properly.

1.C Problems related with SHG:

1. Not interested in continuing the group
2. Non-cooperation among the members
3. Problem in getting loan
4. Lack of resources like money, space
5. Lack of knowledge regarding various income generating activities,
6. Lack of trainings
7. Lack of follow-up and monitoring from the forming agencies.

8. In hills farm holdings are very small and large part is rainfed depending upon rains with very low and uncertain productivity.
9. Young people do not stay in villages and move to other areas or take up other profession such as tourism, transport, hospitality etc.
10. People remaining in villages are not very enterprising.

2.A Existing Micro-entrepreneur employment: Sheetla fal sanraakshan Semiti Lohaghat, Maa purnagiri ajeevika sewa sahkarita Bapru Champawat, Shri ram fal sanrakshan udhayogic aasthan Champawat

2.B Micro-entrepreneur employment to be generated in the specific agro-ecological region of district for doubling agricultural income:

1. Poultry growing group
2. Honey and honey products unit
3. Milk and milk products shops
4. Honey collection and production group

3.A Existing skill development facilities: Extension training institute

3.B Skill development facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units
5. Value addition and food chain centre
6. Storage, grading and Packaging centre
7. Silk worm based skill development units
8. Bioagent and bio fertilizers production lab
9. Tissue culture lab for massive production of elite planting material
10. Medicinal plant growing and processing units
11. Survey need to be conducted regarding locally available crops, fruits, vegetables and other things. On the basis of these enterprise can be generated. Handloom weaving can be promoted Training centre, processing and packaging units as per the locally available resources

4.A Existing women skilling facilities: Not Available

4.B Women skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Khadi and Kargha training for women skill
2. Drudgery reduction practices for high efficiency
3. Herbal dye based skill training and skill for local textiles.
4. Value addition skill for women

5.A Existing youth skilling facilities: Extension training institute

5.B Youth skilling facilities to be created in the specific agro-ecological region for doubling agricultural income:

1. Mushroom production and training facilities
2. Development of advanced horticultural handling units
3. Fish ponds
4. Dairy/Poultry/ gottary units
5. Value addition and food chain centre
6. Storage, grading and Packaging centre
7. Silk worm based skill development units
8. Bioagent and bio fertilizers production lab
9. Tissue culture lab for massive production of elite planting material

10. Medicinal plant growing and processing units

Beekeeping

Beekeeping is an environment friendly and agro-forestry based occupation. It provides enormous potential for income generation, poverty alleviation and sustainable use of forest resources. Beekeeping is one of the oldest traditions in India for collecting the honey. Honey bee farming is becoming popular due its demand in national and international markets as well. *Apis cerana indica* is the indigenous bee, is known to be the ideal pollinator for organically grown mountain crops due to its capacity to significantly enhance agricultural productivity. India has a potential to keep about 120 million bee colonies that can provide self-employment to over 6 million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tons of honey and about 15,000 tons of beeswax.

Less Investment: Bee Farming is not a manufacturing activity, as such costly machine and tools are not required. There is nothing like production capacity as well. Only small wooden frames with boxes are needed. Their sizes are also standardized. To begin with around 15 such sets/boxes can be purchased or assembled at rate of Rs.1500.00 per box that would cost Rs.22, 500/- for 15 Boxes. Honey extractors would cost to the tune of Rs.5, 000/- each with filtration facilities. For other miscellaneous expenditures including training and consultancy services a sum of Rs.5000.00 can be earmarked. That means total of Rs.32, 000.00 would be required to start Bee Farming with 15 Boxes which is equivalent or less than the cost of cultivation of one acre of paddy field.

More Returns: As per the established norms, each box comprises 7-8 hives which is able to harvest around 30-35 kg of honey in a year. The annual harvest of honey starting with 15 bee boxes could be 450-525 kg depending on the flowering season. Even after considering very conservative selling price of Rs. 150/- per kg; the annual realisation would be to the tune of Rs. 67,500/- to Rs.78,750/-. Therefore, Bee Farming can be considered as an excellent, profitable agro-based green enterprise for landless farmers and entrepreneurs.

Beekeeping in Uttarakhand: Beekeeping has been an integral part of human society since centuries in hill regions of Uttarakhand state. The state of Uttarakhand has a predominantly agrarian economy and large number of small and marginal farmers in the mountainous state call for augmenting agricultural production by organic means. The indigenous bee sub-species *Apis cerana indica* commonly is ideal pollinator for organically grown mountain crops, with the capacity to significantly enhance agricultural productivity with an indirect but vital role in combating soil degradation by pollinating wild plants thereby enabling improved regeneration of bio mass, to be returned to the soil. Beekeeping with *Apis cerana indica F*. is a common practice in hills of Garhwal and Kumoun Himalaya which is carried out mostly by using traditional methods since long past and is stationary in nature. In these regions, beekeeping is also carried out with *Apis mellifera,* but in winter season, due to temperature lower than 20ºC, colonies are being migrated to plains. According to report given by KVK Jeolikot(2017), in Uttarakhand, there are about 4,790 beekeepers with 45,247 number of *A. cerana indica* colonies yielding 546.70 mt of honey production. Whereas, in Almora region of Uttarakhand, there are about 400 beekeepers with 1,165 number of *A. cerana indica* colonies yielding 16.4 mt of honey production. The Uttarakhand state has extremely rich bee forage plants. In most of the remote areas where *Apis cerana indica* beekeeping is common, the use of pesticides and chemicals is negligible, the level of dangerous chemicals in the atmosphere is insignificant and the environmental pollution is at minimal level. Honey produced from such areas is purely natural, free of any residues and can be sold as an organic product. There is vast potential for beekeeping in the country. However, due to lack of knowledge, scientific beekeeping is not being practiced by, most of the beekeepers. It is necessary for beekeepers to participate in the trainings / other capacity building programmes on the subject to gain scientific knowledge on the subject. Selection of good apiary site, good

quality bees and proper management are the main keys for success of beekeeping. Following are the important points to start beekeeping and further management practices.

1. Selection of good apiary site: Select apiary site by considering the following:

1. Apiary ground should be clean & free from dry leaves etc. to avoid fire during summer
2. Apiary site should be away from power station, brick kilns, highway and train tracks
3. Site should be open & at dry place having shade
4. Site should be easily accessible by road
5. Fresh running water should be easily available near the apiary
6. It should have natural / artificial wind breaks
7. Site should receive early morning and afternoon sunshine
8. There should not be other commercial apiary within 2-3 kilometers from the apiary site
9. There should not be any source of stagnant / dirty water, chemical industry/ sugar mill, etc., nearby the apiary
10. Area should be rich in bee flora

2. Selection of good quality bees: Beekeeping depends on floral resources, climatic conditions, management and also quality of bees, particularly queen. Therefore, the following should be kept in mind to select the bee colonies:

1. Buy disease free bee colonies from existing reputed beekeepers after getting training on the subject.
2. Select and multiply honey bee colonies only from disease resistant, high honey yielding, young, healthy and high egg laying capacity queen, less swarming tendency etc.
3. Keep colonies with good prolific queens
4. Capture few bee colonies from their natural abodes in forests which may be used for further breeding/ multiplication to prevent inbreeding.

3. Management of apiary:

A. Placement of colonies in apiary

1. Hives should be as per specification of BIS/ISI and should be of locally available seasoned light weight wood. Unseasoned and heavy wood should be avoided
2. Avoid nailing the bottom board with the brood chamber
3. Restrict number of bee colonies in a apiary from 50-100
4. Keep row to row and box to box distance as10 and 3 feet, respectively

Hives used for traditional beekeeping in hilly areas are

Wall hives: Wall hives locally known as 'Khadra', 'Jaala' or 'Jalota' are rectangular structures made in the walls of houses and 'Chhaan' or 'Sunni' (cattle sheds) at the time of construction. Each hive has a small round or rectangular opening on the outer side as an entrance for bees. The size of 'Jalotas' varies in different locations; usually they are 45-60 cm in length, 25-30 cm in width and 20-30 cm in height. Generally one hive is made in each wall, but numbers may vary from 2-4. The interiors of hives are smoothed with cow dung and clay. In winters due to lack of floral resources and extreme cold in the hills, the population of *Apis cerana* colonies decreases to a great extent. Thick wall hives provide considerable insulation in such conditions.

Log hives: Two types of log hives are found, Type I: These are made up of cylindrical hollowed pieces of tree trunk 60-100cm long and 20-40 cm in diameter; however size depends upon the circumference of available trunks. This type of log hives is usually made from the trunk of *Quercus leucotrichophora, Q. floribunda, Rhododendron arboreum and Pinus roxburbhii.* The entrance is made at the mid front side. Both sides are plastered with a mixture of cow dung and clay. Type II: Old cooperages locally known as 'Pariya' or 'Dokha' when rendered useless for milk products, are used as hives. These are about 70-90 cm long with the diameter at top from 25-35 cm and thickness of log 3-5cm. An entrance is made towards the outside and the hive is placed horizontally on a raised platform of stones or the

wall of a courtyard. It is mainly made up of the wood of *Ougeinia oogeinesis, Rhododendron arboreum, Toona* sp. A stripe of old comb is fixed to the upper part, inside the hive, and is plugged with a wooden or metal cover, then sealed with a mixture of clay and cow dung. The wooden lid is fixed at the top with an entrance on it.

Miscellaneous Types: These are rectangular box hives made up of separate wooden boards with movable top cover. Their size varies in different localities. Usually these are 80-110 cm long, 25-30 cm wide and 40-50 cm high. During extraction, the top cover is removed along with attached combs and bees, and taken away from the hive, then each comb is smoked and shaken gently. Bees return to the hive and beekeepers cut combs easily.

All hives are made from locally available materials, thus are economically cheaper and environmentally friendly. These hives have thicker walls as compared to modern hives thus provide protection to bees from extremely low and high temperatures. In higher hills traditional hives are more suitable than modern hives but for the drawback in colony management.

B. Inspection of colonies

1. Adopt general colony and personal hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board, top cover, etc. frequently
2. Check the colonies periodically for any abnormalities or changes in behaviour of bees
3. Inspect colonies on clear sunny days preferably at temperatures between 20 and 30°C
4. Do not inspect colonies in cold, windy and cloudy days
5. Use smoker when needed to subdue the bees
6. Use protective dress and veil while inspecting colonies
7. Handle colonies gently, avoid jerks
8. Avoid crushing bees as it could lead to stinging
9. Isolate the diseased colonies from healthy ones.
10. Handle diseased and healthy colonies separately

C. Provision of fresh water in the apiary

Ensure availability of fresh water preferably in shallow containers near the apiary to maintain a healthy apiary. Water is needed for the following

1. Maintenance of adequate humidity in a colony to ensure proper incubation of eggs
2. For feeding bee bread by nurse bees, the mixture of honey and pollen of certain consistency is required for which water is needed
3. When temperature in the apiary increases beyond 37°C, water is used by bees to evaporate and cool the colony

D. Dearth period management

1. Provide 50% sugar syrup to the colonies during dearth periods when honey stores in the colonies is not adequate and nectar is not available in the area. The syrup should be prepared by boiling clean water in the vessel and sugar added with slow stirring for few minutes. Cover the vessel with lid and let it cool. Feed cooled syrup.
2. Sugar syrup should be kept in such a way that the bees should not drown in it. This should be ensured by using shallow vessels with straw to facilitate easy feeding
3. Do not prepare the feed in open in the apiary and avoid dripping on the ground to prevent robbing by bees and ants
4. Feed the colonies in the evening preferably after sunset
5. Feeding should be given to all colonies in the apiary at one time
6. Pollen substitute comprising of fat free soyabean flour (3 parts) + Brewer's yeast (1 part) + skimmed milk powder (1 part) + sugar (22 parts) +honey (50 parts) made in the form of patties should be provided when pollen stores in the colonies is not adequate and pollen is not available in the area
7. Provide fresh water near the colony in shallow vessels

8. Extra frames should be stored in air tight chambers and fumigated with sulphur powder regularly
9. Old and dark combs should be discarded

E. Care during honey extraction

1. Use honey extractor, containers and other bee hive tools /equipments made of stainless steel / food grade plastic. Don't use tins & containers made of other degraded material
2. Wash all the equipments / containers etc. thoroughly with warm water before honey extraction
3. Extract honey from super chambers only
4. Select frames only with 75% sealed cells with ripened honey for extraction
5. Cover the entrance gate of the colony with small branches or twigs to avoid robbing
6. Extract honey in a closed room and not in the open to avoid robbing
7. Do not leave super and brood frames, after extraction of honey open in the apiary;
8. Do not spill honey in the apiary

F. Care during migration

1. Migrate colonies during non-availability of flora to areas with abundant flora.
2. Before migration survey the area to assess the availability of the flora to locate the colonies
3. Ensure honey extraction before migration
4. Close the entrance gates of the colonies in the evening after all worker bees are inside the colony
5. Pack the colonies internally and externally before migration to avoid jerking
6. Colonies in the vehicle should be packed in such a way that the entrance side should face the front side of the vehicle
7. Start migration late in the evening and ensure the colonies reach the destination within 10-12 hrs. the next day morning and entrance gates are opened after landing in the new location
8. Avoid jerking in the way while transporting bee colonies

G. Seasonal management of apiary

a**) Summer Management**

1. Keep the colonies in thick shade
2. Regulate the microclimate of the apiary by using wet gunny bags over top cover and sprinkling water around the colonies in the apiary during noon hours.
3. Provide fresh water in/near the apiary

b) Monsoon management

1. Clean and bury deep the debris lying on the bottom board
2. Keep the surroundings of the colony clean by cutting the unwanted vegetation which may hamper free circulation of the air
3. Provide artificial feeding (sugar syrup and/or pollen substitute) as per requirement of the colony
4. Check the robbing within the apiary
5. Unite weak/laying worker colonies
6. Control predatory wasps, ants, frogs, lizards in the apiary

c) Post monsoon season management

1. Provide sufficient space in the colony
2. Strengthen the colonies to stimulate drone brood rearing
3. Control ectoparasitic mites, wax moth and predatory wasps

(d) Winter management

1. Examine the colonies and provide winter packings in weak colonies specially in hilly areas
2. Feed sugar/pollen substitute to weak colonies as stimulative feeding to provide energy and

initiate brood rearing
3. Shift the colonies to sunny places
4. Protect the colonies from chilly winds by using wind breaks
5. Unite the weak colonies with stronger ones

e) Spring management

1. Unpack the colonies, clean the bottom board, replace the worn out hive parts and provide sufficient space
2. Provide stimulative sugar/pollen substitute to increase brood rearing
3. Equalise the colonies
4. Extra frames should be raised by providing comb foundation sheets
5. Replace the old queens with new ones through mass queen rearing or divide the colonies
6. Manage the colonies in such a way to prevent swarming
7. Monitor regularly for ectoparasitic mites and adopt control measures

H. Protecting colonies from pesticides

1. Persuade the farmers not to use pesticides or use selective pesticides that are less harmful to bees at recommended concentrations
2. Avoid the use of dust formulations as they are more harmful to bees than spray formulations
3. Prior information about spraying would help in reducing poisoning of bees
4. Avoiding spraying of pesticides during flowering of the crop and peak foraging time of the bees would help in reduction in the mortality of foraging bees
5. Spraying may be done in the evening after sun set when bees do not forage
6. Colonies may be temporarily shifted if heavy spraying schedule is fixed
7. If shifting of the colonies is not possible, feed with 200 ml sugar syrup and close the gate by using wire screen for the day of spraying.

I.Methods of attracting and catching swarms

1. Swarming is a natural process for propagation of honey bees. Swarms are the lone source of bees in traditional beekeeping of *Apis cerana* while only a few empty hives are inhabited by absconded or feral colonies.
2. Empty hives are cleaned and smeared with clay, cow dung or both. Honey or jaggery are put inside hive to be used as bait to attract the swarm.
3. Flowering shoots of *Brassica campestris, or Raphanus sativus* can also be used just above the hive entrance, hoping that scout bees will find their home in the empty hive.
4. When swarms is found in the vicinity, water can be sprinkled and soil or ash can be thrown to settle them. 'Tofri' or 'Garori' (special baskets) made up of 'Ringal' (bamboos); 'Jhola' (bag) can be used to catch and carry swarms. 'Kutrine' (burning cotton cloth) is used as a traditional smoker and 'Talikh' (a cloth) to save faces while catching the swarm.
5. To catch a swarm layer of jaggery or honey is applied at the inner base of the basket and hang it inverted near the settled cluster. The cluster is gently displaced from the other side with smoke to direct the bees towards the basket. As the swarm makes a cluster on the basket, it is transferred to the hive. When the bees are settled the basket is removed. Finally the hive is closed with its wooden cover and be smeared with a mixture of cow dung and clay.

J. Management of Honey Bee Diseases and pest

Honey bees could be affected by diseases and the real cause of abnormality or any disease present in the honey bee broods need to be ascertained before taking up any control measures. It is best to contact the researchers/scientists/beekeeping experts at the nearest centre or university or Government department working on honey bees. After the exact diagnosis of the causal agent of the particular disease, the guidelines/ recommendations given by the expert should be followed in true letter and spirit. However, general advisory for the management of

common diseases of honey bees is given below:

1. Select good site to locate the apiary preferably in an open, dry place with shade.
2. Adopt general colony hygiene in the apiary like cleanliness in the beehives including cleaning the bottom board frequently.
3. Select and multiply honey bee colonies only from disease resistant stocks.
4. Keep colonies with good prolific queens.
5. Create broodlessness in colony for at least 15 days by enclosing the queen in a queen cage.
6. Check the colonies periodically for any abnormalities or changes in behaviour of bees.
7. If you observe any colonies with disease, isolate them from healthy ones. Handle diseased and healthy colonies separately.
8. Keep the colonies strong by adding sealed brood comb or worker population only from healthy colonies and also by providing adequate food during dearth periods.
9. Prevent robbing, drifting, absconding and avoid migration of bee colonies when you notice disease symptoms.
10. Follow 'Shook Swarm' or shaking method to remove contaminated combs completely by transferring entirely new combs in one operation to the colonies with disease symptoms. Destroy the removed combs by burning.
11. Sterilise the combs and equipments by any one of the following methods:

e. Disinfect the empty combs and equipments with 80 per cent acetic acid @ 150 ml per hive body in piles for few days at a protected place. Air the treated materials before use.

f. Dip the contaminated equipments and combs in soap solution containing 7 per cent formalin for 24 hours. Then wash the treated material with water, dry and use.

12. Use of antibiotics to control honey bee diseases is likely to result in contamination of honey causing problems in export of honey.
13. The traditional method to check the entry of ants is spreading ash or turmeric powder in their way.

K. Honey Extraction

The main honey seasons in hilly areas are '*Chait*' (April), '*Baisakh*' (May) and '*Ashaad*' (July-August). In some localities, an additional extraction during '*Kartik*' (October) is also done. Colonies yield most honey in '*Chait*'-'*Baisakh*' and the least in '*Kartik*'. Traditional tools used are '*Dathule*'. (sickle) to open the cover or wooden plug and '*Buwan*' (traditional brush) made up of '*Babul*' (*Eriophorum comosum*) to brush off bees. Besides these traditional smokers, large pans for keeping combs, a pot with water and '*Parunla*' or knife for cutting '*Faur*' or '*Fwar*' (bee combs) are required at the time of harvest. Honey is mostly extracted at night but a few beekeepers do it in day time also. Combs are cut down, leaving the innermost comb for feeding and to attract swarms the next year. Honey combs are squeezed after removing the brood area from the cut combs. The harvested honey has many impurities like insect body parts, wax cells, etc. Usually, squeezed combs are thrown away after extraction, which can be fed to cattle especially bulls. Honey is stored in plastic or metal containers and in bottles.

The beekeepers doing beekeeping with modern hives should use honey extractors to harvest honey. The quality of honey extracted using honey extracting machine is much better than squeezing method.

Mushroom cultivation

The shrinking land, demand for functional foods, priorities for recycling agricultural residues and changing trades in view of globalization are going to play an important role in the agricultural scenario, and secondary agriculture is likely to play a pivotal role. Our country can emerge as a major player in mushroom production in wake of availability of plenty of agricultural residues and labour. To remain competitive it will be important to harness science

and modern technologies for solving the problems of production and bio-risk management. Mushroom being an indoor crop, utilizing vertical space offers solution to shrinking land and better water utility. Packages and practices of mushroom cultivation in Almora is as follow:

1. **White Button Mushroom (*Agaricus bisporus*)**

Button mushroom scientifically known as *Agaricus bisporus* and has he widest acceptability. Cultivation of this mushroom is a complex process and requires two different temperature i.e. 22-26^{0}C for spawn run and 14-24^{0}C for fruit body formation. Besides specific temperature, it require proper humidity (80-90%) and enough ventilation during fruit body formation.

Steps of cultivation process

Compost preparation: Compost is an artificially prepared growth medium from which mushroom is able to derive important nutrients required for growth and fructification. Cemented floors and shade over the floor are required for making good quality compost. There are two main methods for compost preparation:

Long method of composting: This is an outdoor process and takes around 28 days in its completion with a total of seven turnings. The following materials are required for long method of compost:

Wheat straw	1000 Kg	Urea	10 kg
Wheat bran	50 kg	Gypsum	100 kg
Ammonium sulphate or calcium ammonium nitrate	30 kg	Furadan	500 g
Super phosphate	10 kg	B.H.C.	500 g
Muriate of Potash	10 kg		

Before making compost, wheat straw is spread on cemented floor and is turned many times with water being sprayed at regular intervals.

Day 0: At the stage, there should be around 75% humidity content in the wheat straw, to which wheat bran, calcium ammonium nitrate, urea, murate of potash, and super phosphate are mixed thoroughly and evenly. The material is then piled 1.5m thick x1.25m high with the help of wooden rectangular block. The blocks are removed. Once the entire material has been stacked up or piled up. Water is sprayed twice or thrice to keep the substrate moist. Temperature should be in the range of 70-750C.

1st turning Day 6: On the sixth day first turning is given to the stack. The purpose of turning is that every portion of the pile should get equal amount of aeration and water. If the turnings are not given, then anaerobic condition may prevail which may lead to the formation of non-selective compost. In the stack, the central zone is fermenting at its peak and has maximum temperature rest of the portion is either not at all fermented or ferments improperly. The correct method of turning is as: Removing about 15cm of compost from the top and spread it on one side of the floor, the rest part of compost on the other side of the floor. Now turning is done by shaking the outer (top most) part and the inner part of the compost, first separately and then missing them altogether thoroughly with the help of wooden buckets.

2nd turning (Day 10): On the tenth day, again the top most part and the inner part of the compost is separated, water is sprayed on the top part. Again the two parts are piled up together in such a way that now the top part is inside and the inner part is on the top of the stack.

***3rd turning (day 13)*:** it is also done in the same way as described earlier and required quantity Gypsum mixed at this stage.

***4th turning (day 16)*:** The same process of turning is followed. The required quantity of furadan & lindane are added during this turning.

***5th turning (day 19)*:** The compost is turned in the same manner.

***6th turning (day 22)*:** The same process of turning is followed. The required quantity of furadan and lindane are added during this turning.

***7th turning (day 25)*:** The compost is turned in the same manner

***8th turning (day 28)*:** if no ammonia persists in the compost, spawning is done.

Short method of composting: Compost prepared by short method of composting is superior in production quality and the chances of infection and disease is quite low. Composting by this method requires special infrastructures; equipments etc. that initial cost is to high, therefore, the farmers can purchase the readymade compost from the authentic composting units. The compost when ready for spawning should have the following characteristics:

Moisture	About 68%	**Ammonia**	Below 0.006%
pH	7.2-7.5	**Nitrogen**	Around 2.5%
Fire fangs (Actinomycetes)	Excellent growth		

Proper timing for cultivation: Sept. – Nov.& Feb.-April (02 crop)

Cultivated strain: Delta, U-3, S-11, MC-465, A-15

Spawning :The process of mixing of the spawn in the compost is known as spawning. Spawn is thoroughly mixed in the compost at the rate of 600-750 gm per 100 kg of compost (0.6-0.75%). The spawned compost is filled in tray or polypropylene bags covered with formalin treated news papers. In case of bags, they should be folded at the top and covered up. After spawning, temperature and humidity of crop room should be maintained at 22-26^{o}C and 85-90%, respectively for spawn run. Water should be sprayed over the covered news papers, walls and floors of the crop room. After 12-14 days of spawning white mycelial growth is seen running the entire length of the tray/bag. This is then covered with casing soil on the surface.

Casing soil : The significance of casing soil is to maintain the moisture content and exchange of gases within the surface of the compost which helps in the proper growth of the mycelium. The pH of the casing soil should be 7.5-7.8 and must be free from any infection or disease. In our country casing soil is prepared from the following ingredients.

Two years old manure + garden soil	3:1
Two year old manure + garden soil	2:1
Two year old manure + spent compost	1:1
Two year old manure + spent compost	2:1

Pasteurization of casing soil: The casing soil is piled on cemented floor and is treated with 4% formalin solution. Thorough turning of the soil is done and it is covered with polythene sheet for the next 2-3 days. After that remove the polythene cover and turn the casing soil so that it is free from the smell of formalin.

Using the casing soil: A layer of casing soil (3-4cm thick) is being spread uniformly on the compost when the surface has been covered by white mycelium of the fungus. Formalin solution (0.5%) is then being sprayed. Temperature and humidity of the crop room should be maintained at 14-18^{o}C and 80-85%, respectively. Proper ventilation should be arranged with water being sprayed once or twice a day.

Harvesting of crop: Pin head initiation takes place after 12-18 days of casing and the fruiting bodies of the mushroom can be harvested for around 50-60 days. The crops should be harvested before the gills open as this may decrease its quality and market value.

Productivity: From 100 kg compost prepared by long method of composting 14-18 kg of mushroom can be obtained. Similarly, 18-22 kg mushroom can be obtained from pasteurized compost (Short Method Compost).

2. Oyster mushroom

The species of the genus *Pleurotus* are commonly known as oyster mushroom or dhingri mushroom. This mushroom can be cultivated at a temperature range between 20-28^{o}C and relative humidity between 75-90 per cent.

Steps of cultivation process

Substrate and its preparation

The tropical wastes like rice straw, wheat straw, corncobs, dried water hyacinth, sugarcane bagasse, banana leaves, cotton waste or sawdust are used as substrate for cultivation. The straw should be cut into small pieces (3-5cm long) to facilitate proper wetting as well as to increase surface area. Although this mushroom can be cultivated on simple water soaked straw but there are chances of crop failure due to presence of contaminants. In order to avoid contaminations the straw should be treated by hot water and chemical.

Hot water treatment-The substrate should be is treated with hot water at 65^{o}C for 1 hour. The excess water is then drained off and substrate cool down to room temperature for spawning.

Chemical treatment- The materials are usually soaked in water chemically sterilized with carbendazim (7-10g) and formalin (120-150 ml)/ 100 litre of water for 16-18 hours. After that straw is taken out from solution and spread on clean cemented floor or on polythene sheet to evaporate the excess water. The ready substrate should contains 65-68 per cent moisture.

Proper timing for cultivation March.- May & July.-Sept (02 crop)

Cultivated spices: *P. sajor-caju, P. florida, P. sapidus, P. eryngii, P. cornucopiae, P. flabellatus, P. djmore, P. eous, P. ostreatus*

Spawning and crop management : Oyster mushroom spawn should be about 15-20 days old when mycelium has formed complete coating around the grain. The normal rate of spawning in a pasteurized substrate is 2-3% of the wet substrate. The spawning is usually done by mixing the spawn throughout substrate. Before filling the substrate in polythene bags, holes of about 1 cm diameter are made at 10-15 cm distance all over the surface for free diffusion of gases and heat generated inside. The optimum temperature for growth of mycelium is 23 ±2^{o}C. Relative humidity in growing room should be range between 85-90% during spawn-run. Spawn run usually takes about 15-20 days. After complete spawn run, polythene removed completely with help of sharp knife carefully. Usually 3-4 days after opening the bags, mushroom primordial (pin heads) begin to form. After opening the bags water should be sprayed 2-3 time per day regularly.

Harvesting and yield: Mature mushrooms become ready for harvesting in another 2-3 days. An average biological efficiency (fresh weight of mushrooms harvested divided by dry substrate weight x 100) can range between 70-80% and sometimes even more. To harvest the mushrooms, they are grasped by the stalk and gently twisted and pulled. A knife should not be used.

I. Enabling Policies

1.A Existing policies related with agriculture and animal husbandry:

Subsidies and incentives are given on all agricultural inputs. More than 50% subsidies are granted on all inputs and implements.

1.B Policies to be suggested for doubling income in the specific agro-ecological region:

1. Selection of crop and area specific crop production program
2. Timely and assured supply of agricultural inputs to farmers at door.
3. Popularization of playhouses technology for vegetables and flower production
4. Inclusion of hybrid seed programme for crop production.
5. Establishment of seed production units for temperate crops.
6. Need to establish more food processing unts.
7. Availabilities of credit at minimum interest rate.

8. Assured byback policy for agricultural produce.

2.A Existing Institutions:

1. Directorate of cold water fisheries research farm, KVK, Cow Breeding Centre of State Government
2. NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district:

1. Establishment of food proceesing units at distt level to procure and marketing of surplus.
2. Testing of new crops in non-traditional areas for doubling the crop production.

3.A Existing Incentives: -

3.B Incentives to be suggested for doubling income in the specific agro-ecological region of district:

1. An assured bonus to farmers to grow new crop or higher production potential
2. Selection of farmers at village for trendsetter for dissemination of technical knowledge and technology may be awarded
3. Free access to libraray and one institute at least once in a year.

4.A Existing risk coverage facilities: Crop and Animal Insurance Schemes

4.B Risk coverage facilities to be suggested for doubling income in the specific agro-ecological region:

1. Risk coverage may be applicable for all agricultural products and animals
2. Declaration and minimum support price be fixed well in time

J. Marketing and value addition in specific agro-ecological region

1.A Existing marketing facilities:Local market

1.B Marketing facilities to be suggested for doubling income in the specific agro-ecological region:

Contractual farming, linkages with MNCs and NCs, Mahila hat, local hat, weekly bazaar, local mandi, AC van,

2.A Existing grading facilities: Nil

2.B Grading facilities to be suggested for doubling income in the specific agro-ecological region:

Mechanical grading facilities should be made available on cluster basis

For grains:

1. Indented cylinder for rice/paddy grading
2. Sieve gyrator for particular commodity
3. Dockage tester for particular commodity

For horticultural crops:

1. Sorter for particular commodity
2. Size grader for particular commodity
3. Weight grader for particular commodity
4. Colour grader for particular commodity

2.C Processing facilities to be created for better marketing and value addition in the district:

Grading and packaging facilities, small scale fruit and vegetable processing units

For grains:

1. Processing unit with facilities of mechanical drying, farm level shed drying, cleaning and milling
2. Mobile seed processing unit at village level for particular commodity
3. Mobile paddy miller at village level for particular commodity
4. Rice mill with parboiling, drying, dehulling, grading and polishing at district level
5. Small capacity flour mill with packaging facility at village level for particular

commodity

6. Large capacity multigrain flour mill with washing, drying, milling and packaging unit at district level for particular commodity
7. Cleaner, splitter, grader and packaging at village level for pulse milling
8. Pearler, grader, miller and packaging unit for millets
9. Cleaner, mechanical oil expeller, hydro-distillation unit (clevanger), bottling and canning unit at district level for particular commodity
10. Sugarcane crusher, open pan evaporator, moulds for jaggery, packaging unit at village level

For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unit for particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity
5. Maintaining cold chain from farm to folk (depending upon the commodity)

2.D Packing facilities to be created for better marketing and value addition in the district :

No marketing facility, No value addition facility, High transportation cost,

For grains:

1. Packaging infrastructure at village level with packaging, sewing, sealing and labeling facilities
2. Jute bags and raffia bags with LDPE coated for particular commodity
3. 3-ply laminated packaging bags for particular commodity (polyethylene, polypropylene, or a co-polymer)
4. IRRI bags for particular commodity

For horticultural crops:

1. Packaging platform at farm level with packaging, sticking, sealing and labeling facilities
2. Wooden boxes or lined or unlined corrugated fibreboard boxes for fruits and vegetables
3. Small LDPE and HDPE polybags for particular commodity
4. Fresh fruits packaging with active packaging (ethylene, oxygen, moisture scavangers)
5. Paperboard boxesfor particular commodity
6. Perforated paperboard boxes and LDPE/HDPE polybags for highly perishable crops
7. Shrink and wrapping packaging for fresh and minimal processed
8. Litchi peeling and shredding unit

3. Existing marketing and value addition problems in the specific agro-ecological region:

For grain:

1. Multipurpose warehouse with mechanical drying and fumigation facility
2. Drying cum storage silo
3. Modified atmosphere and Hermetic storage structure
4. Kothar, metal bins for small capacity

For Horticultural crop:

1. Air/water pre-cooling chambers on farm level for removal of field heat
2. Evaporative cool chamber for chilling sensitive crops
3. Modified or control atmospheric storage structures
4. Cold storage structures
5. Zero energy cool chamber for hilly areas
6. Solar power cooling chambers
7. Jaggery storage bin

K. Online Management and Evaluation

1.A: Existing online management structure available: Internet etc.

1.B: Restructuring required for online management and evaluation in specific agro-climatic region of district: Each village should be connected by Internet facility with proper device, awareness about internet user.

2.A: Existing evaluation procedure: Manual

2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: GPS, Email, Whatup, ITC tools

3.A: Existing monitoring system: Physical

3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Regular visits and online report submission, farmer feed back

4.A: Existing feedback system: Manually

4.B: Feedback system required for online management and evaluation in specific agro-climatic region of district: Internet and proper software for evaluating ongoing activities

5.A: Existing reading system: Literature, Booklets, Hindi Extension Journals etc

5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Farm advisory portal, online helpdesk services

Specific action plan for doubling agricultural income in agro-ecological region

Strategy 1 : Productivity Enhancement

Introduction, adoption and popularization of high yielding varieties for increasing productivity

1. Promotion of high yielding varieties of wheat {UP-2572, VL *Gehun* 829, VL *Gehun* 907, VL *Gehun* 953, HS 507, HPW 349 (from 1500 to 1700m amsl), VL Gehun 832 and HPW 155, HS 365 (from 1700 to 2400m amsl)} in Pati blocks
2. Promotion of high yielding varieties of finger millets (VL Mandua 352 upto 2000m amsl and PRM1), Barnyard millet (PRJ-1, VL *Madira* 172 and VL *Madira* 207 upto 2000m amsl) and in Pati blocks.
3. Promotion of high yielding variety of lentil (PL 4, Pl 5) and soybean (PS 1092) inPati blocks.
4. Promotion of high yielding varieties of vegetable pea (Vivek Matar 11 for main season & VL Ageti Matar 7 for August sown), French bean (VL Bean 2), tomato (VL Tamatar 4 upto 1800m amsl), Onion (VL Piaz 3 upto 2000m amsl), VL Shimla Mirch 3 upto 1800m amsl and garlic (VL Lahsun 2) in Pati blocks.

Recommended package and practices will be followed for the above said crop varieties

Strengthening of traditional water storage structure

1. Strengthening of existing water storage structures like ponds, Naula and Check dam in most of the villages of all blocks of the region.
2. Creation of rain water harvesting structure in private as well as government buildings in all the villages of the region.
3. Creation of trenches for high percolation of water in most of the area of Pati blocks.
4. Promotion of water conservation techniques like mulch, sprinkler and drip in juvenile plants in low or valley areas of of this region.

Adoption of cluster approach for holistic development

1. Cultivation of citrus fruit (lime/ lemon/ malta) plants, Kiwi (Allison/ Haward/ Monty + Tomari) at mid & high hills in Pati blocks.
2. Promotion of ginger cultivation in all *region*.
3. Promotion of organic cultivation of turmeric in Pati block.
4. Promotion of onion and garlic cultivation in Pati block.
5. Promotion of off season vegetables (tomato, capsicum, cole crops etc.,) cultivation inPati

block.

6. Promotion of production of vegetable pea in Pati blocks.

Management of wild animal problem

1. Promotion of live fencing of lime/ lemon at larger scale in fruit crops, ginger or turmeric in shady areas, Lemon grass to ward off wildlife in cultivated field.
2. Enacting legislative measures for protection of crop from wild animals.
3. Promotion of protected cultivation of vegetables (Tomato, Capsicum, Cabbage, Cauliflower and Cucumber) in Pati block.
4. Promotion of cultivation of Kafal, Mango, Hishalu and other wild fruits in different pockets in forest areas for wild animals.
5. Promotion of chestnut and stone fruits.

Adoption of Farm mechanisation (Power tiller, thresher etc)

1. Popularization of multi crop thresher and Power Tiller/ Mini Tractor at Nyay Panchayat level in all the blocks.
2. Promotion of improved sickle, maize sheller, Vivek Millet thresher cum pearler, VL Paddy thresher and Vivek small tool kit for reduction in drudgery of hill farmers.

Adoption of efficient irrigation techniques

1. Micro Irrigation (Drip and Sprinkler Irrigation) where water is available,
2. Drip Irrigation in integration with water harvesting structure where irrigation water is not available
3. Green House Cultivation for Vegetables

Management of soil health in low or valley areas

1. Popularization of soil testing in intensive mode and distribution of soil health card to farmers for judicious use of fertilisers.
2. Promotion of vermi composting unit and green manuring in all the villages of this region.
3. Organic cultivation of local grain and millets in different blocks.

Others

1. Cluster approach for holistic development.
2. Promotion of timely and local availability of high yielding varieties of all the cereal, pulse, High Value Crops like vegetable, fruits, spices, etc.
3. Cultivation of fodder crops & medicinal plants.
4. Adoption of only well decomposed FYM/ value added compost.
5. Promotion of efficient and timely use of IPM and IDM practices.
6. Compulsion of seed treatment through bio agent/ chemical in the cluster.
7. Adoption of moisture conservation practices.
8. Promotion to focus on timely weed management

Strategy 2 : Livestock: Goatary, Poultry, Fisheries

1. Promotion and up-gradation of local breeds with high milking breeds of cows (Jersey & Holstein friesian), and goats (Sirohi) in Pati block,
2. Establishment of Fodder Bank in Pati block to meet fodder requirement of area particularly during lean period.
3. Establishment of milk chilling plant at Devidhura block.
4. Promotion of Urea, Molasses, and Mineral mixer blocks at *Nyaypanchayat* level.
5. Establishment of hatcheries for need of broilor or croilor at district level to meet out the requirement of chicks to the farmer's.
6. Promotion of availability of feed material with low prices & timely health check-ups of animals.
7. Introduction and promotion of Cross bred milch breed of animal for increasing income of marginal farmer.

Strategy 3 : Integrating Farming system

Following Integrated farming system model may be developed:

Cropping system (Area 4000m^2)

Soybean – Lentil

Cole Crops – Vegatable pea

Maize- Potato

Pea - Wheat

Horticulture

Kiwi & Pear fruits (100 plants)

Livestock

Cow (01) + Sheep(10)

Others

Bee Keeping and poly tunnels for nursery raising

Vermi-composting (20m^2)

Strategy 4 : Reducing post harvest losses and value addition

1. Establishment of mini fruit grading plant for Kiwi, pear and stone fruits at Pati block.
2. Establishment of Food Processing Units for pear atPati blocks.
3. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
4. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in Pati block.
5. Establishment of small processing units for tertiary and value addition of Kiwi, citrus fruits, pear in Pati block.
6. Promotion of common resources on custom hire basis viz. Power tiller in Pati block,
7. Mini wheat and Paddy thresher in Pati block.

Strategy 5 : Waste land development and waste water

1. Contour making for arable purpose in waste land in Balik, Ramak, Mangal lakh, Garsh lakh, Dharonchand other high hills areas.
2. Afforestation of plants and perennial grasses in steep slope of more than 40% slope in Pati block.
3. Plantation of Mulberry plants, Wild fruit plants, Fodder trees (Utees, Oak, Mulberry etc.) may be promoted in Pati block.
4. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all block.
5. Popularization of trenches or silages for percolation of water to avoid surface run off in Pati block.
6. Construction of check dam and artificial structure to maximize water percolation rate in Pati block.
7. Construction of tank for storage of water for lean season in all blocks.
8. Establishment of storage system for rain water in monsoon season.
9. Establishment of waste water treatment plants based on phycoremediation technique at sewer drainage points.

Strategy 6 : Reduced cultivation cost

1. Promotion of specific fertilizers and micronutrients like Zinc, Boron, Phosphorus, etc. may be provided.
2. Provision of mechanization (Use of Power tillers, Power weeders, Mandua/ Madira threshers, Maize Sheller, Wheel Hand hoe, horticulture improved kits etc.)
3. Promotion of well decomposed FYM, Vermicompost and Biofertilizers.
4. Promotion of line sowing and balanced fertilizers application in crops.
5. Promotion of recommended seed rate, spacing and depth.
6. Promotion of need based application of pesticides and other agricultural inputs. `
7. Promotion of hand tools in agricultural and horticultural operations.

8. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
9. Promotion of pressurized irrigation techniques in horticultural crops.

Strategy 7 : Off-farm income

1. Promotion of apiculture/ sericulture/ mushroom for small and landless farmers in all blocks of Champawat district.
2. Promotion of cultivation and collection of medicinal plants in Pati block.
3. Promotion of skill development in women and youth in all three blocks.
4. Creation of new SHGs in villages.
5. Encouragement to existing SHSs for collective farming, opening small scale enterprise like Candle making, Pickle making, Jam & Jelly making, Spice cultivation, Ghee making & packing, etc. may be provided for better performance in all block.

Strategy 8 : Enabling Policies

1. Land consolidation in Champawat district is essentially required.
2. Implementation of Policies for control of wild animal menace in agricultural areas.
3. Implementation of Soil Health Card Scheme.
4. Increasing institutional support by providing subsidises and incentives to small and marginal farmers in Pati blocks.
5. Labelling of organic inputs and certification mechanism for various crops in Pati block.
6. Popularization of Udhyan and KCC for widespread use of government incentives/ subsidies to farmers.
7. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
8. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

Strategy 9 :Marketing and value addition in specific agro-ecological region

1. Installation of mini *mandies* at Block level.
2. Creation of better transportation facilities with cool chain van at Block level.
3. Creation of direct linkages with food processing industries for better prices.
4. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.
5. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.
6. Installation of mini grading machines at village level.
7. Promotion of local *Hatt* at Tahsil level in all blocks.
8. Development of proper marketing network to check the interference of middle men in marketing of agricultural produce of the farmers.
9. Development of policies to ensure the purchasing of farm produce/ products at farmers field site to encourage the farmers

Strategy 10 : Online Management and Evaluation

1. Development of Mobile apps/ software for online management and evaluation at district level.
2. Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level.
3. Organization of monthly review meeting at district to solve the problems related with farmers.
4. Promotion of use of community radio, TV talks and Whatsapp etc. for effective implementation of programme.