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

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

A.General information about Agroeco-region

District: Dehradun

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

Main Blocks in Region: Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur, Doiwala

Main village cluster in blocks: Badwala in Vikasnagar; Charba in Sahaspur; Ranipokhri in Doiwala

Rainfed Clusters: Kwanu in Chakrata block, Thano in Raipur

Existing rain water management facilities:

1. Water harvesting tanks in few pockets of Chakrata, Kalsi and Raipur blocks
2. Collections from hill slope
3. Village ponds
4. Interflow harvesting

B. Productivity Enhancement

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

1. Water harvesting tank
2. Roof top harvesting system
3. Conjunctive and multiple use of water resources
4. Better water conveyance system such as HDPE pipeline

2. Existing practices for soil health improvement

1. Green manuring
2. Use of un-decomposed farmyard manure/ compost
3. Meagre use of biofertilizers
4. Imbalanced nutrient use
5. Meagre practice of green manuring in low land paddy
6. Use of raw/partially decomposed FYM
7. Meagre compost making/ recycling of crop residue

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

i) 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 etc. through composting and/or vermicomposting
4. Use of FYM @4-5t/ha or application of 2.5-3.0 t/ha vermicompost

(ii) Pulses and soybean

1. Seed with specific *Rhizobium* inoculant and 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

(iii) **Vegetables and spices**

1. Seed/ nursery soil inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture (each of 200 g/m2 for nursery soil inoculation; for seed

inoculation quantity varies depending on seed size).
2. Seedling inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture at transplanting.
3. Soil test based balanced use of fertilizers; INM shall be preferred
4. Use of FYM @ 4-5 t/ha or application of 2.5-3.0 t vermicompost

Sugarcane

1. Set inoculation with Acetobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture.
2. Recycling of sugarcane trash through windrow composting
3. Soil test based use of balanced fertilizers
4. Use of FYM @10-12 t/ha or application of 3-4 t/ha vermicompost

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

1. Adjustment of sowing/planting date to coincide with monsoon
2. mulching is done by the farmers in orchards to conserve the moisture
3. drip irrigation is being used in some areas
4. Occasional occurrence: Drought, heat wave, hail storm, cold wave and frost.
5. 5.50% area is irrigated where major crops like rice, wheat, sugarcane are being grown.
6. Vegetables and horticultural crops are being grown over very small area.

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

1. Rajma, urd, moong, lentil, pigeon pea, vegetable pea, tomato, chilli, ginger cultivation need to be promoted on large scale as these crops are already grown by the farmers but their productivity is low in most of the areas.
2. Hence high yielding varieties and hybrids suitable for specific region need to be introduced and commercialized.
3. The climatic projection suggesting increasing air temperature and erratic distribution of rainfall. Therefore following strategy should be followed to increased income under changing climatic scenario.
4. Intercropping of sugarcane + rajma need to be encouraged to increase the income of the farmers.
5. The coverage of GKMS should be increased for enabling farmers to take farm decisions as per ensuing weather conditions.
6. Due to higher precipitation activities (approximately 2200 mm rainfall/annum) the rain water should be properly stored (in polythene tank, by forming bunds) and harvested for Kharif season crops.
7. There is a good demand of off season vegetables therefore area under off season vegetable should be increased at least double by the year 2022.
8. Imbalance use of fertilizer is in practise in lower part (Sub-tropical region) of Dehradun therefore Site Specific Nutrient management should be adopted for enhancing Nutrient use efficiency, water use efficiency and crop productivity.
9. According to the frost forecast the crop residue should be burnt around the vegetable crops to increase energy level and to create a layer of smog for retardation of outgoing radiation.
10. Soil erosion triggered by high rainfall intensity is the major issue of Dehradun. Therefore water and soil conservation techniques like terrace farming, bunding etc should be encouraged.
11. Climatic conditions are suitable for scented rice.
12. The proper canopy geometry of mango, litchi and apple should be maintained to avoid losses due to hail storm

6 A. Name of Field Crop: Wheat

i. **Existing varieties being used:** HS-490, HS-507, UP-2572, VL-907, VL-892, HD-2967, PBW-550, PBW-502, DPW-621-50, HD-3086

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 349, HS-490, HS-507, UP-2572, VL-907, VL-892, HD-2967, PBW-550, PBW-502, DPW-621-50, HD-3086

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

1. Most of the farmers using low yielding and old varieties
2. They also do not use balanced dose of fertilizers
3. Farmers also not adopting proper plant protection measures and effective herbicide for weed management.

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

1.Sowing should be done in IInd fortnight of November in plains of Dehradun however
2.In valleys of Dehradun sowing be done in IInd fortnight of October.
3.Water harvesting tank need to be created in rain fed areas to provide timely irrigation.
4. Sowing should be done by ferti seed drill machine to reduce the seed rate and improve the yield.
5. Balanced use of nutrients to be applied in the soil as per the soil testing report. Quality seed of high yielding varieties should be chosen after that seed must be treated with carbendazim 2 g per kg of seed before sowing.

v. **Major insect pests associated with crop:** Aphids, white grub

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

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	

1. For management of white grub, drenching of chlorpyriphos 1 ml per liter of water should be done.
2. Light trap be used during adult emergence in the month of June-July for mass trapping aphid

vii. **Major disease associated with crop:** Yellow rust, Powdery mildew, Karnal bunt

viii. **IPM Module for management of disease:**

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

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

Karnal bunt: *Tilletia indica = Neovossia indica*

Name of the Fungicides	(gm/ml) /ha	Waiting period (days)
Carboxin 75% WP (Seed Treatment/Kg)	2-2.5	
Thiram 75% WS (Seed Treatment/Kg)	2.5-3.0	7-10
Propiconazole 25% EC	500	30
Bitertanol 25% WP	2240	
Triadimefon 25% WP	500	25

ix. **Major weeds associated with crop:** *Phalaris minor, Chenopodium album ,* wild oat

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

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

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. Cropping pattern of rice-wheat-moong under irrigated condition.

2. Cropping pattern of maize-wheat-moog under irrigated condition.
3. Cropping pattern of ground nut-wheat-moong under irrigated condition.
4. Cropping pattern of soybean-wheat-moong under irrigated condition.
5. Cropping pattern of brinjal-wheat-moong under irrigated condition.

xii. Production constraints in agro-ecological region:

1.Lack of quality seed
2.Poor awareness of seed treatment
3.Poor weed management
4.Imbalanced use of chemical fertilizer
5.Lack of awareness about pest and disease management among farmers
6.In rain fed areas farmers dependent on rainfall for first irrigation at CRI stage which mosthe time is not happened.

6B. Name of Field Crop: Rice

i. Existing varieties being used: VL-85, VL-207, VL-208, VL-209, Pant Dhan-10, Pant Dhan-11, Pant Dhan-12, Pant Dhan-19, Kasturi Basmati, Pusa Basmati-1509, Pusa Basmati-1121, Hybrid rice: Arize-6444, HKR-47

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

Hybrid rice: Arize-6444, NDR-359, Pant Basmati-1, Pant Basmati-2, Pusa-44, Pant Dhan-18, HKR-47, PR-113, Pusa Basmati-1509, Pusa Basmati-1121, Arize-6129, Pant Dhan 24, 26, Pant Sankar Dhan 3

iii. Existing package of practices being used:

1. Majority of the farmers using low yielding and old varieties of rice they are susceptible against various pests and diseases
2. Farmers also not taking green manuring before rice cultivation.
3. They use imbalanced chemical fertilizers.
4. Due to lack of proper knowledge
5. Majority of the farmers do not adopt proper plant protection measures which adversely affect the productivity.

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

1. Green manuring must be followed before two months of planting.
2. Moong can be grown during summer season to improve the soil health.
3. Line planting be done to minimize weed infestation
4. Incidence of pests and diseases and for ideal vegetative growth of the plants. Planting should be done in Ist fortnight of July in plains and valleys of Dehradun. Water harvesting tank need to be created in rain fed areas to provide timely irrigation.
5. Rice planter may be used in plains of Dehradun. Balanced use of nutrients to be applied in the soil as per the soil testing analysis.

Quality seed of high yielding varieties should be preferred after that seed must be treated with carbendazim 2 g per kg of seed before raising the nursery.

v. Major insect pests associated with crop: Stem borer,Leaf folder,Green leaf hopper,Brown plant hopper,White grub

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% 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	

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	

vii. Major disease associated with crop: 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

C.During transplanting

Drenching of PsF (10g/lt. of water) in 1sqm in nursery soil one day before up rooting of seedling.

Do not planting under full or partial shade to avoide bacterial blight (BLB) infection.

After bacterial blight infection of drain the water from field and stop the application nitrogenous fertilizer. Crop should be spray with 15g streptocycline + 500g copper oxychloride with 1000 lt. of water in per ha. Area.

Transplant 2-3 seedling

Row to row spacing 20 cm and plant to plant spacing 10 cm.

D. After transplanting till maturity

Drain of water to check spread of sheath blight and bacterial blight.

Two spay of PsF + Th (10 g/lt. water or Propiconazole/carbendazime @ 1 ml/g/lt. of water) at 10 days interval beginning at symptoms appearance of sheath blight, sheath rot, blast, false smut and brown spot (need based)

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) /ha	Waiting period (days)
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	(gm/ml) /ha	Waiting period (days)
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, L. laptocloa,* sedges

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

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	

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

1. Cropping pattern of rice-wheat-moong under irrigated condition.
2. Cropping pattern of rice-rajma-moog under irrigated condition.
3. Cropping pattern of rice-vegetable pea-moong under irrigated condition.
4. Cropping pattern of rice-sarson-moong under irrigated condition.
5. Cropping pattern of rice-cauliflower-moong under irrigated condition.
6. Cropping pattern of rice-cabbage-moong under irrigated condition.
7. Cropping pattern of rice-lentil-moong under irrigated condition.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed
2. Poor awareness of seed treatment
3. Poor weed management, imbalanced use of chemical fertilizer
4. Lack of awareness about pest and disease management among farmers.
5. Lack of green manuring before planting of rice
6. Farmers do not grow summer moong to improve the soil health and to get additional income from moong crop.

6C. Name of Field Crop: Maize

i. Existing varieties being used: Kanchan, VL-Maize 16, VL-Maize 88, Navin, Shweta

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 QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2, Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta

iii. Existing package of practicesbeing used:

1. Farmers are not adopting high yielding varieties released for commercial cultivation in the recent years.
2. They also do not follow balance use of chemical fertilizers.
3. It is also observed that due to lack of knowledge
4. Most of the farmers adopt improper plant protection measures.

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

region:

1. Green manuring must be followed before two months of sowing.
2. Moong can be grown during summer season to improve the soil health.
3. Line planting be done to minimize weed infestation, incidence of pests and diseases and for ideal vegetative growth of the plants.
4. Sowing should be done in Ist fortnight of June in plains and hills of Dehradun. Water harvesting tank need to be created in rain fed areas to provide timely irrigation.
5. Balanced use of nutrients to be applied in the soil as per the soil testing analysis. Quality seed of high yielding varieties should be preferred after that seed must be treated with carbendazim 2 g per kg of seed before sowing.
6. In order to avoid lodging problem in hilly areas, hybrids such as 9164 having dwarf in nature and provide yield up to 25 Q per acre should be preferred for commercial cultivation.

v. Major insect pests associated with crop: Stem borer,White grub

vi. IPM Module for management of insect pests:

Maize stem borer

1. Collection and burrying stubble and stalks or ploughing and destruction of crop residue.
2. Growing maize in association with various legumes.
3. Intercropping maize with soybean.

Name of the Insecticides	(gm/ml)/ha	Waiting period (days)
Phorate 10 %CG	3000	30000
Dimethoate 30% EC	350	1155
Monocrotophos 36% SL	250	625
Oxydemeton methyl 25% EC	250	1000

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

viii. IPM Module for management of disease:

A.White rust:

1.Disease management strategies

a. Use of disease free certified seeds
b. Deep ploughing during summer
c. Crop rotation
d. Application of bio-agents i.e. *Psedumonas fluorescens* as seed treatment (10g /kg seed) plus soil application (2.5 kg/ha) and spray @ 0.1% and seed treatment with *Trichoderma viride* (10g /kg seed) and their stimulation by the addition of amendments can be done.

2.Fertilizer application

a. A fertilizer dose of 80 Kg N, 60 Kg P2O5, 40 Kg K2O is generally required.
b. Entire PK and 10% of N is applied as basal. Remaining nitrogen is applied in 4 splits i.e. 20% at 4 leaf stage, 30% at 8 leaf stage, 30% at flowering stage and 10% at grain filling stage.

3.Row spacing

Should be done at 60-75 cm & plant to plant spacing, 20-25 cm.

4.Cultural practices

Cultural practices which includes sufficient availability of plant nutrients, optimum soil pH (6.2-7.0), adequate water in fields, weed control, optimum plant population and use of disease free and high quality seeds are very helpful in reducing the damage caused by various diseases by reducing the plant stress.

Leaf blight of maize: *Stenocarpella maydis, Glomerella graminicola*

Name of the Fungicides	(gm/ml)ha
Mancozeb 75% WP	1500-2000
Ziram 75% WP	1500-2000

ix. Major weeds associated with crop: *Echinochloa, Laptocloa*, Sedges

x. IPM Module for management of weeds:

1. Bispyribac sodium 2 5 g ai per ha should be applied 15-20 days after planting for management of sedges.
2. Apply Atrazine 50%WP @ 1.0 kg a.i/ha or Alachlor 50%EC @ 2.5 kg a.i/ha or Diuron @ 0.8 kg a.i/ha within 3 days after sowing followed by one hand weeding at 25-30 days after sowing.
3. Apply 2,4-D Dimethyl Amine Salt 58%SL @ 0.5 kg a.i/ha or 2,4-D Ethyl Ester 38%EC @ 0.9 kg a.i/ha at 25 days after sowing to control broad leaf weeds.
4. Apply Tembotrine @ 120 g a.i/ha at 15-20 days after sowing to control grassy and non grassy weeds.
5. Minimum two hand weeding at 20& 35 DAS are required.

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

1.Cropping pattern of maize-wheat-moong under irrigated condition.
2.Cropping pattern of maize-rajma-moog under irrigated condition.
3.Cropping pattern of maize-vegetable pea-moong under irrigated condition.
4.Cropping pattern of maize-sarson-moong under irrigated condition.
5.Cropping pattern of maize-cauliflower-moong under irrigated condition.
6.Cropping pattern of maize-cabbage-moong under irrigated condition.
7.Cropping pattern of maize-lentil-moong under irrigated condition.
8.Cropping pattern of maize-vegetable pea-tomato under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties and hybrids, poor awareness on seed treatment
2. Poor weed management
3. Imbalanced use of chemical fertilizer
4. Lack of awareness about pest and disease management among farmers.
5. Lack of green manuring before sowing of maize
6. Farmers do not grow summer moong to improve the soil health and to get additional income from moong crop.

6D. Name of Field Crop: Sugarcane

i. Existing varieties being used: CoS-8279, CoS-8432, CoS-98268, CoS-96436, Co Pant-90223, Co Pant-5224

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 Varieties : Co Pant 84211, Co Pant 94211, Co Pant 03220, CoS 8436, CoS 88230, CoJ 85, CoS 96268, Co 238) and Mid-late varieties : Co Pant 84212, Co Pant 90223, Co Pant 96219, Co Pant 97222, Co Pant 99214, Co Pant 05224

iii. Existing package of practicesbeing used:

1.Farmers are adopting old and low yielding varieties having poor sugar recovery
2.They also do not follow intercropping in their sugarcane crop
3.Majority of the farmers do not adopt balanced dose of chemical fertilizers and judicious use of chemical pesticides for pest and disease management.
4.Poor ratoon management by the farmers also responsible for low yield.

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

1. Intercropping of sugarcane with rajma has been found very effective in plains of Dehradun.
2. Line sowing be done to minimize weed infestation, incidence of pests and diseases and for ideal vegetative growth of the plants.
3. Sowing should be done in the month of February.
4. Balanced use of nutrients to be applied in the soil as per the soil testing analysis. Quality seed of high yielding varieties should be preferred after that seed must be treated with carbendazim 2 g per kg of seed before sowing.
5. Adoption of high yielding varieties, intercropping with rajma along with proper nutrient

management and judicious use of chemical pesticides for effective management of various pests and diseases can double the production of sugarcane.

v. Major insect pests associated with crop: Shoot borer,Top borer,Root borer

vi. IPM Module for management of insect pests:

1. For management of shoot and top borer, cholorantramiliprole 0.5 ml per liter of water should be applied in the month of May-June as per need.
2. For management of root borer, drenching with chlorpyriphos 2 ml per liter of water can be done according to need.

Early shoot- borer: *Chilo infuscatellus* snell.

1. Immediately after harvest, up root and destroy all the stubble.
2. In initial stage of attack, collect and destroy the egg masses. Eggs are laid in the lower surface of the leaves.
3. Remove the dead heart regularly.
4. Two or three earthing during May and June reduce borer attack considerably.
5. Use *Trichogramma chilonis* @ 50,000 per hectare just after 45 days of planting 5 to 6 times at the interval of 10 days.
6. Wherever possible, frequent light irrigations, which would have the same inimical effect on the borer as earthing-up and trash mulching.
7. In the subtropics, intercropping with spices like coriander, onion and garlic, potato and green gram, depending on the season of planting, reduces shoot borer incidence. In the tropics, pulses like green gram, black gram and soybean or coriander reduce the borer incidence when grown as intercrops.
8. The *economic threshold level* of this pest is 10 to 15 percent dead heart so if the dead harts are seen more than this, Broad cast

Name of the Insecticides	**(gm/ml)ha**	**Waiting period (days)**
Chlorantraniliprole 0.4% GR	18750	147
Chlorantraniliprole 18.5% SC	375	208
Fipronil 0.3% GR	25000-33300	270
Fipronil 5 %SC	1500-2000	270
Monocrotophos 36% SL	1500-2250	
Chlorpyriphos 20% EC	1250-1500	

Top Borer: *Scirpophaga excerptalis* wlk.

1. Collecting and destroying egg cluster and affected shoots from March to June.
2. Release of *Isotima javensis* Rohw. a parasitoid which attacks the larvae and pupae of the pest, is effective.
3. Intercropping with onion, methi, sauf and ajwain reduces the infestation of the pest.
4. Use *Tricogramma japonicum* @ 50,000 per hectare just after 60 days of planting 4 to 6 times at the interval of 10 days.
5. Intercropping with spices like coriander, onion, garlic, fenugreek, and fennel, and other crops such as wheat, potato and mustard reduces top borer incidence.
6. The economic threshold level of the pest in third brood is 7 percent incidence. So if the incidence of the pest increases more than this, use

Name of the Insecticides	**(gm/ml)ha**	**Waiting period (days)**
Chlorantraniliprole 0.4% GR	18750	147
Chlorantraniliprole 18.5% SC	375	208
Carbofuran 3% CG	33300	

Sugarcane Root borer:*Emmalocera depressella* swinh

1. Deep ploughing must be done after the harvest of the previous crop and before growing of the

new crop.
2. Mechanical destruction of affected shoots along with borer larvae in the pre-monsoon period reduces pest inoculum.
3. In endemic areas, avoidance of ratoons minimizes proliferation of the pest. In such areas, digging and destroying stubbles after harvest.
4. In spring/summer planted sugarcane, green gram grown as intercrop followed by its incorporation reduces early incidence of the borer.
5. Collection and destruction of moths using light traps also minimizes perpetuation of the borer.
6. Release of *Trichogramma chilonis* @ 50,000/ha at 15 days intervals from July to October offers partial protection.
7. Drenching of Fipronil

Name of the Insecticides	**(gm/ml)ha**	**Waiting period (days)**
Fipronil 0.3% GR	25000-33300	270
Fipronil 5 SC	1500-2000	270

at the time of planting or after infestation.

vii. **Major disease associated with crop:** Red rot disease

viii. IPM Module for management of disease:

1. Seed treatment with carbendazim must be done.
2. Seed should be taken from healthy and disease free crop.
3. Resistant/ tolerant varieties should be preferably taken for cultivation.
4. As most of the important sugarcane diseases such as red rot, smut, wilt, leaf scaled, Pokkahboeng, grassy shoot (GSD) ratoon stunting (RSD), mosaic & yellow leaf disease (YLD) are sett transmissible therefore, to overcome the problem follow the following practices:

a. Use only recommended resistant varieties of the zone.
b. Select only healthy cane seed/sett from the disease free field/nursery.
c. Treat/dip setts by carbendazim 50 WP 0.1% solution at least 30 minutes before planting.
d. If possible moist hot air treatment (MHAT) 540C for 4 hrs.
e. Ratooning of infected fields should be strictly avoided.
f. Follow proper selection of field and crop rotation.
g. Vectors and weeds should also be control to check the spread of viral/pytoplasmal diseases.

ix. Major weeds associated with crop: *Echinochloa, Laptocloa*, Sedges

x. IPM Module for management of weeds:

1. Bispyribac sodium 2 5 g ai per ha should be applied 15-20 days after planting for management of sedges.
2. Apply Atrazine 50%WP @ 2.0 kg a.i/ha or Diuron @ 1.6 kg a.i/ha or Metribuzin 70%WP @ 1 kg a.i/ha at 3-5 days after planting to control broad leaf weeds and grasses.
3. Apply 2,4 Dimethyl Amine Salt 58%SL @ 3.5 kg a.i/ha or 2,4-D Ethyl Ester 38% EC @ 1.2-1.8 kg a.i/ha or Metsulfuron-methyl 20%WP @ 0.006 kg a.i/ha at 30-35 days after planting to control broad leaf weeds.
4. Apply Hexazinone 13.2%+Diuron 46.8% @ 0.264+ 0.936 kg a.i/ha at 20-25 days after planting to control grasses and broad leaf weeds.
5. Apply Paraquat @ 0.5 kg a.i/ha at 4-5 (as pre emergence) or 25-30 (post emergence) days after planting to control all weeds.
6. Irrigate field at 40-45 day stage and do hoeing at this stage fb spray Atrazine @ 2.0 kg/ha or Metribuzine @ 1.0 kg/ha or Pendimethalin @ 1.0 kg/ha at 3-4 days after planting.
7. Apply halosulfuron methyl @ 60-67.5 g a.i/ha at 20-25 days after planting to control*Cyperus rotundus*.

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

1. Cropping pattern of sugarcane + rajma-cauliflower under irrigated condition.

2. Cropping pattern of sugarcane + rajma-cabbage under irrigated condition.
3. Cropping pattern of sugarcane + rajma-broccoli under irrigated condition.
4. Cropping pattern of sugarcane + urd-carrot under irrigated condition.
5. Cropping pattern of sugarcane + urd-coriander under irrigated condition.
6. Cropping pattern of sugarcane + tomato-radish under irrigated condition.
7. Cropping pattern of sugarcane + tomato-methi under irrigated condition.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Poor awareness on seed treatment
3. Poor ratoon management
4. Imbalanced use of chemical fertilizer
5. Lack of awareness about pest and disease management among farmers.
6. Lack of green intercropping in sugarcane with rajma or urd or tomato.

7A. Name of the Pulse crop: Rajma

i. **Existing varieties being used:** Chakrata 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: VL Rajma 63,** VL Rajma 125, PDR-14 (Udai)

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

1. Almost all the farmers of mountain region grow unknown variety of Rajma which is popular in the name of Chakrata local.
2. Its quality is good but productivity is very low.
3. Demand of Chakrata local rajma is very high in the market.
4. The low yield of Chakrata rajma is due to several factors i.e. poor plant protection measures
5. Poor nutrient management adopted by the farmers
6. Rain fed condition also responsible for low yield due to poor monsoon.
7. Farmers do not follow seed treatment and soil treatment.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Water harvesting tank need to be created to provide irrigation during poor monsoon.

v. **Major insect pests associated with crop:** Pod borer,White grub

vi. **IPM Module for management of insect pests:** For management of pod borer, quinalphos 2 ml per liter of water or imidacloprid 0.75 ml per liter of water can be used judiciously.

vii. **Major disease associated with crop:** Root rot, Anthracnose

viii. **IPM Module for management of disease:**

1. For management of root rot, carbendazim + mancozeb @ 2 g per liter of water may be applied in the root zone on need basis.
2. For management of anthracnose, copper oxy chloride 3 g per liter of water can be used according to need.

ix. **Major weeds associated with crop:** *Echinocloa, Laptocloa*,Sedges

x. **IPM Module for management of weeds:** Hand weeding and intercultural operations effectively reduced the weed infestation

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

1. Cropping pattern of rajma-vegetable pea under rain fed condition.

2. Cropping pattern of rajma-lentil under rain fed condition
3. Cropping pattern of rajma-onion under irrigated condition
4. Cropping pattern of rajma-garlic under irrigated condition
5. Cropping pattern of rajma-chickpea under rain fed conditionretain the medical efficacy of plants in their natural habitats

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers etc.
4. Poor irrigation facilities where rajma is grown in the kharif season of mountain region. It has been observed that sometimes poor monsoon affect its productivity.

8A.Name of the Fruit crop: Mango

i. **Existing varieties being used:** Dushari, Langra, 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:** Dushari, Langra, Chausa, Amrapali, Mallika, Bombay green, Pusa surya, Pusa Arunima, Arunika, Pusa shreshta, Pusa Lalima

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

1. Farmers do not use balanced dose of chemical fertilizers in their orchard
2. They also do not apply chemical pesticides judiciously for management of various pests and diseases.
3. Farmers also do not use micro nutrients in their orchards to reduce fruit dropping and improve the fruit quality.
4. It has been also observed that very few farmers apply liquid fertilizers to improve the productivity and quality.

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

1. Management of various pests and diseases is important
2. Balanced use of chemical fertilizers must be done
3. Decomposed farm yard manure should be used in the orchard.
4. Problem of fruit dropping, fruit growth, colour development and shining in the fruit can be overcome by applying micro nutrients and NPK 18:18:18 and NPK 0:0:50.
5. Canopy management is generally not care by the farmers which is also responsible for low yield and quality.

v. **Major insect pests associated with crop:** Shoot gall psylla, Mango hopper,Mango fruit fly ,Mango mealy bug ,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
4. Rainy season with proper drainage.
5. Avoid excess use of nitrogenous fertilizers
6. Smoking of orchards by burning of crop residues/cow dung cake during evening hours.
7. 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 insecticides	(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 insecticides	**(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 insecticides	**(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 insecticides	**(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.
3. Insert cotton plug soaked in kerosene or petrol or DDVP into the holes and paste them with mud.

vii. **Major disease associated with crop:** Powdery mildew

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

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: Local weeds

x. IPM Module for management of weeds: Inter cultural operations in the orchard reduces the weed infestation.

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

1. Management of pests and diseases will help in improving the productivity and quality.
2. Balanced use of chemical fertilizers will also help in increasing the productivity and quality.
3. Balanced use of liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 has been found very effective in improvement of yield and quality.
4. Mulching in rain fed areas, reduces fruit dropping, accelerate fruit growth and improve the productivity and quality.
5. Canopy management play an important role in improving the fruit quality and productivity as it gives proper shape to the plant for ideal vegetative growth and development.
6. It was also observed in the orchard where canopy management is done, incidence of various pests and diseases is low.

xii. Production constraints in agro-ecological region:

1. Poor management of pests and diseases
2. Imbalanced use of chemical fertilizers and liquid fertilizers
3. Poor canopy management
4. Cultivation of mango in rain fed areas etc.

8B. Name of the Fruit crop: Litchi

i. **Existing varieties being used:**Rose scented, Calcuttia

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, calcuttia, gandaki Sampada, Gandaki lalima, Gandaki yogita (suitable for high density plantation

iii. Existing package of practicesbeing used:

1. Most of the farmers do not use balanced dose of chemical fertilizers in their orchard
2. They also do not apply chemical pesticides judiciously for management of various pests and diseases.
3. Farmers also do not use micro nutrients in their orchards to reduce fruit dropping and improve the fruit quality.
4. It has been also observed that very few farmers apply liquid fertilizers to improve the productivity and quality.

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

1. Management of various pests and diseases is important
2. Balanced use of chemical fertilizers must be done
3. Proper pollination by honey bees must be provided
4. Decomposed farm yard manure should be used in the orchard.
5. Problem of fruit dropping, fruit growth, colour development and shining in the fruit can be overcome by applying micro nutrients and NPK 18:18:18 and NPK 0:0:50. Canopy management is generally not care by the farmers which is also responsible for low yield and quality.

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

vi. IPM Module for management of insect pests:

Litchi bug:

1. Thiamethoxam 0.5 g per liter of water can be used according to need.

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
5. Quinalphos 2 ml per liter of water or indoxacarb 0.5 ml per liter of water or imidaclopride 0.75 ml per liter of water can be applied on need basis.

Litchi leaf roller:

1. Low infestation can be reduced by destruction of infested rolled leaves.
2. Application of Monocrotophos or Quinolphos @ 2ml/l of water at new flush

vii. Major disease associated with crop: Anthracnose, Brown spot

viii. IPM Module for management of disease:

Anthracnose disease:

Copper oxy chloride 3 g per liter of water can applied on need basis.

Brown spot:

Difenconazole 0.5 ml per liter of water may be applied as per need.

ix. Major weeds associated with crop: Local weeds

x. IPM Module for management of weeds: Inter cultural operations in the orchard reduces the weed infestation.

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

1. Management of pests and diseases will help in improving the productivity and quality.
2. Balanced use of chemical fertilizers will also help in increasing the productivity and quality.
3. Balanced use of liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 has been found very effective in improvement of yield and quality.
4. Mulching in rain fed areas, reduces fruit dropping, accelerate fruit growth and improve the productivity and quality.
5. Canopy management play an important role in improving the fruit quality and productivity as it gives proper shape to the plant for ideal vegetative growth and development and it was also observed in the orchard where canopy management is done, incidence of various pests and diseases is low.

xii. Production constraints in agro-ecological region:

1. Poor management of pests and diseases
2. Imbalanced use of chemical fertilizers and liquid fertilizers
3. Poor canopy management
4. Cultivation of litchi in rain fed areas etc.

9A. Name of the vegetable crop: Tomato

i. Existing varieties being used: Himsona, manisha, Shahanshah, Avtar, Abhinav
Private company varieties like Rakshhak 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: Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen 2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3

iii. Existing package of practices being used:

1. In hills of Dehradun, most of the farmers grow heamsohna hybrid of tomato from the last 10

years which has become susceptible against bacterial wilt.

2. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
3. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.

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

1. High yielding varieties and hybrids must be adopted, use of organic manure should be promoted, balanced use of chemical fertilizers need to be done, judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
2. Mulching should be done as it has been fetching outstanding result particularly use of plastic mulch. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
3. 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.
4. Use micronutrient including Ca, B and Mo
5. Crop rotation Tomato-cowpea-Early cauliflower.

v. Major insect pests associated with crop: Fruit borer,White fly and other sucking pests,Cut worm,White grub

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: Late blight, Fruit rot, Leaf curl disease

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

A.In Nursery:

1.Soil Solarization of nursery bed by covering with polythene sheet (25 – 50 □□) for 45 to 60

days during April-June.
2.Use TH/PsF colonized compost
3.Seed biopriming with TH / PsF @ 10 g/kg seed.
4.Use resistant cultivars like Arka Rakshak, Arka Samrat, Ramya etc., if possible
5.Grow the nursery under tunnel of poly net of 50 mesh.

B.On Crop

1. Use TH/PsF colonized compost.
2. Use of healthy seedling.
3. Root dipping of seedlings in TH/PsF suspension (10 g/l water).
4. Roguing of virus infected plants and destruction of weeds followed by need based spraying of systemic insecticides for vector management
5. Remove all previous season tomato plants

Late blight :

1. Burn the infected crop debris,
2. A void 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

Early Blight :

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

Name of the fungicides	**(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

ix. Major weeds associated with crop: *Echinochloa sp. , Laptocloa sp.*, Sedges

x. **IPM Module for management of weeds:** Use of plastic mulch reduces weed infestation upto 80 per cent

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

1. Cropping pattern of tomato-maize-vegetable pea under irrigated condition.
2. Cropping pattern of tomato-grounnut-vegetable pea under irrigated condition.
3. Cropping pattern of tomato-moong-urd under irrigated condition.
4. Cropping pattern of tomato-chiili under irrigated condition.
5. Cropping pattern of tomato-brinjal under irrigated condition
6. Cropping pattern of tomato-cabbage under irrigated condition
7. Cropping pattern of tomato-cauflower under irrigated condition
8. Reduce number of spray of pesticides.
9. Raise nursery on treated soil.
10. Treat seed with fungicide before sowing.
11. Manage fog during fruiting period.

xii. **Production constraints in agro-ecological region:**

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching and staking etc.
6. Imbalance use of fertilizes.
7. More numbers of pesticides' spay
8. Increase incidences of Bacterial wilt.

9B. Name of the vegetable crop: Chilli

i. **Existing varieties being used:** Laher, Soldier,Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika,Kalyani

ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani

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

1. In hills of Dehradun, most of the farmers grow old varieties of chilli from the last more than 10 years which has become susceptible against bacterial wilt.
2. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
3. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.
4. Growing local varieties.
5. No line transplanting.
6. Generally they plant two over aged seedling at one place.
7. No or very less use of fertilizer.
8. Sowing of untreated seed.

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

1. High yielding varieties and hybrids must be adopted, use of organic manure should be promoted, balanced use of chemical fertilizers need to be done, judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
2. Mulching should be done as it has been fetching outstanding result particularly use of plastic

mulch.

3. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
4. Grow high yielding varieties.
5. Treat the seed with copper containing fungicides before sowing.
6. Adopt soil testing.
7. Transplant one seedling at one place.
8. Transplant the seedlings when they attain 5-6 leaf stage.
9. Transplant the seedlings at proper spacing-
10. Dwarf varieties like Kashi Anmol at 45 x 30 cm
11. Tall varieties like Pusa Sadabahar, Pant C-1 at 50 x 50 cm.
12. 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: Cut worm and white grub **,**Chilli thrips**,** *Scirtothrips dorsalis* Hood (Thripidae: Thysanoptera)

vi. IPM Module for management of insect pests:

Management strategies sucking pests

A. Crop Hygiene

1. 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.
2. 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

Use proper pre-planting practices.

1. 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.
2. Avoid yellow clothing or utensils as these attract whitefly adults. Delay planting new fall crops as long as possible.
3. Do not plant new crops near or adjacent to old, infested crops.

Use proper post-planting practices.

1. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc.
2. 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.
3. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
4. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

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

vii. Major disease associated with crop: Leaf curl disease

viii. IPM Module for management of disease:

1. For management of leaf curl disease
2. Thiamethoxam 0.5 g per liter of water can be applied according to need.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Use of plastic mulch reduces weed infestation upto 80 per cent.

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

1. Cropping pattern of chilli-vegetable pea-rajma under irrigated condition.
2. Cropping pattern of chilli-cauliflower-moong under irrigated condition.
3. Cropping pattern of chilli-cabbage-urd under irrigated condition.
4. Cropping pattern of chilli-broccoli-urd under irrigated condition
5. Cropping pattern of chilli-tomato under irrigated condition
6. Grow high yielding varieties.
7. Treat the seed with copper containing fungicides before sowing.
8. Adopt soil testing.
9. Transplant one seedling at one place.
10. Transplant the seedlings when they attain 5-6 leaf stage.
11. Transplant the seedlings at proper spacing.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching etc.
6. Non availability of quality seed.
7. Less irrigation facilities.
8. High cost of hybrid seeds.
9. Unaware about the insect-pest management

9C. Name of the vegetable crop: Pea

i. **Existing varieties being used:** Arkle, PSM-3, Azad Matar-2, Azad Matar-3, Arka Ajit, VL Matar-7, Kashi Udai

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, and Vivek Matar 12, VL Ageti Matar 7, Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, Arkle, Azad Matar-2, Arka Ajit and Kashi Udai

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

1. Majority of the farmers in hills and plains of Dehradun using Arkle variety which is early but very old.
2. Its yield is also low as compared to other varieties released for commercial cultivation in the

recent years.

3. Due to continuous cropping of Arkle variety, incidence of pests and diseases increased considerably.

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

1. High yielding varieties and hybrids must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
6. 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).
7. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time and sow in October-November month.
8. 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.
9. Water the crop as per need especially during flowering and pod setting. Use Pendimethaline @ 1kg ai/ha as pre-emergence and one hoeing 25-30 days after sowing

v. Major insect pests associated with crop: Pod borer,White grub and cut worm r

vi. IPM Module for management of insect pests:

1. For management of pod borer, quinalphos 2 ml per liter of water should be applied on need basis.
2. For management of cut worm and white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Powdery mildew

viii. IPM Module for management of disease:

1. For management of Powdery mildew
2. Thiophenate methyl 1 g per liter of water may be applied on need basis.

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: Chenopodium, Senji

x. IPM Module for management of weeds:

Hand weeding and application of pendi methalin @ 1.0kg/ha as pre emergence

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

1. Cropping pattern of vegetable pea-wheat-maize under irrigated condition.
2. Cropping pattern of vegetable pea-rajma-moong under irrigated condition.
3. Cropping pattern of vegetable pea-ginger under irrigated condition
4. Cropping pattern of vegetable pea-cabbage-urd under irrigated condition
5. Cropping pattern of vegetable pea-cauliflower-maize under irrigated condition.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers etc.

9D. Name of the vegetable crop: Ginger

i. **Existing varieties being used:** Reo de genero, Varad

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Nadia, Reo de genero, Varad, Surbhi, Suruchi, Suprabha

iii. Existing package of practices being used:

1. Farmers do not adopt proper plant protection measures for management of rhizome rot which is a serious problem in ginger growing areas.
2. They use undecomposed farmyard manure due to which incidence of white grub become serious. Farmers also unable to use high yielding varieties having high demand in the market. Most of the farmers do not adopt balanced use of chemical fertilizers.
3. Majority of the farmers grow ginger in rain fed areas. Sometimes poor monsoon affect its productivity.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.

v. Major insect pests associated with crop: White grub

vi. IPM Module for management of insect pests:

For management of white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Rhizome rot

viii. IPM Module for management of disease:

1. For management of rhizome rot, drenching with copper oxy chloride @ 3 g per liter of water may be done in the root zone on need basis.
2. Proper drainage facility should be followed as water logging condition in the field increases the incidence of rhizome rot disease.
3. In sick soil soil solarization by covering with polythene sheet (25 – 50 μ) for 45 to 60 days during April-June, if possible
4. Use *Trichodermaharzianum* colonized compost.
5. Dipping of rhizome in suspension of TH (10 g per liter + 10 g FYM powder). Cover treated rhizomes with polythene for 24 h before sowing.
6. Drenching near base of the plants with TH+ PsF (10 g/l) whenever symptoms appear in any plant. Drenching may be restricted to infected as well as a few surrounding plants only.
7. Need based spraying of PsF + mancozeb (2 + 2 kg/ha) at 15 days interval.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Intercultural operations in the initial stage of the crop reduces weed infestation and mulching

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

1. Cropping pattern of ginger-cauliflower under irrigated condition.
2. Cropping pattern of ginger-vegetable pea under irrigated condition
3. Cropping pattern of ginger-vegetable pea under irrigated condition
4. Cropping pattern of ginger-lentil under irrigated condition
5. Cropping pattern of ginger-wheat under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers

10A.Name of the fodder crop: Berseem

i. **Existing varieties being used:** Vardan, Maskavi , 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:** Maskavi, BL-1, BL-42 and BL-180, High yielding varieties developed by PAU, Ludhiana have better performance in nearby other State s as well as Uttarakhand must be adopted by the local farmers therefore increase the bio mass of green fodder.

iii. **Existing package of practices being used:** Most of the farmers sow the berseem crop in zero tillage method after harvesting of the paddy crop in the month of November without treating any rhizobium culture.

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

1. It is reccomended that berseem seed should be treated with rhizobium culture and 10 % solution of molasis/ gur for removal of berseem weed i.e. kasani.
2. Berseem sowing need to be done in Iind fortnight of October for proper germination and vegetative growth.
3. Soil : loam to clay soil
4. Field preparation: 3-4 Harrowing + Leveling the field.
5. HYVS. – Mescavi, Warden. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
6. Seed rate: 25-30 kg/ha
7. Sowing method:
    a. Wet method-like rice in puddled field
    b. Dry method: Without puddled.
8. Sowing time: First an week of October
9. Fertilizer: 30:60:70:: N:P2O5 K2O kg/ha
10. Irrigation: Field should remain at field capacity throughout the crop period after germination.
11. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
12. Cutting management: First cut -45-50 DAS
13. Other cutting at 25-30 days interval- total 5-6 cutting are taken
14. 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: IPM Module for management of disease:**

viii. **Major weeds associated with crop:** Most of the field of berseem crop affacted with kasani weed which reduces the biomass yield of berseem resulted in causing bloat problem in dairy animals.

ix. **IPM Module for management of weeds:** It is reccomended that berseem seed should be treated with rhizobium culture and 10 % solution of molasis/ gur and stiring for 15-20 minutes for removal of berseem weed i.e. kasani.

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

1. Cropping pattern of berseem-maize-berseem
2. Cropping pattern of berseem-lobia-jwar-berseem
3. Berseem seed mixed with oat @ 100 g + 50 g musturd seed per kg of berseem seed during sowing to increase the biomass in first cutting.

xi. **Production constraints in agro-ecological region:** Berseem fodder crop damaged due to heavy frost affecting the crop in foot hills and valley areas

C1. Livestock: Cattle

1.A Existing breeds available: HF cross, Jersy cross, Sahiwal cross

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

2.A Existing feeds being used:

1. Paddy straw
2. Maize strove
3. Cherry strover

2.B Specific feeds to be introduced / advised:

1. Promotion of UMMB blocks, complete feed block as well as promotion of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras and temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye etc.
2. It is also recommended that addition of non conventional feed and fodder i.e. vegetable and fruit bi-products can be used.
3. Promotion of high yielding varieties of hybrid napier grasses, para grasses, barseem, oats and African tall maize crop need to be done.
4. Use of balance feed in mesh form and prepares by local available good quality grains with socking in water to increase the digestibility of the concentrate need to be encouraged.

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

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

1. At present most of the animals suffer from internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.

2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.
3. Poor availability of quality fodder

C2. Livestock: Buffalo

1.A Existing breeds available: Murrah cross, Nili Ravi cross, Jafrabadi cross , Badawari cross

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding and artificial insemination with pure Murrah and Nili Ravi by using pure buffalo bulls

2.A Existing feeds being used:

1. Farmers feed their livestock by, paddy straw, maize strover, cherry strover, berseem, oats as a green fodder
2. Farmers feed their livestock as readymade concentrate mixture in mesh and pallet form upto some extent.

2.B Specific feeds to be introduced / advised:

1. Promotion of UMMB blocks, complete feed block
2. Promotion of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras
3. Temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye etc.
4. It is also recommended that addition of non conventional feed and fodder i.e. vegetable and fruit bi-products can be used.
5. Promotion of high yielding varieties of hybrid napier grasses, para grasses, barseem, oats and African tall maize crop need to be done.
6. Use of balance feed in mesh form and prepares by local available good quality grains with socking in water to increase the digestibility of the concentrate need to be encouraged.

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.Other Disease Control Programs/ Health Camps (criteria, target): Infertility Camps

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Promotion of male calf rearing for future breed improvement of Murrah and Niliravi buffalo.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle in shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system-

1. Presently most of the animals are prone to internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.
3. High mortality in male buffalo calf due to deprive of milk.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.

C3. Livestock: Sheep

1.A Existing breeds available: Local & Merino Cross

1.B Specific breeds to be introduced: Merino

2.A Existing feeds being used: Fodder tree leaves, Forest grasses

2.B Specific feeds to be introduced / advised: Commercialization of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras,

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle shed in improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size are commonly used for livestock management in all the three regions.
4. These existing practices are responsible for contamination of diseases

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system:

1. At present most of the animals in all the three regions suffer from internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.

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

Poor availability of quality fodder

C4. Livestock: Goat

1.A Existing breeds available: Black Bangal, Cross Sirohi , Non descript of local goats

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding with selection of elite buck in existing stock of the herd and artificial insemination with pure Gaddi, Black Bangal, Jamunapari and Barbri fetch from the ICAR-CIRG, FARAH for breed improvement.

2.A Existing feeds being used: Farmers adopted only grazing system 5-6 hours in a day.

2.B Specific feeds to be introduced / advised:

1. Concentrate feed @ 100-120 g of leguminous grains i.e. gram, soybean, rajma Protineous geen fodder i.e morus leaves and ficus group trees leaves.
2. Mineral mixture must be fed @25-30 g per day per animal for maintain the proper health and fertility condition.Scientific grazing systems should be adopted on grazing lands and alpine grasslands

3.A Existing health services:

Most of the goat farmers reared their goats with their traditional methods for control of internal and external parasites, mites, flies and viral infestation i.e. FMD, PPR and protozoal infestation

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

1. Veterinary officer need to be appointed at nyay panchayat level.

2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Farmers need to be educated on various issues of goat farming for doubling the income.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed therefore most of the goat flock suffer with respiratory problem,
2. Improper condition of the floor sheds,
3. Manger and standing passage of the paddock is very poor in shape and size.

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

1. Proper housing space with suitable material,
2. At the time of stall feeding and cleanliness management practices must be adopted to fulfil the required amount of dry matter as per their body weight ,
3. Concentrate and mineral mixture along with timely deworming and vaccination practice..

5.A Problems of Livestock system:

1. Lack of pure genetic breed in-breeding condition is high therefore the mortality of the kids and poor conception is high.
2. Most of the goat herd have very shortage of quantity and quality of concentrate feed and mineral mixture the productivity of goat is continuous deteriorated.

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

1. Lack of local available good quality grains as concentrate feed reduce the health condition of the goat
2. Due to inbreeding and anorexia the morbidity and mortality is very high.

C5. Livestock: Poultry

1.A Existing breeds available:

1. Non descriptive local for dual purpose
2. Synthetic strain for meat purpose

1.B Specific breeds to be introduced:

1. The popularization of Cari Devendra, RIR cross with Aseel, Kadaknath, Chibro breed for cross with RIR
2. Playmouthrock for dual purpose
3. Cari Dhanraja, Cari Mritunjay for meat purpose
4. Cari Priya, Cari Sonali for egg production in backyard condition
5. Synthetic stain and WLH, Red Cornish for organized sector

2.A Existing feeds being used: Majority of the poultry farmers reared the birds in range condition during the day time and night in battery cages

2.B Specific feeds to be introduced / advised:

1. For successful strengthening of the poultry sector must be provided balance concentrate feed i.e. pre starter, starter, grower
2. Finisher ration for proper growth of the chicks and growing birds.

3.A Existing health services:

1. Most of the chicks died in brooding stage due to negligence of the management of the owner.
2. Unhygienic conditions of poultry farm increase the mortality percentage.

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

1. Proper brooding facilities
2. Proper vaccination schedule and techniques
3. Use of good quality liter material
4. Proper ventilated housing facilities

5. Awareness of the poultry growers for contagious disease transmitted one farm to another

4.A Existing management practices:

1. Non organized poultry growers in remote areas,
2. Lack of vaccination schedule,
3. Proper housing space and poor sanitation practices adopted in poultry shed.

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

1. Rearing of healthy DOC chicks,
2. Proper brooding system,
3. Suitable environmental condition and vaccination practices must be required.
4. Isolation and removal of morbit birds and liter material away from healthy stock in proper way.

5.A Problems of Livestock system:

1. Lack of pure DOC genetic stock
2. Bacterial and viral contamination is higher
3. Cost of feed is higher
4. Proper marketing facilities is not available
5. Non availability of suitable medicine and vaccines in local market

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

1. Most of the farmers purchase poultry chicks from private hatchery, they are having poor genetic stock of poultry chicks.
2. Cost of chicks is very high in private hatcheries but despite of that farmers are helpless to purchase the chicks from those hatcheries because of non availability of chicks in hatcheries of government organizations at regular interval.

D. Integrating Farming system

1.A Existing farming system:

Cereals + vegetables + livestock + fruits

Cereals + millets + pulses + livestock + fruits

1.B Specific farming system for doubling income in specific agro-ecological region:

Cereals + mushroom + bee keeping + vegetables

Millets + fisheries + livestock + vegetables

E. Reducing post harvest losses and value addition

1.A Existing grading facilities:

Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

Proper infrastructure need to be developed for hi-tech grading especially for fruits, vegetables and spices.

A.For grains:

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

B.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: There are no processing facilities in District Dehradun.

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

region of district:

Litchi and mongo are commercially important fruit crops of plains of Dehradun but due to lack of processing unit, farmers sale their produce afresh in the market and most of the time they do not get premium price of their produce in the markets.

A.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

B.For horticultural crops:

1. Destoner, pulper, juicer, pasteurizer, open pan evaporator at village level for particular commodity
2. Minimal processing unitfor particular commodity
3. Drying unit for particular commodity
4. Canning and bottling unit at district level for particular commodity

Maintaining cold chain from farm to folk (depending upon the commodity)

3.A Existing packing facilities:

1. There are no packing facilities.
2. Farmers use traditional method of packing.

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

Proper packing facilities i.e. packing in corrugated boxes need to be introduced as it significantly reduce the post harvest losses during transportation.

Packing facilities need to be established in Kalsi and Chakrata block of Dehradun where tomato, chilli, ginger, vegetable pea, rajma are largely grown.

A.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

B.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)

4.A Existing storage facilities: There are no storage facilities.

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

Storage facilities need to be set up in Kalsi and Chakrata block of Dehradun to store tomato, chilli, ginger, vegetable pea, caggabe, cauliflower, broccoli, coriander etc so that same could be sold in the market during lean period of the produce in the markets when prices are high.

A.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

B.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. Farmers generally do bunding of their fields to check soil erosion, but occasional heavy rainfall destroys those bunds and soil erosion occurs.
2. Contour bunding and grading with levelling of land, plantation of fodder trees on bunds and wiring of slopes where there is extensive problem of land erosion.

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

1. Due to high rainfall in the upper hills of district Dehradun, the top most soil cover is lost, which tenders the soil barren and unproductive.
2. However due to judicious management of slope and selection of plant species like *Rhodendron* and *Quercus* vegetative cover can be attained in short time and management of wasteland is done.
3. It is also true that as such there is no problem of wasteland in district Dehradun as there is no salt affected or acidity affected area.
4. Treatment of wastewater in district Dehradun is also not a problem as there are no effluent emitting industries.

2.A Existing plantation: *Eucalyptus* 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. Not applicable as problem of wasteland and wastewater does not occur in district Dehradun. However in some areas slope management, soil movement stabilization, contour farming and afforestation with suitable species like rhodendron and Quercus need to be encouraged to reduce soil erosion and management of wasteland.
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: Jwar, Bajra, Maize, Oat, Berseem, Napier are grown by the farmers.

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:

1. Hybrid napier grass,
2. Perennial fodder grass i.e. cocksfoot, talfescue, Italian rye
3. Fodder trees i.e. morus, khadik, bhimal can be promoted in mid and high hills
4. Hybrid napier, berseem, sudan grass, saftal in plain and valley areas.

A.Guinea grass (*Panicum maximum*),

1. Seed rate(Kg/ha)-3-4
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management-60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

B.Setaria grass (*Setaria anceps*)

1. Seed rate(Kg/ha)-1.5 2.0
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 100:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

C.Spear grass (*Hetropogon contortus*)

1. Seed rate(Kg/ha)-4-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available..
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days

interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting

D.Rhode grass (*Chloris gayana*)

1. Seed rate(Kg/ha)-3-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
3. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
4. Irrigation management-Crop must be irrigated after each cut provided water is available.
5. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

E.Marvel grass (*Dicanthium annulatum*)

1. Seed rate(Kg/ha)-4-6
2. Spacing (cm)- 50cm x 30cm
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.

Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

4.A Type of waste water:

1. Effluent from kitchen and bathroom
2. Flowing springs
3. Effluent from industries

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. Domestic wastewater from kitchen and bathroom should be treated before being used for irrigation in vegetables and other crops.
2. 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.
3. Sewage water from cities should be treated by municipal corporations or other agencies.

G. Reduced cultivation cost

1.A Existing inputs being given:

Seeds of high yielding varieties and hybrids of various crops, quality pesticides effective for management of different pest and diseases are given to the farmers by the State Departments on subsidized ratres.

A.Rice-wheat/Sugarcane-Ratoon-wheat/Mustard/Toria,Maize-Pea/wheat/Chickpea /Lentil

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. Foliar spray of 1% $FeSO_4$ in rice nursery and maize.
4. 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
5. In Mn deficient soils, application of 30 kg $MnSO_4$/ha, if Mn deficiency exist in field or two foliar spray of 0.5% $MnSO_4$ + 0.25% lime before first irrigation and one month after .

B.Mango/Litchi/Jack fruit

1. In deficient soils, application of 215 kg gypsum/ha, if S deficiency exist in field.
2. Two foliar spray of 0.2% $ZnSO_4$ +0.2% $MnSO_4$ + 0.1% $CuSO_4$ + 0.25% Lime in Feb. & March.
3. Two foliar sprays of 0.2% Borax in April at fortnightly interval.
4. Apply FYM as per age of the plant.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district:

1. Soil health card need to be issued to all the farmers who are actively involved in the farming.
2. Accordingly, commercially important crops to be suggested for doubling their income by maintaining the sustainability.

2.A Existing mechanization:

1. Power tiller
2. Tractor and traditional method used

A.Sugarcane

1. Seedbed preparation using disc harrow and ridge making by tractor drawn ridger.
2. Manual sett cutting / or by tractor PTO operator sett cutter.
3. Manual planting.
4. Tractor operated cultivator and manual weeding for Interculture.
5. Manually operated sprayer for plant protection.
6. Manual harvesting.

B.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 incombine harvested field.

C. 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.

D.Rapeseed - Mustard

1. Conventional tillage using disc harrow and planker.
2. Sowing by manual broadcasting.
3. Chemical weed control and plant protection using manually operated sprayers / dusters.
4. Manual harvesting.
5. Manual threshing / tractor treading.

E.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
7. threshers

F.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:

1. In hills of Dehradun, power tiller need to be promoted to reduce the cost of cultivation.
2. In valley areas and foot hills, small tractors of 15-20 HP can also be promoted to reduce the cost of cultivation.

A.Sugarcane

1. Seedbed preparation using rotary plough.
2. Tractor operated sugarcane sett cutter planter.
3. Sugarcane rotary power weeder (tractor / self-propelled).
4. Tractor operated fertilizer placement-cum-earthing up machine.
5. High pressure canopy sprayer for plant protection / power operated ULV sprayers.
6. Self-propelled sugarcane harvester.
7. Ratoon manager.

B.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
8. Application recovery of wheat straw using tractor drawn baler.

C.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. Promotion 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
12. Application recovery of paddy straw using tractor drawn baler.

D. Rapeseed - Mustard

1. Seedbed preparation by rotary plough / rotavator / disc harrow followed by planker.
2. Precision drill for sowing.
3. Power operated rotary weeder.
4. Plant protection using power operated ULV sprayers.
5. Manual harvesting to be replaced by mechanical harvesters.
6. Power thresher.

E. 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.

F.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: Seed, fertilizers, pesticides

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

1. Seeds of high yielding varieties and hybrids of various crops, quality pesticides effective for management of different pest and diseases has to be given to the farmers by the State Departments on subsidized rates in order to reduce the cost of cultivation.

2. Seed, fertilizers, pesticides, FYM, vermin compost, micro nutrients, herbicides, medicines, vaccines, dewormers etc.

Bhabhar and Lower Hills

1. Fertilizer application should be based on soil test value at right time, right place and 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, green manure and crop residue incorporation to supplement costly fertilizers to reduce cost up to 25-30%.
4. Inclusion of pulses in crop rotation and reduce dose of chemical fertilizers.
5. Need based and recommended concentration of plant protection chemicals using correct method of application.
6. Enhanced use of bio-agents to control disease & 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 excessive irrigation.

Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district:

1. Poor awareness about the advancement in the field of agriculture and its allied sectors among farming community.
2. Poor economic condition of the farmers due to which they do not adopt modern technology having low cost of cultivation.
3. Factors responsible for increasing cost of cultivation:
4. No proper and timely supply of water in canal and govt. owned tube well systems under irrigated condition.
5. Faulty roistering system of water.
6. Unavailability of farm labourers in agricultural operations during sowing to harvesting of crops.
7. Non availability of farm machinery, tools and implements for small and marginal farmers.
8. Gentle to moderate slopes(1-2%) in farm land causing surface runoff of soil and nutrients.
9. Timely non availability of farm inputs viz., HYV seeds, N:P:K fertilizers, micronutrient containing fertilizers, low cost FYM, vermi compost, pesticides and effective insecticides.
10. Application of high rate of fertilizer without knowing the nutrient status of their soil.
11. Non/inadequate application of FYM/Vermi compost.
12. Negligence among farmers for testing of their soils for soil health and application as per crop needs.

13. Non availability of mobile soil testing labs van for spot testing of their soils.
14. No efficient irrigation and fertigation system in orchards.
15. No proper drainage system on farm lands of small and marginal farmers.
16. Lack of storage facilities (cold rooms and houses) and processing units for their produce.
17. Involvement of middle man in crop trading system.
18. Lack of interest among govt. machinery for dissemination of technologies, input and subsidies to small and marginal farmers.

H. off-farm income

1.A Existing SHGS operative in specific agro-ecological region of district:

A.SHGs are working but their impact is not visible among farming community, hence SHGs need to be strengthened with modern development taking place in the field of agriculture and its allied sectors.

1. Kalimata(Maletha)
2. Mahasu Devata(Rikhad)
3. Shilgur Devata (Rikhad)
4. Chanda(Vyasnahari)
5. Gayatri(Dakiyarana)
6. Gulista (Gorakhpur)
7. Nav Chetna(Gorakhpur)
8. Jyoti(Barovala)
9. Bhairav (Kunna),

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

SHGs need to be created in large number with the help of NABARD by involving progressive farmers and farm women to increase the income of the farmers.

SHG already formed and need to be encouraged:

1. Kalimata(Maletha),
2. Shilgur Devata(Rikhad),
3. Gayatri(Dakiyarana),
4. Gulista(Gorakhpur),
5. Nav Chetna(Gorakhpur)
6. Jyoti(Barovala)
7. Bhairav (Kunna)

1. 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.
2. 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.
3. Imparting the information to the groups about various govt. schemes regarding loan, trainings and marketing of the product.
4. 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.
5. 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.
6. Loan procedure should be made more flexible with less interest rate.
7. 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.

8. 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.
9. 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.
10. Enterprises need to be identified depending upon local resources- human and material.
11. Market linkages need to be developed so that people can sell their produce gainfully.
12. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
13. 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.
11. It is seen in the survey that all individuals who took loan increase their livestock only that is their traditional work and did not start any other enterprises.

2.A Existing Micro-entrepreneur employment:

1. Handloom
2. Rambaans
3. natural fibre craft etc

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

1. Above existing micro-enterprise can be further promoted
2. Micro-entrepreneur employment need to be generated with the help of NABARD in which involvement of innovative farmers and farm women must be compulsory.

3.A Existing skill development facilities:

1. Skill development facilities are done by KVKs and Line departments.
2. Office of Development commissioner (handicrafts)
3. Handicraft marketing, service and extension centre

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected by providing proper funding.
3. Training centre, processing and packaging units as per the locally available resources

4.A Existing women skilling facilities:

1. Skill development facilities are done by KVKs
2. Line departments

3. NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected by providing sufficient funding.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

5.A Existing youth skilling facilities:

1. Skill development facilities are done by KVKs
2. Line departments
3. NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

Beekeeping

Packages of Practices for beekeeping with Italian honey bee, *Apis mellifera*

Beekeeping (or apiculture) is the maintenance of honey bee colonies, commonly in man-made hives, by humans. A beekeeper (or apiarist) keeps bees in order to collect their honey and other products that the hive produces (including beeswax, propolis, pollen, and royal jelly), to pollinate crops, or to produce bees for sale to other beekeepers. A location where bees are kept is called an apiary or "bee yard." Beekeeping provides excellent source of employment for the rural unemployed, enhances income of farmers, and the landless beekeepers. It enhances the productivity levels of agricultural, horticultural and fodder crops through pollination services. Beekeeping with *A. mellifera* L. is a common practice in hills as well as plains of Uttarakhand for honey production. For successful beekeeping, a person must require basic to advanced knowledge about all the aspects of honey bees with good management practices which involve following general points:

A good beekeeping management practices include:

1. Selection of good site for an apiary
2. Knowledge of bee flora
3. Seasonal bee management
4. Nutrition managements or artificial feeding during dearth period
5. Dividing and uniting colonies
6. Swarming : prevention and control
7. Disease and enemies management
8. Migration management
9. Other management practices for successful beekeeping

Selection of a good site for an Apiary

1. Selecting a good site for apiary can make a huge difference to honey bee health. There are following important things to consider when choosing a site:
2. It's important to know the bee foraging plants in a preferred area and their flowering periods.
3. Plants chosen should be producing high eminence nectar and pollen. Among the best beekeeping vegetation areas are forest woodlands, grasslands with dense covers of flowering herbs/shrubs, agricultural crops yielding nectar in abundance can be good beekeeping sites *e.g.* mustard, litchi, eucalyptus, barseem, maize, sunflower, legumes, cucurbits, apple, cherry,

papaya, citrus, pear *etc*.

4. Apiary should be near to the running and fresh source of water.
5. Apiary location should be away from public places and roadsides (more than 300 meters).
6. Colonies should be sheltered from the extreme sun heat, frost, wind and floods.
7. An apiary should be sited far from fields which are sprayed with pesticides to avoid bee poisoning and honey contamination.
8. Avoid spraying when the plants are on flower or during peak foraging periods, if bees placed nearby the commercial farm fields.

Knowledge of bee flora

In order to survive, prosper and be productive, honey bee colonies must have a regular supply of both nectar and pollen in adequate quantities. Not all plant species are equally good for beekeeping. Some supply both nectar and pollen abundantly when in bloom and these are often called honey plants, because they are best suited for honey production. Plants producing nectar but little or no pollen are also considered to be honey plants. Other plants, however, may yield pollen but little or no nectar. These pollen plants are also important in beekeeping, especially at the time of colony build-up, when the bees need large amounts of the protein contained in pollen for their brood-rearing.

Seasonal bee management

Good management practices are the key to success as a beekeeper. Honey bee colonies should be opened, checked or monitored one to four times as per requirement of the season. Management practices are varying in different regions, availability of bee flora and climatic conditions.

a) Honey bee buildup season: This season comes before nectar flow season when colonies should be strong. Following practices should be taken by a beekeeper.

1. The strength of the colony should be improved for entering honey flow season.
2. Week colonies should be united.
3. If necessary, provide sugar syrup and make sufficient population.

b) Honey flow season: This season coincides with spring which has a plenty of bee flora, nectar and pollen from the various flowering plants. During this season, a beekeeper must follow these steps:

1. Provide more space for honey storage by giving comb foundation sheet or built combs.
2. Confine queen to brood chamber by using queen excluder.
3. Prevent swarming as explained in swarm management.
4. Prior to honey flow, provide sugar syrup and build sufficient population.
5. Divide strong colonies into 2-3 new colonies, if colony multiplication is needed.
6. Queen rearing technique may be followed to produce new queens for new colonies.

c) Dearth period Management: During the hot summers, chilled winters and heavy rainy days when there is no bee flora, bees cannot go outside and suffer with starvation. A beekeeper should consider following points:

1. Enough honey may be left in the hive to keep colony alive.
2. Protect from rain, wind and enemies
3. When the nectar is generally not available colonies should be given sugar syrup in the evening.
4. Remove empty combs and store in air tight container.
5. Use dummy division board to confine bees to small area.
6. Unite weak colonies, provide sugar syrup, pollen supplement and substitute

i. Summer management: Bees have to survive intense heat and dearth period by following means.

1. Provide sufficient shade, under trees or artificial structure.
2. Reduce heat by sprinkling water twice a day on gunny bag or rice straw put on the hives.
3. Increase ventilation by introducing a splinter between brood and super chamber.
4. Provide sugar syrup, pollen supplement, substitute and water.
5. Enough honey may be left in the hive to keep colony alive.
6. Unite weak colony with strong colony.

ii. Rainy season and monsoon management

1. Avoid dampness in apiary site and provide proper drainage.
2. In rains when bees are confined to the hive, provide sugar syrup feeding.
3. Remove empty combs and store in air tight container.
4. Use dummy division board to confine bees to small area.
5. Unite weak colonies and provide sugar syrup, pollen supplement and substitute.
6. Avoid bloodlessness in colonies, if pollen stores and fresh pollen is not available, feed the colonies either pollen substitute or pollen supplement.
7. If colonies are week and have poor food stores, provide candy or dry sugar instead of sugar syrup
8. Keep in check the attack of enemies like wax moth, ants, mites and wasps.
9. The hive is kept on stands sloping towards entrance in order to drain out water.

iii. Winter management: It includes the following practices.

1. Maintain strong and disease free colonies and provide new queen to the hives.
2. Provide winter packing in cooler areas or hilly regions.
3. Remove empty combs and store in air tight container.
4. Use dummy division board to confine bees to small area.
5. Unite weak colonies and provide sugar syrup, pollen supplement and substitute.

iv. Nutrition management or artificial feeding during dearth period

Paying awareness to honey bee diet is just one of the more important aspects of successful beekeeping. Honey bee collects a number of substances to ensure its survival viz., nectar, pollen, water, propolis etc. However, during the scarcity of above essential diet components bees may not able to survive. Shifting the hives to alternate floral sources will help them stay healthy.

Sugar Supplement syrup foods for Honey Bees: About 8-11 lts of 2:1 sugar syrup (2 parts sugar to 1 part water) is the usual feeding per colony. In spring feeding, the syrup mix may be reduced 1:1 (1 part sugar to 1 part water). 3:1 bee syrup mix is for winter. At this concentration there is little water to evaporate. It is also less likely to freeze. Use boiling water in making the syrup. Allow to cool before serving.

Protein Supplement Foods for Honey Bees: The adult bees of a colony obtain their dietary protein from the pollen the workers collect and bring back to the hive or from nitrogenous food-stuffs provided by the beekeeper. There is a multitude of different artificial diet available as substitute or supplement for pollen but the following provides a general guide: Pollen: 5% ,Sugar: 20–50%, Yeast (torula): 20–50%, Flour (soya): 20–50% and Vitamin supplement: 1–3%. Increasing the amount of pollen and sugar will make the supplement more attractive to the bees which contain the quality and quantity of proteins and amino acids, lipids, vitamins, and minerals required for growth and development of individuals and reproduction of the colony. Pollen patties or protein cakes may well be an attractive proposition.

Supplying bees with water: A supply of water must be available to bees at all times. A lack of it adversely affects the nutrition, physiology, brood rearing, and normal behavior.

Swarming : Causes and management

Swarming is a natural phenomenon that ensures the survival of the species through a colony reproducing itself. Swarming normally occurs in spring, allowing the colony to establish itself over the following summer and autumn before winter brings a serious reduction in flowering species from which food can be obtained.

Cause of swarm:

1. Reproductive swarm
2. Overcrowding - too many bees, food stores and no cell space for the queen to lay eggs in.
3. March-April is swarming season and healthy colonies develop strong swarm desire.
4. Inclement weather - crowded bees confined by cold, wet weather will build queen cells and

swarm out on the first sunny, warm day. All colonies in similar condition will swarm as soon as weather becomes favorable.

5. Large amount of drone brood in early spring is a precursor to strong swarm impulse.

Management:

1. Allowing this form of reproduction often results in the loss of the more vigorous division. The remaining colony may be so exhausted and set back due to the brood cycle disruption that it is unproductive for the season.
2. Beekeepers control swarming prior to the natural swarm time.
3. Place two or three drawn out combs in an empty super and place on top of the parent colony, separated by a queen excluder.
4. Examine all the frames from the brood nest of the bottom colony for queen cells.
5. If the old (caged) queen is worth saving, a small nucleus consisting of two combs of brood and adhering bees can be made for her accommodation.
6. Capture any subsequent swarms with the help of swarming bag and return to the old hive by simply shaking the bees in front of the hive entrance.
7. In case parent colony, from where swarm has been issued is not known, the captured swarm should be placed in the new empty hives.
8. Only one young queen will survive and the bees will no longer attempt to swarm. If they do swarm again, repeat this step.
9. Provision of sufficient nectar storage space.
10. Colonies should receive maximum sunlight early in the season
11. Requeening a colony can help minimize swarming tendencies. Young queens produce more pheromones, thus inhibiting swarm preparation by the workers.
12. Clipping a queen's wing is a good way to minimize swarming tendencies in colonies
13. Removing queen cells from colonies before they swarm, a technique called "cutting queen cells," is useful as a swarm behavior repressor.

Disease and enemies management

Brood Diseases: They are generally easier to recognize as a group than adult diseases but are more difficult to control.

Disease	**Causal Organism**	**Symptoms**	**Management**
Bacterial Diseases			
American Foulbrood (AFB)	Spore forming bacterium, *Paenibacillus larvae* in temperate and sub-tropical regions.	1. The dead pre-pupae lie straight with head towards the opening of the cell (Sealed Cell) 2. Cell capping of infected brood becomes darker in colour, sunken and perforated. 3. A tooth pick inserted into the body of prepupa and drawn out shows ropiness. 4. The putrefying brood turns brown and has fish glue odor. 5. Dead broods dry up into scales, adhere to the cell bottom.	1. Sterilize the combs and other hive parts with Formalin @ 150 ml/ l or ethylene oxide @ 1 g/l water, for 48 h at 43^{o}C in fumigation chambers. 2. Terramycine capsule @ 250 mg per 3 liter sugar syrup or 500 mg per 5 liter sugar syrup should be given as half lt sol / box and should be given at weekly interval for 1 month .

European Foulbrood (EFB)	Non-spore-forming bacterium, *Melissococcus plutonius*	1. 3-5 days old are more susceptible to infection than older larvae 2. Bacteria, on swallowing with food, multiply in mid gut and are discharged with feces. 3. Diseased larvae become flaccid, turn brown and give foul-sour smell.	3. Breeding disease resistant strains of bees is one of the best measures for the disease management. 4. Provide sufficient sugar syrup to the diseased bees. 5. Fumigate all the equipments with formalin in a closed place. 6. Streptomycin , 0.2 gm per half lt sugar syrup should be given twice a week to diseased bees.
Fungal Diseases			
Chalk Brood	Spore-forming fungus, *Ascosphaera apis.*	1. The infected larvae (3-4 days old) are quickly covered by the white cotton-like mycelium which eventually fills the entire cell. 2. The white/grey mass soon hardensThe larva in the cell will resemble a lump of chalk, hence, the name of the disease chalkbrood	1. Removal of mummies by bees results in natural control. 2. Collect and burn the mummified larvae. 3. Replace old, blackened brood combs as these may harbor chalk brood spores. 4. If a colony lacks sufficient food stores, supplement with good-quality feed. 5. Replace queens with stock bred for hygienic behavior and/or disease resistance. 6. Put bee boxes at proper ventilated and clean place, these should not be placed at places with higher humidity. 7. Thymol (0.7 % sol) can be used to prevent the disease. 8. 5 % sol of Formalin (40 %) can be used for disinfection of frames and equipments.
Stone Brood	*Aspergillus flavus*	1. It only infects larvae that are three to four days old. 2. The larval body becomes harden and mummify.	
Viral Disease			
Sac Brood Virus (SBV) and	Disease symptoms for diagnosis of	1. Brood death in prepupal but in unsealed stage. 2. Dead larvae straightening out	1. For viral pathogens, there is no chemical control.

Thai Sac Brood Virus (TSBV)	both the diseases are similar. SBV is infective on *Apis cerana,* while TSBV infects *Apis mellifera.*	and lying on their backs, with tip of the head capsule turned upwards. 3. Dead pre-pupae that turn into sac like structure. 4. Affected larvae becoming yellow or grayish, later darkening to blackish; the change in colour first starts from mouth-parts and head. 5. Dead larvae and pre pupae drying up in brood cells forming loose scales.	2. Affected colonies should be isolated beyond their flight range. 3. Check robbing, drifting and swarming. 4. Undertake selective breeding for natural resistance 5. 250 mg terramycin / 5 lt of sugar syrup should be given to diseased honey bees at weekly interval.

Adult diseases:

Disease	**Causal Organism**	**Symptoms**	**Management**
Protozoan Disease			
Nosema Disease	*Nosema apis* Zander	1. Bees become dysenteric with distended abdomens. 2. Young infected bees take up nursing duties as usual but soon stop rearing brood because food glands are affected and they shift to foraging. 3. Affected bees have disjointed wings and are found crawling in front of the hive. 4. Large number of spores can be observed in the mid gut contents of infected bees under microscope. 5. The disease is particularly severe during spring and winter and there is depletion of strength	1. Provide upward ventilation to reduce humidity. 2. Feed bees with fumagillin @ 10 mg/ lt water in concentrated syrup. It inhibits DNA replication of the pathogen. And Gramicidin may also be used for its treatment. 3. Disinfect the empty hives with ethylene oxide or acetic acid fumigation @ 120 ml / hive. 4. Wash hands with soap before inspecting the box and disinfect all the beekeeping equipments with Formalin to prevent the infection. 5. This disease is mainly due to dirty water of rainy season. Provide clean water in a pot and put it over a stand. Make one hole in pot and fix cotton plug along with wooden stick in the hole so to distrupt the rapid flow of water and bees can easily take the water.

Amoeba Disease:	*Malpighamoeba mellifecae*		1. Scarp off the bottom board and disinfect it with 2% carbolic acid or acetic Acid. 2. Spores can be destroyed by temperature treatment at 49°C for 24hr. 3. Feed bees with Fumagillin @10 mg per liter of sugar syrup.
Mite diseases			
Varroasis	An Ectoparsitic mite,*Varroa destructor*	1. Parasitize immature drone and worker bees within their cells. 2. Colonies severely infested appear restless and weakened. 3. Only a few bees remain along with the queen 4. Mites tear the integuments of the adult bees and suck the haemolymph. 5. Reduced adult bee population in the infested colonies queen supersedure, spotty broods are common. 6. Affected young larvae turn in to light brown colour 7. The brood fails to develop in to adults or malformed adults are formed.	1. Screened bottom board with sticky board. 2. Application of formic acid (as vapor or pads). 3. Thymol powder @ 0.25g/ hive dusted in the passages of frames. 4. Thirty two grams of crystal oxalic acid (dehydrate) is thinned in one liter of sugar water (1:1). 5. Lactic acid (8 ml of 15 % acid per comb) is clearly better tolerated by bees and does not cause problems in warmer climatic zones.
Brood mite	An ectoparasitic mite, *Tropilaelaps clareae*		
Acarine diseases	Treacheal mite, *Acarapis woodi,* An endoparsitic mite	1. Mites pierce the wall of the tracheae and suck the haemolymph. 2. Infested bees have shorter longevity and reduced flight ability. 3. Irregular dark stains initially develop on the infested tracheae which ultimately blacken. 4. In severe cases, “K winged” shape can be is seen, where the two wings on one side of the thorax become unattached, such bees	1. Use of folbex strips (a mixture of potassium nitrate and chlorobenzilate) as a fumigant at the rate of 1-2 strips per colony. 2. Use of menthol crystals @ 50 g per hive or menthol strips. 3. Formic acid @ 5ml. per hive in glass vial.

		unable to fly.	

Enemies of honey bees:

Enemy	Important Features	Management
Wax Moth		
Greater wax moth (*Galleria mellonella*)	Observed throughout the year but its occurrence is severe during July to Oct and Nov to Dec. Empty combs, rendered wax, comb foundation and bee collected pollen, if not properly stored and left unattended, almost always suffer considerable damage from wax-moth infestation	1. The entrance should be reduced to avoid the entry of adult moths. 2. A water soluble concentrate of spores of *Bacillus thuringiensis* Serotype 7 provides an excellent protection of stored combs without affecting the organoleptic properties of the honey. 3. Stack the empty combs in supers (up to 8-9 super) leaving some empty space in lower most super. Make it airtight by using mixture of mud and dung. 4. Avoid fumigation with naphthalene, ethylene die-bromide and PDB 5. Fumigate the empty combs with sulphur powder @ 230g/m3 and after that seal them properly.
Lesser wax moth (*Achroia grisella*)	The lesser wax moth is generally smaller than the greater wax moth, except when the latter is dwarfed owing to poor diet during its larval stage.	
Wasps &Hornets (*Vespa orientalis, V.cincta, V. magnifera* etc)	They appear after spring and continue during monsoon season and cause maximum damage to colonies during July-September in Uttarakhand.	1. Keep the colonies strong and ensure proper food in the colonies. 2. Reduce the hive entrance or use queen gate or protective screens. 3. Destroy the wasp combs and use wasp traps with honey/ sugar/ Gur.
Ants	Ants may destroy whole colony within few hrs by robbing honey, pollen, predating on eggs, brood & adults. Attack is usually observed in rainy season.	1. Keep apiary clean by removing old and rotton woods, stones, weeds etc. 2. Place the hive stand post on the water filled bowl or earthen pots. And clean the bowl regularly.

Other enemies :

1. Wax beetle, *Platybolium* sp. (Tenebrionid beetle) and small hive beelte, *Aethina tumida*.
2. Birds: King crow, *Dicrurus* sp; Bee eater, *Merops* sp.
3. Lizards, termites, toads and frogs.
4. Others like death's head hawk moth, *Acherontia styx;* robber flies; dragon flies, praying manids. Some mammals: bears, badgers and off course man

Migration management

Migration of bee colonies from one place to another where sufficient bee flora is available for the survival of bees and better honey production is an essential task in beekeeping. For example plains to forests, hills to farms and orchards in the adjacent plains in order to utilize the local bee flora and improve bee forage availability to bee colonies. Migratory beekeeping in the *Tarai* region of Uttarakhand could enhance honey production and colony multiplication. The suitable areas identified for migration in Tarai region are as follows:

Sl. No.	Location	Period	Honey crop
1.	Pantnagar	April, May and June	Papaya, Maize and Sunflower
2.	Haldi, N- block Pantnagar	December and January	Berseem and Mustard
3.	Pilibhit	November, December and January	Mustard
4.	Melaghat, Khatima	January – February	Eucalyptus
5.	Pattharchatta, Pantnagar and Ramnagar	March	Litchi
6.	Sitarganj	May- June	Jamun
7.	Moradabad	July	Maize
8.	Sambhal	August –October	Bajra

Preparing colonies for migration:

1. Provide proper ventilation by using entrance screens and even top screen in place of inner cover during hot weather
2. Nail all the movable parts of the hive properly or tie with migratory belts
3. Before packing the colony, remove frames of honey which are more than half sealed since honey combs cannot bear much jolts. However, the colonies should have sufficient food during the journey
4. Close the entrance in the evening when all bees have returned.
5. Colonies should be moved during night .For deciding migrating site, the beekeeper should have a detailed knowledge of honey flow sources and density of bee colonies in the surrounding area. Avoid areas which already have lot of bee colonies.
6. Migration can involve shifting of one truck load of bees up to 200 Km or even more. If journey cannot be undertaken in one night during hot periods then the truck should be parked in the shade during day, entrances opened and provision of water should be made. Journey can be started in the evening after closing hive entrance.
7. On arrival at the destination, colonies are unloaded and placed at the desired site. Then the entrance screens are removed

Other Management Practices for successful beekeeping

Practice judicious methods

1. Monitor colony strength and unite weak colonies.
2. Use logical services for ideal colony assessment.
3. Ensure frames of brood for planned strength to coincide with honey flow season.
4. Do not combine weak collapsing colonies with healthy colonies

Managing Stock:

1. Maintain genetic quality to meet out all objectives:
2. Maintain stocks that are prolific disease and pest resistant.
3. Encourage high drone densities to provide well-mated queens and genetically diverse colonies.
4. Discourage stocks that are excessively defensive.
5. Select stock by propagating colonies that flourish when other colonies exhibit symptoms of stress.

Hive Maintenance:

1. Keep your equipment in good condition.
2. Check apiary for hive condition.
3. Inspect for rotten, loose or broken boards and frames.
4. Reconstruct, tighten or replace frame parts.
5. Paint supers with light colors to beat summer heat.
6. Take advantage of the bee flora/honey season to do maintenance and prepare for the new season.

Hygiene:

1. Practice good hygiene with hands, gloves, and other equipment to reduce transmission of pathogens between colonies.
2. Replace comb with new foundation to minimize residual chemicals in old wax.
3. Develop a comb replacement schedule.

Hive Security: Hive security can minimize economic losses.

1. Be aware that the probability of theft has increased with the increased value of pollinating crops.
2. Secure a signed contract when entering into a honey flow season.
3. Practice discretion when showing where your hives are located.

Final steps

1. Inspection of surroundings to place the apiaries in appropriate areas.
2. Observation of quarantine measures for all new introductions that have to be made in the apiary.
3. Regular verification of the health status of the colonies during the year.
4. Frequent renewal of honeycombs (every 2 yrs) and regular replacement of queens (every 1-2 yrs).
5. Selection of queens who show resistance to diseases, hygienic behaviour, low tendency to swarm and high productivity.
6. Ensuring that hive capacity is sufficient to discourage swarming.
7. Preventing acts of looting (not having in apiary highly diseased, weakened colonies).
8. Feeding colonies having no food stocks or in case of unfavorable weather conditions.
9. Providing adequate water supplies particularly in hot periods.
10. Appropriate use of the bee smoker (respecting the bees welfare and avoiding using toxic material that can contaminate the honey).
11. Elimination of the use of toxic substances or paints for hives (e.g. disinfectants, chemical treatments for wood, etc.).
12. Exclusive application of drugs registered for use in bees respecting instructions, maintenance of beekeeping equipments in good order and cleaning and, when necessary, renewing the materials.

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-

26^0C for spawn run and 14-24^0C 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

8*th 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).

1. 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: KVK follow the policies of ICAR and GBPUAT, Pantnagar for transfer of technology among farming community.

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

Proper funding need to be provided to the KVK, Dehradun for large scale adoption of farmers friendly technologies at gross root level.

2.A Existing Institutions:

1. ICAR Institutes
2. Department of Agriculture, Horticulture, Animal Husbandry, Fisheries
3. ULDB
4. KVK
5. NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district: Existing institutions need to be strengthened particularly KVK, Dehradun to make it more effective, more responsible for the welfare of farming community in doubling their income.

3.A Existing Incentives: As per Govt. norms

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

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: Pradhanmanti fasal bima yojana

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

1.A Existing marketing facilities: Farmers sale their produce in local markets

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

1. Proper marketing facilities need to be developed in various region of the district do that farmers could get premium price of their produce.
2. It has been seen that despite of high production, farmers do not get remunerative price of their produce in the markets due to poor marketing system

2.A Existing grading facilities: Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

Proper infrastructure need to be developed for hi-tech grading especially for fruits, vegetables and spices.

A.For grains:

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

B.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:

Litchi and mongo are commercially important fruit crops of plains of Dehradun but due to lack of processing unit, farmers sale their produce afresh in the market. Establishment of processing unit can help the farmers in doubling their income.

A.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

B.For horticultural crops:

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

Packing facilities need to be established in Kalsi and Chakrata block of Dehradun where tomato, chilli, ginger, vegetable pea, rajma are largely grown.

A.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

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

1. Problem of marketing is the biggest issue in the farmers.
2. In doubling income of farmers, role of proper marketing has immense importance.

3.Value addition is also important for which proper training, demonstrations, infrastructure need to be developed.

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: Internet and video conferencing etc.
2.A: Existing evaluation procedure: Manual
2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.
3.A: Existing monitoring system: Physical
3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.
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 video conferencing etc.
5.A: Existing reading system: Literature, Booklets, leaflets, folders
5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Hindi Extension Journals, film show, success stories, visit of farmers at regular interval etc.

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
Promotion of high yielding varieties of

1. **Wheat** (VL *Gehun* 829, VL *Gehun* 892, VL *Gehun* 907, VL *Gehun* 953, HS 349, HS-490, HS-507, UP-2572, VL-907, VL-892, HD-2967, PBW-550, PBW-502, DPW-621-50, HD-3086 suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
2. **Paddy** (Hybrid rice: Arize-6444, NDR-359, Pant Basmati-1, Pant Basmati-2, Pusa-44, Pant Dhan-18, HKR-47, PR-113, Pusa Basmati-1509, Pusa Basmati-1121, Arize-6129, Pant Dhan 24, 26, Pant Sankar Dhan 3) suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
3. **Maize** (Vivek QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2, Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta) suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
4. **Sugarcane** (Early Varieties : Co Pant 84211, Co Pant 94211, Co Pant 03220, CoS 8436, CoS 88230, CoJ 85, CoS 96268, Co 238) and Mid-late varieties : Co Pant 84212, Co Pant 90223, Co Pant 96219, Co Pant 97222, Co Pant 99214, Co Pant 05224) suitable for *Vikasnagar, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
5. **Tomato** (Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen 2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3 suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
6. **Chilli** (DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani) suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
7. **Vegetable pea (**Vivek Matar 10, and Vivek Matar 12, VL Ageti Matar 7, Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, Arkle, Azad Matar-2, Arka Ajit and Kashi Udai suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun
8. **Rajma (VL Rajma 63,** VL Rajma 125, PDR-14 (Udai), Chakrata local suitable for *Vikasnagar, Kalsi, Sahaspur and Raipur* blocks of district Dehradun
9. **Mango (**Dushari, Langra, Chausa, Amrapali, Mallika, Bombay green, Pusa surya, Pusa Arunima,

Arunika, Pusa shreshta, Pusa Lalima) suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun

10. **Litchi (**Rose scented, calcuttia, gandaki Sampada, Gandaki lalima, Gandaki yogita (suitable for high density plantation) suitable for *Vikasnagar, Kalsi, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun

Strengthening of traditional water storage structure

1. Strengthening of existing water storage structures like ponds in *Vikasnagar, Sahaspur, Raipur* and *Doiwala* blocks of district Dehradun and Naula and Check dam in *Chakrata* and *Kalsi* blocks.
2. Creation of rain water harvesting structure in private as well as government buildings in all the villages of the region so as to create awareness among the villagers.
3. Creation of trenches for high percolation of water in most of the area of *Chakrata, Kalsi* and *Raipur* blocks.
4. Promotion of water conservation techniques like mulch, sprinkler and drip irrigation.

Adoption of cluster approach for holistic development

1. Rejuvenation of existing senile orchards of mango and litchi in *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.
2. Promotion of ginger cultivation in *Vikasnagar, Sahaspur, Raipur, and Kalsi blocks of the region*.
3. Promotion of onion and garlic cultivation in *Kalsi, Vikasnagar* and *Sahaspur* block of Dehradun.
4. Promotion of off season vegetables (tomato, vegetable pea, chilli, capsicum, cole crops etc.,) cultivation in *Kalsi and Chakrata* blocks.
5. Promotion of production of tomato cultivation in *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks with the use of proper crop rotation.
6. Promotion of production of vegetable pea, okra in *Vikasnagar, Sahaspur, Raipur and Kalsi* blocks.
7. Promotion and production of basmati rice in *Vikasnagar, Sahaspur, Kalsi* and *Doiwala* blocks.

8. Management of wild animal problem

1. Wild animals especially elephants are a big problem in Doiwala and Raipur block. In Kalsi and Vikasnagar blocks there is a problem of wild boars. Electric fencing is required in these places. 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 cultivation of fruit crops in the forest areas so that wils animals do not come in the cultivated areas in Doiwala and Raipur Kalsi and Vikasnagar block. 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. Farm mechanization will help in the timely sowing of crops. Mini harvesters should be developed so as to harvest on time.
3. Use of mechanized weeder in crops like sugarcane and maize will immensely help the farmers to do weeding on time and thus reduce drudgery of female farmers.
4. 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 plain areas

Without improvement in soil health, crop productivity enhancement under the rain fed farming system in the District Dehradun plains and hilly region is a difficult task. Soil and water conservation together should be considered a major thrust area for management of soil health . In a watershed approach, various soil and water conservation measures including construction of water harvesting structures, activities for prevention of soil erosion, forestation, terracing and land development should be taken up in the District Dehradun .

1. Popularization of soil testing in intensive mode and distribution of soil health card to farmers for judicious use of fertilisers.
2. Popularization of biofertilizers like Rhizobium, Azotobacter, Azospirillum, PSB, PSM, K solubilising micro-organism and use of these biofertilizers with FYM at the time of sowing.
3. Fortification of FYM with pseudomonas and trichoderma
4. Promotion of vermi composting unit and green manuring in all the villages of this region.
5. Promotion of cultivation of green manuring crops like Sesbania and Sunhemp in different blocks.
6. Promotion of green manuring in *Vikasnagar, Sahaspur, Doiwala* blocks of all the villages of this region.
7. Introduction of one leguminous crop in a yearly crop rotation. Vegetable pea is a very popular crop in all the blocks of district Dehradun and this crop can be successfully included in the crop rotation.

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 of high milk breeds of cows (Sahiwal, Red Sindhi & Jersey), buffaloes (Murrah) and goats (Beetal, Sirohi & Jamunapari) in *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala block*, while promotion of wool yielding breeds of sheep in *Chakrata* block.
2. Establishment of feed and fodder Bank in *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* block to meet fodder requirement of area particularly during lean period.
3. Establishment of milk chilling plant at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* block.
4. Promotion of Urea, Molasses, and Mineral mixer blocks at *Nyaypanchayat* level at all the blocks of Dehradun.
5. Introduction of poultry breeds like CARI Devendra and CARI Nirbheek as back yard poultry breeds. These breeds are suitable for egg and meat purposes.
6. Establishment of hatcheries for need of broilor or croilor at district level to meet out the requirement of chicks to the farmer's.
7. Strengthening of traditional water bodies/ rivulets with Mahaseer or carps at *Kalsi* block. The river Yamuna and Tonas can be used for fish farming.
8. Availability of feed material with low prices & Timely health check-ups of animals.
9. Introduction and promotion of Cross bred milch breed of animal for increasing income of marginal farmer.

Strategy 3 : Integrating Farming system

In District Dehradun the variations in altitude and climate offer natural advantage for crop diversification. As such, alternative strategies for agriculture related enterprises viz., horticulture, forestry, floriculture, medicinal plants needs to be strengthened. Besides, less remunerative crops can be replaced with more profitable crops on a rotational basis. Utilization of fallow lands may also provide additional gains. The traditional and scientific resources/know-how should be blended and disseminated to improve the agricultural economy of hills. It is essential to integrate the available natural resource, tap the untapped potential of crops/varieties and technical know-how in an eco-friendly

manner to enhance agricultural productivity for food and nutritional security as well. Introduction of vegetable crops in the crop sequence is capable of enhancing profitability by 2-3 times.

Following Integrated farming system model may be developed:

Cropping system (Area 4000m^2)

rice-wheat-moong
maize-wheat-moog
rice-wheat-moong
rice-vegetable pea-moong
maize-wheat-moong
maize-rajma-moong
maize-vegetable pea-moong
sugarcane + rajma-cauliflower
sugarcane + urd-coriander
tomato-maize-vegetable pea

Horticulture

Mango/Litchi/Guava/ Lemon (100 plants)

Livestock

Cow (01)/ Buffalo(01) + Backyard Poultry (100)

Others

1. Vermi-composting (20m^2)
2. Fodder production in terrace risers and bunds.
3. Mushroon production
4. Bee keeping

Strategy 4 : Reducing post harvest losses and value addition

1. In district Dehradun there should be plan to establish agro-processing facilities close to the points of production in rural areas, which will promote off-farm employment.
2. Agricultural Cooperatives and Gram Panchayats can play a leading role in this effort. As a part of post harvest management strategy, additional logistic infrastructure will also be required to be created.
3. District Dehradun produces large varieties of cereals, fruits, vegetables and spices. A sizable quantities of this produce are wasted because of lack of storage, processing and packaging facilities. In order to develop and strengthen this sector, backward and forward linkages can be established by involving private sector and coordination with all concerned departments and agencies of the State and Central Government.
4. Establishment of Small & Medium Size Agro Parks, which provide common infrastructure facilities for storage, processing and marketing of surplus fruits and vegetables.
5. Establishment of fruit & vegetable based wineries.
6. Establishment of mini fruit grading plant for mango, litchi and stone fruits at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks .
7. Establishment of Food Processing Units for mango at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.

8. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
9. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.
10. Tertiary and value addition of mango, citrus fruits, in at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks by establishment of small processing units.
11. Establishment of Food and Processing Units at at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks fo*r* pickle making using *mango & lemon*.
12. Promotion of common resources on custom hire basis viz. Power tiller, Mini wheat and Paddy thresher in at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.
13. Gravity ropeways to be constructed in Kalsi block to provide road head access to the farm produce need to be taken to be taken at a larger scale.
14. Private investment must also be encouraged in post harvest technology and infrastructure to bridge the gap in agricultural marketing.

Strategy 5 : Waste land development and waste water

As such there is no problem of wasteland and waste water in District Dehradun. But where the slope is very steep, there is some problem of soil erosion. In the hills of Kalsi and Raipur blocks Contour making for arable purpose in waste land in Kalsi block and other hill areas.

1. Afforestation of plants and perennial grasses in steep slope of more than 40% slope in Raipur and Kalsi blocks.
2. Plantation of Mulberry (*Morus*) plants, Wild fruit plants, Fodder trees (*Grewia*, *Alnus*, *Quercus*etc.) may be promoted in at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.
3. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all blocks.
4. Construction of tank for storage of water for lean season in all blocks.
5. Establishment of storage system for rain water in monsoon season.
6. 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, potassium etc.
2. Use of fortified FYM, vermicompost along with biofertilizers will increase the macro nutrient availability and thus will decrease the use of fertilizers. The soil organic matter content will increase and soil fertility will increase.
3. Foliar application of nutrients will also reduce the cultivation cost.
4. Provision of mechanization (Use of Power tillers, Power weeders, Paddy threshers, Wheat threshers, Maize Sheller, Wheel Hand hoe, Manual/ power operated Wheat/Paddy reapers etc.)
5. Promotion of well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers in at *Vikasnagar, Sahaspur, Raipur, Kalsi* and *Doiwala* blocks.
6. Promotion of line sowing and balanced fertilizers application in crops.
7. Promotion of recommended seed rate, spacing and depth.
8. Promotion of need based application of pesticides and other agricultural inputs. `
9. Promotion of hand tools in agricultural and horticultural operations.
10. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
11. Promotion of pressurized irrigation techniques in horticultural crops.

Strategy 7 : Off-farm income

1. Promotion of apiculture in Vikasnagar, Sahaspur, and Doiwala blocks / sericulture in Vikasnagar, Sahaspur, and Doiwala blocks, / mushroom for small and landless farmers in all blocks of Dehradun district.
2. Promotion of skill development in women and youth in all *Vikasnagar, Sahaspur, Raipur, Kalsi* and

Doiwala blocks.

3. Creation of new SHGs in all villages of all blocks and linking them with NABARD or lead banks of that areas.
4. Encouragement to existing SHGs 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 six blocks.

Strategy 8 : Enabling Policies

Adequate and timely availability of inputs is essential for agricultural growth. A dynamic and growing, agricultural sector requires seed, fertilizer, plant protection chemicals, bio pesticides, agricultural machinery and credit at reasonable rates to the farmers.

1. Land consolidation (Chakbandi) in Dehradun district is essentially required. This will help in proper planning and execution of farming practices.
2. Buy back mechanism of the government should be strengthened and all produce of the farmer should be bought by the government.
3. Implementation of policies for control of wild animal menace in agricultural areas (by sterilization/castration/killing).
4. Implementation of Soil Health Card Scheme in each nyay panchayat of all blocks.
5. Providing quality inputs at right time to the farmers
6. Increasing institutional support by providing subsidises and incentives to small and marginal farmers in all blocks.
7. Popularization of Udyan cards and KCC for widespread use of government incentives/ subsidies to farmers.
8. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
9. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

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

Action points that need to be considered for closing in on the present marketing gaps are:-

1. Transportation is the major problem in hill regions. So, either procurement centre may be established in the area or some transportation subsidy may be introduced for improving profitability of the farmers.
2. The awareness among farmers about other post harvest management aspects such as grading, processing etc. needs to be created by the concern departments.
3. For planning of marketing strategies, a data base on consumer behavior market competitiveness, strategies of potential rivals in export market, income and price response needs to be developed in the State.
4. Organization commodity specific growers‟ associations at village, market (AMC) and state level and integrating their functions in relation to market centric activity.
5. Govt. of Uttarakhand may tap Rural Infrastructure Development Fund from NABARD for all the AMCs projects on a comprehensive basis (new as well as modernization).
6. Involving Gram Panchayats to organize and manage markets at local level by undertaking remunerative schemes and improving their revenues.
7. Village level processing should be encouraged by providing appropriate technology and by organizing the marketing of such processed products.
8. Establishment of mini *mandies* at Block level.
9. For highly perishable vegetable and fruit crops like mango, litchi, tomato, capsicum etc creation of better transportation facilities with cool chain van at Block level.
10. Creation of direct linkages with food processing industries for better prices.
11. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.

12. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.
13. Installation of mini grading machines at village level.
14. Establishment of cold storage facilities in Kalsi and Vikasnagar blocks.
15. Promotion of local *Hatt* at Tahsil level in all blocks.
16. 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. Linking up villages to local market; local market to regional/ state markets and state markets to national and international markets duly network them online (e. marketing).
3. Use of internet to increase knowledge and explore marketing possibilities
4. Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level.
5. Organization of monthly review meeting at district to solve the problems related with farmers.

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

A.General information about Agroeco-region
District: Dehradun
Agro-ecological region: Region B (1000-1500)
Main Blocks in Region: Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur, Doiwala
Main village cluster in blocks:
1. Sahiya in Kalsi block
2. Hattal in Chakrata block
3. Pajethilani in Kalsi block
4. Accher gathi in Kalsi block
5. Tiger fall in Chakrata block
6. Tyuni in Chakrata block
7. Tuniya in Kalsi block

Rainfed Clusters:
1. Sahiya in Kalsi block
2. Hattal in Chakrata block
3. Pajethilani in Kalsi block
4. Accher gathi in Kalsi block
5. Tiger fall in Chakrata block
6. Tyuni in Chakrata block
7. Tuniya in Kalsi block

Existing rain water management facilities:
1. Water harvesting tanks in few pockets of Chakrata, Kalsi and Raipur blocks
2. Collections from hill slope
3. Village ponds
4. Interflow harvesting

B. Productivity Enhancement

1. Specific Action / Interventions recommended for harvesting and management of rain water in specific agro-ecological region
1. Water harvesting tank
2. Roof top harvesting system
3. Conjunctive and multiple use of water resources
4. Better water conveyance system such as HDPE pipeline

2. Existing practices for soil health improvement
1. Green manuring
2. Use of un-decomposed farmyard manure/ compost
3. Meagre use of biofertilizers
4. Imbalanced nutrient use
5. Meagre practice of green manuring in low land paddy
6. Use of raw/partially decomposed FYM
7. Meagre compost making/ recycling of crop residue

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

i) 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 etc. through composting and/or vermicomposting
4. Use of FYM @4-5t/ha or application of 2.5-3.0 t/ha vermicompost

(ii) Pulses and soybean

1. Seed with specific *Rhizobium* inoculant and 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

(iii) **Vegetables and spices**

1. Seed/ nursery soil inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture (each of 200 g/m2 for nursery soil inoculation; for seed inoculation quantity varies depending on seed size).
2. Seedling inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture at transplanting.
3. Soil test based balanced use of fertilizers; INM shall be preferred
4. Use of FYM @ 4-5 t/ha or application of 2.5-3.0 t vermicompost

Sugarcane

1. Set inoculation with Acetobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture.
2. Recycling of sugarcane trash through windrow composting
3. Soil test based use of balanced fertilizers
4. Use of FYM @10-12 t/ha or application of 3-4 t/ha vermicompost

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

1. Occasional occurrence: Drought, heat wave, hail storm, cold wave and frost.
2. 50% area is irrigated where major crops like rice, wheat, sugarcane are being grown.
3. Vegetables and horticultural crops are being grown over very small area.1. Adjustment of sowing/planting date to coincide with monsoon
4. Mulching is done by the farmers in orchards to conserve the moisture
5. Drip irrigation is being used in some areas

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

1. High yielding varieties in vegetables, maize, rice, wheat, oilseed, pulses, spices
2. Short duration fruit crops and improved breed of poultry, dairy, goatry need to be introduced and demonstrated for their large scale adoption at gross root level.
3. Mindset of the farmers be changed by mobilizing them towards integrated crop management practices.
4. Post harvest management, processing units and proper marketing network need to be created to improve the income of the farmers.
5. Increasing area under pomegranate cultivation
6. Promotion of backyard poultry farming
7. Protected cultivation of floriculture
8. Poly tunnel technology for nursery raising in vegetable crops can be helped in doubling the income of the farmers.
9. Rajma, urd, moong, lentil, pigeon pea, vegetable pea, tomato, chilli, ginger cultivation need to be promoted on large scale.
10. The climatic projection suggesting increasing air temperature and erratic distribution of rainfall.
11. Therefore following strategy should be followed to increased income under changing climatic scenario.
12. The coverage of GKMS should be increased for enabling farmers to take farm decisions as per ensuing weather conditions.

13. Due to higher precipitation activities (approximately 2200 mm rainfall/annum) the rain water should be properly stored (in polythene tank, by forming bunds) and harvested for Kharif season crops.
14. There is a good demand of off season vegetables therefore area under off season vegetable should be increased at least double by the year 2022.
15. Imbalance use of fertilizer is in practise in lower part (Sub-tropical region) of Dehradun therefore Site Specific Nutrient management should be adopted for enhancing Nutrient use efficiency, water use efficiency and crop productivity.
16. According to the frost forecast the crop residue should be burnt around the vegetable crops to increase energy level and to create a layer of smog for retardation of outgoing radiation.
17. Soil erosion triggered by high rainfall intensity is the major issue of Dehradun. Therefore water and soil conservation techniques like terrace farming, bunding etc should be encouraged.
18. Climatic conditions are suitable for scented rice.
19. The proper canopy geometry of mango, litchi and apple should be maintained to avoid losses due to hail storm

6A. Name of Field Crop: Maize

i. Existing varieties being used: Kanchan, VL-Maize 16, VL-Maize 88, Navin, Shweta

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 QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2, Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta

iii. Existing package of practicesbeing used:

1. Farmers are not adopting high yielding varieties released for commercial cultivation in the recent years.
2. They also do not follow balance use of chemical fertilizers.
3. It is also observed that due to lack of knowledge
4. Most of the farmers adopt improper plant protection measures.

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

1. Green manuring must be followed before two months of sowing.
2. Moong can be grown during summer season to improve the soil health.
3. Line planting be done to minimize weed infestation, incidence of pests and diseases and for ideal vegetative growth of the plants.
4. Sowing should be done in Ist fortnight of June in plains and hills of Dehradun. Water harvesting tank need to be created in rain fed areas to provide timely irrigation.
5. Balanced use of nutrients to be applied in the soil as per the soil testing analysis. Quality seed of high yielding varieties should be preferred after that seed must be treated with carbendazim 2 g per kg of seed before sowing.
6. In order to avoid lodging problem in hilly areas, hybrids such as 9164 having dwarf in nature and provide yield up to 25 Q per acre should be preferred for commercial cultivation.

v. Major insect pests associated with crop: Stem borer,White grub

vi. IPM Module for management of insect pests:

Maize stem borer

1. Collection and burrying stubble and stalks or ploughing and destruction of crop residue.
2. Growing maize in association with various legumes.
3. Intercropping maize with soybean.

Maize stem borer: *Chilo partellus*

Name of the Insecticides	(gm/ml)/ha	Waiting period (days)
Thiamethoxam 30 FS (Seed Treatment/Kg)	2.4	8
Carbofuran 3 %CG	1000	33000

Carbaryl 85% WP	1500	1764
Carbaryl 4 %G	250	6250
Dimethoate 30% EC	200	660
Phorate 10% CG	1000	10000

For management of **white grub,** chlorpyriphos 2 ml per liter of water can be applied in the root zone of the plant on need basis.

vii. Major disease associated with crop: Blight , Banded leaf, sheath blight, Maydis and Turcicum leaf blight, Bacterial stalk rot

viii. IPM Module for management of disease:

1. Use of disease free certified seeds
2. Deep ploughing during summer
3. Crop rotation
4. Application of bio-agents i.e. *Psedumonas fluorescens* as seed treatment (10g /kg seed) plus soil application (2.5 kg/ha) and spray @ 0.1% and seed treatment with *Trichoderma viride* (10g /kg seed) and their stimulation by the addition of amendments can be done.

A.Fertilizer application

a. A fertilizer dose of 80 Kg N, 60 Kg P2O5, 40 Kg K2O is generally required. Entire PK and 10% of N is applied as basal.
b. Remaining nitrogen is applied in 4 splits i.e. 20% at 4 leaf stage, 30% at 8 leaf stage, 30% at flowering stage and 10% at grain filling stage.

B.Row spacing

a. Should be done at 60-75 cm
b. Plant to plant spacing, 20-25 cm.

C.Cultural practices

a. Cultural practices which includes sufficient availability of plant nutrients.
b. Optimum soil pH (6.2-7.0)
c. Adequate water in fields
d. Weed control
e. Optimum plant population
f. Use of disease free and high quality seeds are very helpful in reducing the damage caused by various diseases by reducing the plant stress.

D.Other management practices

a. Excess water or stagnation condition of water should be avoided to check the spread and severity of banded leaf & sheath blight as well as bacterial stalk rot.

E.Sheath blight

a. Clean cultivation and destruction of crop debris
b. Stripping off the lower two or three infected leaves touching the soil along with their sheaths.
c. Spray of Propiconazole @ 1g/lt. water at the time of disease appearance and second spray 7-10 days after first spray or Carbendazim @ 1 g/lt. water.
d. Avoid water logging.

Leaf blight of maize: *Stenocarpella maydis, Glomerella graminicola*

Name of the Fungicides	**(gm/ml)ha**
Mancozeb 75% WP	1500-2000
Ziram 75% WP	1500-2000

ix. Major weeds associated with crop: *Echinochloa, Laptocloa*, Sedges

x. IPM Module for management of weeds:

Bispyribac sodium 2 5 g ai per ha should be applied 15-20 days after planting for management of sedges.

Jungle rice: *Echinochloa* sp. (annual, monocot, narrow leaves, grass)

Name of the Herbicides	**(gm/ml)ha**	**Waiting period (days)**

Alachlor 50% EC	5000	90
Alachlor 10 %GR	15000-25000	
Atrazin 50 %WP	1000-2000	
Diuron 80 %WP	1000	
Paraquat dichloride 24% SL (Before sowing)	800-2000	90-120

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

1. Cropping pattern of maize-wheat-moong under irrigated condition.
2. Cropping pattern of maize-rajma-moog under irrigated condition.
3. Cropping pattern of maize-vegetable pea-moong under irrigated condition.
4. Cropping pattern of maize-sarson-moong under irrigated condition.
5. Cropping pattern of maize-cauliflower-moong under irrigated condition.
6. Cropping pattern of maize-cabbage-moong under irrigated condition.
7. Cropping pattern of maize-lentil-moong under irrigated condition.
8. Cropping pattern of maize-vegetable pea-tomato under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties and hybrids
2. Poor awareness on seed treatment
3. Poor weed management
4. Imbalanced use of chemical fertilizer
5. Lack of awareness about pest and disease management among farmers.
6. Lack of green manuring before sowing of maize
7. Farmers do not grow summer moong to improve the soil health and to get additional income from moong crop.

7A. Name of the Pulse crop: Rajma

i. **Existing varieties being used:** Chakrata 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:** VL Rajma 63, VL Rajma 125, PDR-14 (Udai)

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

1. Almost all the farmers of mountain region grow unknown variety of Rajma which is popular in the name of Chakrata local.
2. Its quality is good but productivity is very low.
3. Demand of Chakrata local rajma is very high in the market.
4. The low yield of Chakrata rajma is due to several factors i.e. poor plant protection measures
5. Poor nutrient management adopted by the farmers
6. Rain fed condition also responsible for low yield due to poor monsoon.
7. Farmers do not follow seed treatment and soil treatment.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Water harvesting tank need to be created to provide irrigation during poor monsoon.

v. **Major insect pests associated with crop:** Pod borer,White grub

vi. **IPM Module for management of insect pests:**

1. For management of pod borer, quinalphos 2 ml per liter of water or imidacloprid 0.75 ml per liter of water can be used judiciously.

2. For management of white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after germination on need basis.

vii. Major disease associated with crop: Root rot, Anthracnose

viii. IPM Module for management of disease:

1. For management of root rot, carbendazim + mancozeb @ 2 g per liter of water may be applied in the root zone on need basis.
2. For management of anthracnose, copper oxy chloride 3 g per liter of water can be used according to need.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*,Sedges

x. IPM Module for management of weeds: Hand weeding and intercultural operations effectively reduced the weed infestation

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

1. Cropping pattern of rajma-vegetable pea under rain fed condition.
2. Cropping pattern of rajma-lentil under rain fed condition
3. Cropping pattern of rajma-onion under irrigated condition
4. Cropping pattern of rajma-garlic under irrigated condition
5. Cropping pattern of rajma-chickpea under rain fed conditionretain the medical efficacy of plants in their natural habitats

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers etc.
4. Poor irrigation facilities where rajma is grown in the kharif season of mountain region. It has been observed that sometimes poor monsoon affect its productivity.

8A. Name of the vegetable crop: Tomato

i. Existing varieties being used: Himsona, Manisha, Shahanshah, Avtar, Abhinav
Private company varieties like Rakshhak 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, Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen 2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3

iii. Existing package of practices being used:

1. In hills of Dehradun, most of the farmers grow heamsohna hybrid of tomato from the last 10 years which has become susceptible against bacterial wilt. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
2. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.
3. Generally crop grown in open field condition
4. Sowing time- Oct-Nov. And Jan-Feb
5. Sowing space-75x60 cm and 75x45 cm

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

1. High yielding varieties and hybrids must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.

5. Mulching should be done as it has been fetching outstanding result particularly use of plastic mulch.
6. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
7. 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.
8. Use micronutrient including Ca, B and Mo
9. Crop rotation Tomato-cowpea-Early cauliflower.

v. Major insect pests associated with crop: Fruit borer,White fly,Cut worm,White grub **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

vi. Major disease associated with crop: Late blight, Fruit rot, Leaf curl disease

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

1. For management of late blight and fruit rot
2. Cymoxanil + mancozeb 2.5 g per liter of water may be applied on need basis.
3. For management of leaf curl disease, thiamethoxam 0.5 g per liter of water can be applied according to need.

Late blight :

1. Burn the infected crop debris,
2. A void excess moisture.

Late blight :

3. Burn the infected crop debris,
4. A void 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

viii. Major weeds associated with crop: *Echinochloa sp , Laptocloa sp.*, Sedges

ix. IPM Module for management of weeds: Use of plastic mulch reduces weed infestation upto 80 per cent

x. Specific workable and sustainable intensification capable of doubling agricultural income

in specific agro-ecological region:

1. Cropping pattern of tomato-maize-vegetable pea under irrigated condition.
2. Cropping pattern of tomato-grounnut-vegetable pea under irrigated condition.
3. Cropping pattern of tomato-moong-urd under irrigated condition.
4. Cropping pattern of tomato-chiili under irrigated condition.
5. Cropping pattern of tomato-brinjal under irrigated condition
6. Cropping pattern of tomato-cabbage under irrigated condition
7. Cropping pattern of tomato-cauflower under irrigated condition
8. Reduce number of spray of pesticides.
9. Raise nursery on treated soil.
10. Treat seed with fungicide before sowing.
11. Manage fog during fruiting period.

xi. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching and staking etc.
6. Imbalance use of fertilizes.
7. More numbers of pesticides' spay
8. Increase incidences of Bacterial wilt.

8B. Name of the vegetable crop: Chilli

i. **Existing varieties being used:** Laher, Soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani, 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:** DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani, VL Shimla Mirch 3

iii. Existing package of practices being used:

1. In hills of Dehradun, most of the farmers grow old varieties of chilli from the last more than 10 years which has become susceptible against bacterial wilt.
2. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
3. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.
4. Growing local varieties.
5. No line transplanting.
6. Generally they plant two over aged seedling at one place.
7. No or very less use of fertilizer.
8. Sowing of untreated seed.

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

1. High yielding varieties and hybrids must be adopted,
2. Use of organic manure should be promoted, balanced use of chemical fertilizers need to be done,
3. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
4. Mulching should be done as it has been fetching outstanding result particularly use of plastic

mulch.

5. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
6. Grow high yielding varieties.
7. Treat the seed with copper containing fungicides before sowing.
8. Adopt soil testing.
9. Transplant one seedling at one place.
10. Transplant the seedlings when they attain 5-6 leaf stage.
11. Transplant the seedlings at proper spacing-
12. Dwarf varieties like Kashi Anmol at 45 x 30 cm
13. Tall varieties like Pusa Sadabahar, Pant C-1 at 50 x 50 cm.
14. 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 ,Cut worm ,White grub

vi. IPM Module for management of insect pests:

Management strategies sucking pests

A. Crop Hygiene

1. 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.
2. 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

Use proper pre-planting practices.

1. 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.
2. Avoid yellow clothing or utensils as these attract whitefly adults. Delay planting new fall crops as long as possible.
3. Do not plant new crops near or adjacent to old, infested crops.

Use proper post-planting practices.

1. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc.
2. 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.
3. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
4. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

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

vii. Major disease associated with crop: Leaf curl disease

viii. IPM Module for management of disease:

For management of leaf curl disease Thiamethoxam 0.5 g per liter of water can be applied according to need.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Use of plastic mulch reduces weed infestation upto 80 per cent.

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

1. Cropping pattern of chilli-vegetable pea-rajma under irrigated condition.
2. Cropping pattern of chilli-cauliflower-moong under irrigated condition.
3. Cropping pattern of chilli-cabbage-urd under irrigated condition.
4. Cropping pattern of chilli-broccoli-urd under irrigated condition
5. Cropping pattern of chilli-tomato under irrigated condition
6. Grow high yielding varieties.
7. Treat the seed with copper containing fungicides before sowing.
8. Adopt soil testing.
9. Transplant one seedling at one place.
10. Transplant the seedlings when they attain 5-6 leaf stage.
11. Transplant the seedlings at proper spacing.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching etc.
6. Non availability of quality seed.
7. Less irrigation facilities.
8. High cost of hybrid seeds.
9. Unaware about the insect-pest management

8C. Name of the vegetable crop: Pea

i. **Existing varieties being used:** Arkle, PSM-3, Azad Matar-2, Azad Matar-3, Arka Ajit, VL Matar-7, Kashi Udai

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, and Vivek Matar 12, VL Ageti Matar 7, Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, Arkle, Azad Matar-2, Arka Ajit and Kashi Udai

iii. Existing package of practices being used:

1. Majority of the farmers in hills and plains of Dehradun using Arkle variety which is early but very old.
2. Its yield is also low as compared to other varieties released for commercial cultivation in the recent years.

3. Due to continuous cropping of Arkle variety, incidence of pests and diseases increased considerably.

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

1. High yielding varieties and hybrids must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
6. 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).
7. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time and sow in October-November month.
8. 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.
9. Water the crop as per need especially during flowering and pod setting. Use Pendimethaline @ 1kg ai/ha as pre-emergence and one hoeing 25-30 days after sowing

v. Major insect pests associated with crop: Pod borer,White grub and cut worm

vi. IPM Module for management of insect pests:

1. For management of pod borer, quinalphos 2 ml per liter of water should be applied on need basis.
2. For management of cut worm and white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Powdery mildew

viii. IPM Module for management of disease:

For management of Powdery mildew, Thiophenate methyl 1 g per liter of water may be applied on need basis.

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: Chenopodium, Senji

x. IPM Module for management of weeds:

Hand weeding and application of pendi methalin @ 1.0kg/ha as pre emergence

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

1. Cropping pattern of vegetable pea-wheat-maize under irrigated condition.
2. Cropping pattern of vegetable pea-rajma-moong under irrigated condition.
3. Cropping pattern of vegetable pea-ginger under irrigated condition
4. Cropping pattern of vegetable pea-cabbage-urd under irrigated condition
5. Cropping pattern of vegetable pea-cauliflower-maize under irrigated condition.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers etc.

8D. Name of the vegetable crop: Ginger

i. **Existing varieties being used:** Reo de genero, Varad

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Nadia, Reo de genero, Varad, Surbhi, Suruchi, Suprabha

iii. Existing package of practices being used:

1. Farmers do not adopt proper plant protection measures for management of rhizome rot which is a serious problem in ginger growing areas.
2. They use undecomposed farmyard manure due to which incidence of white grub become serious.
3. Farmers also unable to use high yielding varieties having high demand in the market. Most of the farmers do not adopt balanced use of chemical fertilizers.
4. Majority of the farmers grow ginger in rain fed areas. Sometimes poor monsoon affect its productivity.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.

v. Major insect pests associated with crop: White grub

vi. IPM Module for management of insect pests:

For management of white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Rhizome rot

viii. IPM Module for management of disease:

1. For management of rhizome rot, drenching with copper oxy chloride @ 3 g per liter of water may be done in the root zone on need basis.
2. Proper drainage facility should be followed as water logging condition in the field increases the incidence of rhizome rot disease.
3. In sick soil soil solarization by covering with polythene sheet (25 – 50 μ) for 45 to 60 days during April-June, if possible
4. Use *Trichodermaharzianum* colonized compost.
5. Dipping of rhizome in suspension of TH (10 g per liter + 10 g FYM powder). Cover treated rhizomes with polythene for 24 h before sowing.
6. Drenching near base of the plants with TH+ PsF (10 g/l) whenever symptoms appear in any plant. Drenching may be restricted to infected as well as a few surrounding plants only.
7. Need based spraying of PsF + mancozeb (2 + 2 kg/ha) at 15 days interval.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Intercultural operations in the initial stage of the crop reduces weed infestation and mulching

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

1. Cropping pattern of ginger-cauliflower under irrigated condition.
2. Cropping pattern of ginger-vegetable pea under irrigated condition
3. Cropping pattern of ginger-vegetable pea under irrigated condition
4. Cropping pattern of ginger-lentil under irrigated condition
5. Cropping pattern of ginger-wheat under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers

9A.Name of the fodder crop: Berseem

i. **Existing varieties being used:** Vardan, Maskavi , 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:** Maskavi, BL-1

iii. **Existing package of practices being used:** Most of the farmers sow the berseem crop in zero tillage method after harvesting of the paddy crop in the month of November without treating any rhizobium culture.

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, Warden. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
4. Seed rate: 25-30 kg/ha
5. Sowing method:
   Wet method-like rice in puddled field
   Dry method: Without puddled.
6. Sowing time: First an week of October
7. Fertilizer: 30:60:70:: N:P_2O_5 K_2O kg/ha
8. Irrigation: Field should remain at field capacity throughout the crop period after germination.
9. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
10. Cutting management: First cut -45-50 DAS
11. Other cutting at 25-30 days interval- total 5-6 cutting are taken
12. 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:** Most of the field of berseem crop affwcted with kasani weed which reduces the biomass yield of berseem resulted in causing bloat problem in dairy animals.

x. **IPM Module for management of weeds:** It is reccomended that berseem seed should be treated with rhizobium culture and 10 % solution of molasis/ gur and stiring for 15-20 minutes for removal of berseem weed i.e. kasani.

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

1. Cropping pattern of berseem-maize-berseem
2. Cropping pattern of berseem-lobia-jwar-berseem
3. Berseem seed mixed with oat @ 100 g + 50 g musturd seed per kg of berseem seed during sowing to increase the biomass in first cutting.

xii. **Production constraints in agro-ecological region:** Berseem fodder crop damaged due to heavy frost affecting the crop in foot hills and valley areas

10A. Name of the Medicinal crop- Pili satawar

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:** CIM Sunhari, Local planting material

iii. **Existing package of practices being used:** No proper management

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

1. Viability of seed should be ensured.
2. Duration of the crop should be maintained at least for two year.

3. Earthing up is one of the important practice for increasing productivity of crop.
4. Intercropping of shallow rooted crops/vegetable is advisable during 1st year of crop cultivation.

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. Earthing up is one of the important practice for increasing productivity of crop.
2. Intercropping of shallow rooted crops/vegetable is advisable during 1st year of crop cultivation.

xii. Production constraints in agro-ecological region:

Lack of knowledge

10B. Name of the Medicinal crop- Lemon grass

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:** Krishna, Chirharit

iii. Existing package of practices being used: No proper management

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

Gap filling be done after observing mortality of plants in the initial period of planting for maintaining proper plant population and better productivity.

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: Proper spacing

xii. Production constraints in agro-ecological region:

Lack of knowledge

10C. Name of the Medicinal crop- Tulsi

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:** Shyama Tulsi, Van Tulsi

iii. Existing package of practices being used: No proper management

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

1. Seed viability should be ensured and tested before going for cultivation.
2. Water logging should be avoided

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: Proper spacing, Water logging should be avoided

xii. Production constraints in agro-ecological region:
Lack of knowledge

10D. Name of the Medicinal crop- Aloevera

i. **Existing varieties being used:** Local, *Aloe barbedensis*

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

iii. Existing package of practices being used: No proper management

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

1. Water logging should be avoided and light textured soils be preferred for better growth and productivity.
2. The crop should be protected from frost conditions by application of irrigation as and when required.
3. To get quality produce (Gel) post harvest arrangement before or just after harvest need to be ensured.

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: Proper spacing, Water logging should be avoided, Harvesting at proper time

xii. Production constraints in agro-ecological region:
Lack of knowledge

10E. Name of the Medicinal crop- Sarpgandha

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:** CIM Sheel, RS-1

iii. Existing package of practices being used: No proper management

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

1. Viability of seed is the prime concern and be tested before going for nursery sowing.
2. Preferably crop should be harvested after 2 years of plantation.
3. Harvesting should be done during winter months to protect alkaloids.

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: Proper spacing, Harvesting at proper time

xii. Production constraints in agro-ecological region:
Lack of knowledge

C1. Livestock: Cattle

1.A Existing breeds available: HF cross, Jersy cross, Sahiwal cross

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

2.A Existing feeds being used:

1. Paddy straw
2. Maize strove
3. Cherry strover

2.B Specific feeds to be introduced / advised:

1. Promotion of UMMB blocks, complete feed block as well as promotion of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras and temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye etc.
2. It is also recommended that addition of non conventional feed and fodder i.e. vegetable and fruit bi-products can be used.
3. Promotion of high yielding varieties of hybrid napier grasses, para grasses, barseem, oats and African tall maize crop need to be done.
4. Use of balance feed in mesh form and prepares by local available good quality grains with socking in water to increase the digestibility of the concentrate need to be encouraged.

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

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

1. At present most of the animals suffer from internal and external parasites, bacterial and viral infections as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.
3. Poor availability of quality fodder

C2. Livestock: Buffalo

1.A Existing breeds available: Murrah cross, Nili Ravi cross, Jafrabadi cross , Badawari cross

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding and artificial insemination with pure Murrah and Nili Ravi by using pure buffalo bulls

2.A Existing feeds being used:

1. Farmers feed their livestock by, paddy straw, maize strover, cherry strover, berseem, oats as a green fodder
2. Farmers feed their livestock as readymade concentrate mixture in mesh and pallet form upto some extent.

2.B Specific feeds to be introduced / advised:

1. Promotion of UMMB blocks, complete feed block
2. Promotion of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras
3. Temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye etc.
4. It is also recommended that addition of non conventional feed and fodder i.e. vegetable and fruit bi-products can be used.
5. Promotion of high yielding varieties of hybrid napier grasses, para grasses, barseem, oats and African tall maize crop need to be done.
6. Use of balance feed in mesh form and prepares by local available good quality grains with socking in water to increase the digestibility of the concentrate need to be encouraged.

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.Other Disease Control Programs/ Health Camps (criteria, target): Infertility Camps

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Promotion of male calf rearing for future breed improvement of Murrah and Niliravi buffalo.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle in shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system-

1. Presently most of the animals are prone to internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.
3. High mortality in male buffalo calf due to deprive of milk.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.
3. Poor availability of quality fodder in Region B

C3. Livestock: Sheep

1.A Existing breeds available: Local & Merino Cross

1.B Specific breeds to be introduced: Merino

2.A Existing feeds being used: Fodder tree leaves, Forest grasses

2.B Specific feeds to be introduced / advised: Commercialization of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras,

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle shed in improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size are commonly used for livestock management in all the three regions.
4. These existing practices are responsible for contamination of diseases

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system:

1. At present most of the animals in all the three regions suffer from internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.

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

Poor availability of quality fodder

C4. Livestock: Goat

1.A Existing breeds available: Black Bangal, Cross Sirohi , Non descript of local goats

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding with selection of elite buck in existing stock of the herd and artificial insemination with pure Gaddi, Black Bangal, Jamunapari and Barbri fetch from the ICAR-CIRG, FARAH for breed improvement.

2.A Existing feeds being used: Farmers adopted only grazing system 5-6 hours in a day.

2.B Specific feeds to be introduced / advised:

1. Concentrate feed @ 100-120 g of leguminous grains i.e. gram, soybean, rajma Protineous geen fodder i.e *Morus* leaves and *Ficus* group trees leaves.
2. Mineral mixture must be fed @25-30 g per day per animal for maintain the proper health and fertility condition.Scientific grazing systems should be adopted on grazing lands and alpine grasslands

3.A Existing health services:

Most of the goat farmers reared their goats with their traditional methods for control of internal and external parasites, mites, flies and viral infestation i.e. FMD, PPR and protozoal infestation

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Farmers need to be educated on various issues of goat farming for doubling the income.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed therefore most of the goat flock suffer with respiratory problem,
2. Improper condition of the floor sheds,
3. Manger and standing passage of the paddock is very poor in shape and size.

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

1. Proper housing space with suitable material,
2. At the time of stall feeding and cleanliness management practices must be adopted to fulfil the required amount of dry matter as per their body weight ,
3. Concentrate and mineral mixture along with timely deworming and vaccination practice..

5.A Problems of Livestock system:

1. Lack of pure genetic breed in-breeding condition is high therefore the mortality of the kids and poor conception is high.
2. Most of the goat herd have very shortage of quantity and quality of concentrate feed and mineral mixture the productivity of goat is continuous deteriorated.

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

1. Lack of local available good quality grains as concentrate feed reduce the health condition of the goat
2. Due to inbreeding and anorexia the morbidity and mortality is very high.

C5. Livestock: Poultry

1.A Existing breeds available:

1. Non descriptive local for dual purpose
2. Synthetic strain for meat purpose

1.B Specific breeds to be introduced:

1. The popularization of Cari Devendra, RIR cross with Aseel, Kadaknath, Chibro breed for cross with RIR
2. Playmouthrock for dual purpose
3. Cari Dhanraja, Cari Mritunjay for meat purpose
4. Cari Priya, Cari Sonali for egg production in backyard condition
5. Synthetic stain and WLH, Red Cornish for organized sector

2.A Existing feeds being used: Majority of the poultry farmers reared the birds in range condition during the day time and night in battery cages

2.B Specific feeds to be introduced / advised:

For successful strengthening of the poultry sector must be provided balance concentrate feed i.e. pre starter, starter, grower

3.A Existing health services:

1. Most of the chicks died in brooding stage due to negligence of the management of the owner.
2. Unhygienic conditions of poultry farm increase the mortality percentage.

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

1. Proper brooding facilities
2. Proper vaccination schedule and techniques
3. Use of good quality liter material
4. Proper ventilated housing facilities

5. Awareness of the poultry growers for contagious disease transmitted one farm to another

4.A Existing management practices:

1. Non organized poultry growers in remote areas,
2. Lack of vaccination schedule,
3. Proper housing space and poor sanitation practices adopted in poultry shed.

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

1. Rearing of healthy DOC chicks,
2. Proper brooding system,
3. Suitable environmental condition and vaccination practices must be required.
4. Isolation and removal of morbit birds and liter material away from healthy stock in proper way.

5.A Problems of Livestock system:

1. Lack of pure DOC genetic stock
2. Bacterial and viral contamination is higher
3. Cost of feed is higher
4. Proper marketing facilities is not available
5. Non availability of suitable medicine and vaccines in local market

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

1. Most of the farmers purchase poultry chicks from private hatchery, they are having poor genetic stock of poultry chicks.
2. Cost of chicks is very high in private hatcheries but despite of that farmers are helpless to purchase the chicks from those hatcheries because of non availability of chicks in hatcheries of government organizations at regular interval.

D. Integrating Farming system

1.A Existing farming system:

Fruits + vegetables + goat + livestock

Spices + vegetable + livestock

1.B Specific farming system for doubling income in specific agro-ecological region:

Spices + livestock + poultry + goat + vegetables

Vegetables + fruits + goat + agroforestry + fisheries

E. Reducing post harvest losses and value addition

1.A Existing grading facilities:

Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

Proper infrastructure need to be developed for hi-tech grading especially for fruits, vegetables and spices.

A.For grains:

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

B.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: There are no processing facilities in District Dehradun.

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

I. Processing facilities need to be set up in Kalsi and Chakrata blocks of Dehradun as tomato, ginger, chilli, vegetable pea are largely grown but due to lack of processing facilities, farmers are bound to sale their produce as raw. Besides, pomegranate, low chilling apple varieties are emerging crop of mountain region of Dehradun for which processing facilities need to be established.

II. Establishment of processing unit can help the farmers in doubling their income.

A.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

B.For horticultural crops:

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

1. There are no packing facilities.
2. Farmers use traditional method of packing.

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

A.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

B.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
6. Maintaining cold chain from farm to folk (depending upon the commodity)

4.A Existing storage facilities: There are no storage facilities.

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

Storage facilities need to be set up in Kalsi and Chakrata block of Dehradun to store tomato, chilli, ginger, vegetable pea, caggabe, cauliflower, broccoli, coriander etc so that same could be sold in the market during lean period of the produce in the markets when prices are high.

A.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

B.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. Farmers generally do bunding of their fields to check soil erosion, but occasional heavy rainfall destroys those bunds and soil erosion occurs.
2. Contour bunding and grading with levelling of land, plantation of fodder trees on bunds and wiring of slopes where there is extensive problem of land erosion.

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

1. Due to high rainfall in the upper hills of district Dehradun, the top most soil cover is lost, which tenders the soil barren and unproductive.
2. However due to judicious management of slope and selection of plant species like *Rhodendron* and *Quercus* vegetative cover can be attained in short time and management of wasteland is done.
3. It is also true that as such there is no problem of wasteland in district Dehradun as there is no salt affected or acidity affected area.
4. Treatment of wastewater in district Dehradun is also not a problem as there are no effluent emitting industries.

2.A Existing plantation: Conifers , Deciduous plants (Chir pine, deodar)

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. Not applicable as problem of wasteland and wastewater does not occur in district Dehradun.
2. However in some areas slope management, soil movement stabilization, contour farming and afforestation with suitable species like rhodendron and Quercus need to be encouraged to reduce soil erosion and management of wasteland.

3.A Existing fodder production: Jwar, Bajra, Maize, Oat, Berseem, Napier are grown by the farmers.

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:

1. Hybrid napier grass, perennial fodder grass i.e. cocksfoot, talfescue, Italian rye
2. Fodder trees i.e. morus, khadik, bhimal can be promoted
3. Hybrid napier, berseem, sudan grass, saftal
4. Rejuvenation/repair of faulty/abandoned terraces
5. Stabilization of eroded land using biological/engineering measures
6. Plantation of suitable trees/brushes in waterlogged and eroded areas
7. All agricultural operations should be done on contours i.e. across the existing land slope.
8. 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.
9. 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.
10. Diversion of runoff through ditches from upper slopes to safer places.
11. Gabion structures can be made along the hill roads as retaining wall, and along the stream banks for protection.
12. 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.
13. Contour trenching (staggered/continuous).
14. Domestic wastewater may be reclaimed at house hold level for use in kitchen gardens.
15. Industrial wastewater must be purified by the concerned industries at their factory level, and should not be thrown into the streams/rivers.
16. The discharge from perennial/seasonal natural water springs must be stored in tanks to ensure continuous water supply for drinking and domestic uses.
17. 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.

A.Guinea grass (*Panicum maximum*),

1. Seed rate(Kg/ha)-3-4
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management-60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

B.Setaria grass (*Setaria anceps*)

1. Seed rate(Kg/ha)-1.5 2.0
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 100:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

C.Spear grass (*Hetropogon contortus*)

1. Seed rate(Kg/ha)-4-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut

5. Irrigation management-Crop must be irrigated after each cut provided water is available..
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting

D.Rhode grass (*Chloris gayana*)

1. Seed rate(Kg/ha)-3-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
3. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
4. Irrigation management-Crop must be irrigated after each cut provided water is available.
5. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

E.Marvel grass (*Dicanthium annulatum*)

1. Seed rate(Kg/ha)-4-6
2. Spacing (cm)- 50cm x 30cm
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

4.A Type of waste water:

1. Effluent from kitchen and bathroom
2. Effluent from industries
3. Flowing springs

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. Domestic wastewater from kitchen and bathroom should be treated before being used for irrigation in vegetables and other crops.
2. 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.
3. Sewage water from cities should be treated by municipal corporations or other agencies.

G. Reduced cultivation cost

1.A Existing inputs being given:

Seeds of high yielding varieties and hybrids of various crops, quality pesticides effective for management of different pest and diseases are given to the farmers by the State Departments on subsidized ratres.

A.Rice-wheat/Sugarcane-Ratoon-wheat/Mustard /Toria,Maize-Pea-wheat/Chickpea/Lentil

1. Annexure–II is enclosed for N,P and K.
2. In Zn deficient soils, application of 25 (sandy loam)- 50 (Clay loam) kg ZnSO4 (21% Zn) /ha or foliar spray of 0.5% ZnSO4 + 0.25% lime in standing crop.
3. Foliar spray of 1% FeSO4 in rice nursery and maize.
4. In Cu deficient soils, application of 4-5 kg CuSO4/ha or foliar spray of 0.25% CuSO4 + 0.125% lime in standing crop
5. In Mn deficient soils, application of 30 kg MnSO4/ha, if Mn deficiency exist in field or two foliar spray of 0.5% MnSO4 + 0.25% lime before first irrigation and one month after .

B.Mango/Litchi/Jack fruit

1. In deficient soils, application of 215 kg gypsum/ha, if S deficiency exist in field.
2. Two foliar spray of 0.2% ZnSO4 +0.2% MnSO4 + 0.1% CuSO4 + 0.25% Lime in Feb. & March.

3. Two foliar sprays of 0.2% Borax in April at fortnightly interval.
4. Apply FYM as per age of the plant.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district:

1. Soil health card need to be issued to all the farmers who are actively involved in the farming.
2. Accordingly, commercially important crops to be suggested for doubling their income by maintaining the sustainability.

2.A Existing mechanization:

Power tiller, tractor and traditional method used

A. Paddy

1. Seedbed preparation by animal drawn Nasuda followed by wooden planker.
2. Conventional nursery raising.
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.

B.Wheat

1. Seedbed preparation by animal drawn Nasuda followed by wooden planker.
2. Manual broadcasting.
3. Manual weed control .
4. Manual fertilizer application.
5. Manual harvesting.
6. Manual threshing .
7. Cleaning by Winnowing fan.

C.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.

D. 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.

E.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.

F.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.

G.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.
7. Manual grading.

F. 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:

In hills of Dehradun, power tiller need to be promoted to reduce the cost of cultivation.

In valley areas and foot hills, small tractors of 15-20 HP can also be promoted to reduce the cost of cultivation.

A.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

B.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.

C.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.

D.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.

E.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.

F.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

G.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.

H 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: Seed, fertilizers, pesticides

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

1. Seeds of high yielding varieties and hybrids of various crops, quality pesticides effective for

management of different pest and diseases has to be given to the farmers by the State Departments on subsidized rates in order to reduce the cost of cultivation.

2. Seed, fertilizers, pesticides, FYM, vermin compost, micro nutrients, herbicides, medicines, vaccines, dewormers etc.
3. Fertilizer application should be based on soil test value at right time, right place and right method.
4. Basal application (50%N+100% P&K) at the time of sowing and 02 foliar application of N, secondary and micronutrients on standing crop.
5. Apply well decomposed organic manures and composts such as vermicompost, biofertilizer, green manure and crop residue incorporation to supplement costly fertilizers to reduce cost up to 25-30%.
6. Inclusion of pulses in crop rotation and reduce dose of chemical fertilizers.
7. Need based and recommended concentration of plant protection chemicals using correct method of application.
8. Enhanced use of bio-agents to control disease & pests; avoid use of costly chemicals.
9. Farmer should use high yielding variety seed and multiply at his own site for next 02-03 seasons.
10. Use optimum and recommended seed rate at optimum spacing and depth.
11. Use good quality of water and avoid excessive irrigation.

Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district:

1. Poor awareness about the advancement in the field of agriculture and its allied sectors among farming community.
2. Poor economic condition of the farmers due to which they do not adopt modern technology having low cost of cultivation.
3. Heterogeneous soils – soils of each situation differ widely in their physical, physio-chemical characteristics as they are developed from a variety of rocks and minerals under joint influence of vegetation, physiography and climate.
4. Sloping lands with high rate of removal of soil and nutrients from surface through erosion resulting to depletion of soil fertility.
5. Scattered holding and marginal land size.
6. 90 % of area of mid and high hills is rainfed.
7. High rates of migration from hills to plains of males and young boys in search of jobs.
8. Women based farming system without technical know – how and inputs.
9. Low efficiency of conventional farm tools and implement.
10. Indigenous breed of livestock with low production and working efficiency.
11. Poor quality of FYM. The method of preparation and application of FYM are defective generally heaped in an open area resulting into loss of nutrients.
12. Mostly soils are slightly to strongly acidic in nature depending upon elevation, vegetation and development of soil from rocks and minerals causing nutrient imbalance in soil and impose hidden nutrient toxicity and deficiency symptoms in crops retard growth and yield.
13. Minimum use of fertilizers: farmers are mostly small and marginal economically backward, not able to apply recommended dosses of fertilizers. The average consumption is < 10 kg N:P:K.
14. Non availability of quality seeds of varieties recommended for rainfed upland situations.
15. The inputs are costly and therefore the small and marginal farmers are not able to adopt the improved technology.
16. Non availability of inputs at right time and right place.
17. Sowing of crops is at the mercy of rains which are erratic. Thus planting is delayed and not done on suitable time. Sowing are done more than once either because of insufficient moisture mostly in rabi crops or due to crust formation in kharif.
18. Farmers follow practice of dry sowing. In such situation the seeds are eaten by birds and grubs resulting in inadequate plant population.

19. Due to limited moisture and nutrient supply the growth of crops is not proper and vegetative phase of growth (flowering and fruiting) are advanced.
20. Improper/Inadequate seed bed preparation: in order to utilize moisture, the farmers do not wait for fine preparation of fields and rush for sowing. This results in improper germination and infestation of weeds.
21. Severe infestation of insect-pest: white grubs and cut worms are the serious polyphagous pests, kill plants and reduce plant population up to 70-80 %. Due to non availability of suitable plant protection chemicals as well as high cost they are beyond the reach of the farmers. Beside, non availability of water for solution also pose problems.
22. Weeds; common weeds of the upland rainfed areas are Tipatiya (Oxalis latifolia), Pardeshi(Galensojaparviflora), Gajar grass (Parthenium Sp.)Kuni(Lantena camera) Kala bansa (Eupatorium sp.).The loss in general in food crops is high from 50-75 %.
23. Improper terrace management: most of terraces developed by farmers are on steep slopes with outward gradient.
24. Lack of proper drainage system for safe disposal of excess rainwater. The heavy runoff of water washes away the top fertile soil leady to steady depletion of nutrients and organic matter.
25. Coarse textured soils (charty/gravely) with low moisture and nutrient retention capacity.
26. Lack of proper storage facilities for crops (cold storage).
27. Lack of awareness for protected cultivation techniques and facilities for commercial high value crops (poly houses, poly tunnels, poly for raising nursery and cash crops.
28. No good marketing facilities.
29. Lack of proper irrigation facilities for minor irrigation and drip irrigation with fertigation.
30. Poor connectivity of road transport system.
31. Lack of farmer's participatory models for crop production technologies under hill agricultural system for the state.

H. off-farm income

2.A Existing SHGS operative in specific agro-ecological region of district:

1. A. SHGs are working but their impact is not visible among farming community.
2. SHGs need to be strengthened with modern development taking place in the field of agriculture and its allied sectors.

i. Kalimata(Maletha)
ii. Mahasu Devata(Rikhad)
iii. Shilgur Devata (Rikhad)
iv. Chanda(Vyasnahari)
v. Gayatri(Dakiyarana)
vi. Gulista (Gorakhpur)
vii. Nav Chetna(Gorakhpur)
viii. Jyoti(Barovala)
ix. Bhairav (Kunna),

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

SHGs need to be created in large number with the help of NABARD by involving progressive farmers and farm women to increase the income of the farmers.

A.SHG already formed and need to be encouraged:

1. Kalimata(Maletha)
2. Shilgur Devata(Rikhad)
3. Gayatri(Dakiyarana)
4. Gulista(Gorakhpur)
5. Nav Chetna(Gorakhpur)
6. Jyoti(Barovala)

7. Bhairav (Kunna)

1. 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.
2. 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.
3. Imparting the information to the groups about various govt. schemes regarding loan, trainings and marketing of the product.
4. 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.
5. 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.
6. Loan procedure should be made more flexible with less interest rate.
7. 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.
8. 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.
9. 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.
10. Enterprises need to be identified depending upon local resources- human and material.
11. Market linkages need to be developed so that people can sell their produce gainfully.
12. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
13. 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.
11. It is seen in the survey that all individuals who took loan increase their livestock only that is their traditional work and did not start any other enterprises.

2.A Existing Micro-entrepreneur employment:

1. Handloom
2. Rambaans
3. natural fibre craft etc

2.B Micro-entrepreneur employment to be generated in the specific agro-ecological region of

district for doubling agricultural income:

Micro-entrepreneur employment need to be generated with the help of NABARD in which involvement of innovative farmers and farm women must be compulsory.

3.A Existing skill development facilities:

1. Skill development facilities are done by KVKs and Line departments.
2. Office of Development commissioner (handicrafts)
3. Handicraft marketing, service and extension centre

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected by providing proper funding.
3. Training centre, processing and packaging units as per the locally available resources

4.A Existing women skilling facilities:

1. Skill development facilities are done by KVKs
2. Line departments
3. NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected by providing sufficient funding.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

5.A Existing youth skilling facilities:

1. Skill development facilities are done by KVKs
2. Line departments
3. NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

Beekeeping

Package of Practices for beekeeping with Italian honey bee, *Apis mellifera*

Beekeeping (or apiculture) is the maintenance of honey bee colonies, commonly in man-made hives, by humans. A beekeeper (or apiarist) keeps bees in order to collect their honey and other products that the hive produces (including beeswax, propolis, pollen, and royal jelly), to pollinate crops, or to produce bees for sale to other beekeepers. A location where bees are kept is called an apiary or "bee yard." Beekeeping provides excellent source of employment for the rural unemployed, enhances income of farmers, and the landless beekeepers. It enhances the productivity levels of agricultural, horticultural and fodder crops through pollination services. Beekeeping with *A. mellifera* L. is a common practice in hills as well as plains of Uttarakhand for honey production. For successful beekeeping, a person must require basic to advanced knowledge about all the aspects of honey bees with good management practices which involve following general points:

A good beekeeping management practices include:

1. Selection of good site for an apiary

2. Knowledge of bee flora
3. Seasonal bee management
4. Nutrition managements or artificial feeding during dearth period
5. Dividing and uniting colonies
6. Swarming : prevention and control
7. Disease and enemies management
8. Migration management
9. Other management practices for successful beekeeping

Selection of a good site for an Apiary

1. Selecting a good site for apiary can make a huge difference to honey bee health. There are following important things to consider when choosing a site:
2. It's important to know the bee foraging plants in a preferred area and their flowering periods.
3. Plants chosen should be producing high eminence nectar and pollen. Among the best beekeeping vegetation areas are forest woodlands, grasslands with dense covers of flowering herbs/shrubs, agricultural crops yielding nectar in abundance can be good beekeeping sites *e.g.* mustard, litchi, eucalyptus, barseem, maize, sunflower, legumes, cucurbits, apple, cherry, papaya, citrus, pear *etc*.
4. Apiary should be near to the running and fresh source of water.
5. Apiary location should be away from public places and roadsides (more than 300 meters).
6. Colonies should be sheltered from the extreme sun heat, frost, wind and floods.
7. An apiary should be sited far from fields which are sprayed with pesticides to avoid bee poisoning and honey contamination.
8. Avoid spraying when the plants are on flower or during peak foraging periods, if bees placed nearby the commercial farm fields.

Knowledge of bee flora

In order to survive, prosper and be productive, honey bee colonies must have a regular supply of both nectar and pollen in adequate quantities. Not all plant species are equally good for beekeeping. Some supply both nectar and pollen abundantly when in bloom and these are often called honey plants, because they are best suited for honey production. Plants producing nectar but little or no pollen are also considered to be honey plants. Other plants, however, may yield pollen but little or no nectar. These pollen plants are also important in beekeeping, especially at the time of colony build-up, when the bees need large amounts of the protein contained in pollen for their brood-rearing.

Seasonal bee management

Good management practices are the key to success as a beekeeper. Honey bee colonies should be opened, checked or monitored one to four times as per requirement of the season. Management practices are varying in different regions, availability of bee flora and climatic conditions.

a) Honey bee buildup season: This season comes before nectar flow season when colonies should be strong. Following practices should be taken by a beekeeper.

1. The strength of the colony should be improved for entering honey flow season.
2. Week colonies should be united.
3. If necessary, provide sugar syrup and make sufficient population.

b) Honey flow season: This season coincides with spring which has a plenty of bee flora, nectar and pollen from the various flowering plants. During this season, a beekeeper must follow these steps:

1. Provide more space for honey storage by giving comb foundation sheet or built combs.
2. Confine queen to brood chamber by using queen excluder.
3. Prevent swarming as explained in swarm management.
4. Prior to honey flow, provide sugar syrup and build sufficient population.
5. Divide strong colonies into 2-3 new colonies, if colony multiplication is needed.
6. Queen rearing technique may be followed to produce new queens for new colonies.

c) Dearth period Management: During the hot summers, chilled winters and heavy rainy days when there is no bee flora, bees cannot go outside and suffer with starvation. A beekeeper should consider following points:

1. Enough honey may be left in the hive to keep colony alive.
2. Protect from rain, wind and enemies
3. When the nectar is generally not available colonies should be given sugar syrup in the evening.
4. Remove empty combs and store in air tight container.
5. Use dummy division board to confine bees to small area.
6. Unite weak colonies, provide sugar syrup, pollen supplement and substitute

i. Summer management: Bees have to survive intense heat and dearth period by following means.

1. Provide sufficient shade, under trees or artificial structure.
2. Reduce heat by sprinkling water twice a day on gunny bag or rice straw put on the hives.
3. Increase ventilation by introducing a splinter between brood and super chamber.
4. Provide sugar syrup, pollen supplement, substitute and water.
5. Enough honey may be left in the hive to keep colony alive.
6. Unite weak colony with strong colony.

ii. Rainy season and monsoon management

1. Avoid dampness in apiary site and provide proper drainage.
2. In rains when bees are confined to the hive, provide sugar syrup feeding.
3. Remove empty combs and store in air tight container.
4. Use dummy division board to confine bees to small area.
5. Unite weak colonies and provide sugar syrup, pollen supplement and substitute.
6. Avoid bloodlessness in colonies, if pollen stores and fresh pollen is not available, feed the colonies either pollen substitute or pollen supplement.
7. If colonies are week and have poor food stores, provide candy or dry sugar instead of sugar syrup
8. Keep in check the attack of enemies like wax moth, ants, mites and wasps.
9. The hive is kept on stands sloping towards entrance in order to drain out water.

iii. Winter management: It includes the following practices.

1. Maintain strong and disease free colonies and provide new queen to the hives.
2. Provide winter packing in cooler areas or hilly regions.
3. Remove empty combs and store in air tight container.
4. Use dummy division board to confine bees to small area.
5. Unite weak colonies and provide sugar syrup, pollen supplement and substitute.

v. Nutrition management or artificial feeding during dearth period

Paying awareness to honey bee diet is just one of the more important aspects of successful beekeeping. Honey bee collects a number of substances to ensure its survival viz., nectar, pollen, water, propolis etc. However, during the scarcity of above essential diet components bees may not able to survive. Shifting the hives to alternate floral sources will help them stay healthy.

Sugar Supplement syrup foods for Honey Bees: About 8-11 lts of 2:1 sugar syrup (2 parts sugar to 1 part water) is the usual feeding per colony. In spring feeding, the syrup mix may be reduced 1:1 (1 part sugar to 1 part water). 3:1 bee syrup mix is for winter. At this concentration there is little water to evaporate. It is also less likely to freeze. Use boiling water in making the syrup. Allow to cool before serving.

Protein Supplement Foods for Honey Bees: The adult bees of a colony obtain their dietary protein from the pollen the workers collect and bring back to the hive or from nitrogenous food-stuffs provided by the beekeeper. There is a multitude of different artificial diet available as substitute or supplement for pollen but the following provides a general guide: Pollen: 5% ,Sugar: 20–50%, Yeast (torula): 20–50%, Flour (soya): 20–50% and Vitamin supplement: 1–3%. Increasing the

amount of pollen and sugar will make the supplement more attractive to the bees which contain the quality and quantity of proteins and amino acids, lipids, vitamins, and minerals required for growth and development of individuals and reproduction of the colony. Pollen patties or protein cakes may well be an attractive proposition.

Supplying bees with water: A supply of water must be available to bees at all times. A lack of it adversely affects the nutrition, physiology, brood rearing, and normal behavior.

Swarming : Causes and management

Swarming is a natural phenomenon that ensures the survival of the species through a colony reproducing itself. Swarming normally occurs in spring, allowing the colony to establish itself over the following summer and autumn before winter brings a serious reduction in flowering species from which food can be obtained.

Cause of swarm:

1. Reproductive swarm
2. Overcrowding - too many bees, food stores and no cell space for the queen to lay eggs in.
3. March-April is swarming season and healthy colonies develop strong swarm desire.
4. Inclement weather - crowded bees confined by cold, wet weather will build queen cells and swarm out on the first sunny, warm day. All colonies in similar condition will swarm as soon as weather becomes favorable.
5. Large amount of drone brood in early spring is a precursor to strong swarm impulse.

Management:

1. Allowing this form of reproduction often results in the loss of the more vigorous division. The remaining colony may be so exhausted and set back due to the brood cycle disruption that it is unproductive for the season.
2. Beekeepers control swarming prior to the natural swarm time.
3. Place two or three drawn out combs in an empty super and place on top of the parent colony, separated by a queen excluder.
4. Examine all the frames from the brood nest of the bottom colony for queen cells.
5. If the old (caged) queen is worth saving, a small nucleus consisting of two combs of brood and adhering bees can be made for her accommodation.
6. Capture any subsequent swarms with the help of swarming bag and return to the old hive by simply shaking the bees in front of the hive entrance.
7. In case parent colony, from where swarm has been issued is not known, the captured swarm should be placed in the new empty hives.
8. Only one young queen will survive and the bees will no longer attempt to swarm. If they do swarm again, repeat this step.
9. Provision of sufficient nectar storage space.
10. Colonies should receive maximum sunlight early in the season
11. Requeening a colony can help minimize swarming tendencies. Young queens produce more pheromones, thus inhibiting swarm preparation by the workers.
12. Clipping a queen's wing is a good way to minimize swarming tendencies in colonies
13. Removing queen cells from colonies before they swarm, a technique called "cutting queen cells," is useful as a swarm behavior repressor.

Disease and enemies management

Brood Diseases: They are generally easier to recognize as a group than adult diseases but are more difficult to control.

Disease	**Causal Organism**	**Symptoms**	**Management**
Bacterial Diseases			
American Foulbrood	Spore forming bacterium,	1. The dead pre-pupae lie straight with head towards the opening of	1. Sterilize the combs and other hive parts with

(AFB)	*Paenibacillus larvae* in temperate and sub-tropical regions.	the cell (Sealed Cell) 2. Cell capping of infected brood becomes darker in colour, sunken and perforated. 3. A tooth pick inserted into the body of prepupa and drawn out shows ropiness. 4. The putrefying brood turns brown and has fish glue odor. 5. Dead broods dry up into scales, adhere to the cell bottom.	Formalin @ 150 ml/ l or ethylene oxide @ 1 g/l water, for 48 h at 43°C in fumigation chambers. 2. Terramycine capsule @ 250 mg per 3 liter sugar syrup or 500 mg per 5 liter sugar syrup should be given as half lt sol / box and should be given at weekly interval for 1 month . 3. Breeding disease resistant strains of bees is one of the best measures for the disease management. 4. Provide sufficient sugar syrup to the diseased bees. 5. Fumigate all the equipments with formalin in a closed place. 6. Streptomycin , 0.2 gm per half lt sugar syrup should be given twice a week to diseased bees.
European Foulbrood (EFB)	Non-spore-forming bacterium, *Melissococcus plutonius*	1. 3-5 days old are more susceptible to infection than older larvae 2. Bacteria, on swallowing with food, multiply in mid gut and are discharged with feces. 3. Diseased larvae become flaccid, turn brown and give foul-sour smell.	
Fungal Diseases			
Chalk Brood	Spore-forming fungus, *Ascosphaera apis.*	1. The infected larvae (3-4 days old) are quickly covered by the white cotton-like mycelium which eventually fills the entire cell. 2. The white/grey mass soon hardensThe larva in the cell will resemble a lump of chalk, hence, the name of the disease chalkbrood	1. Removal of mummies by bees results in natural control. 2. Collect and burn the mummified larvae. 3. Replace old, blackened brood combs as these may harbor chalk brood spores. 4. If a colony lacks sufficient food stores, supplement with good-quality feed. 5. Replace queens with stock bred for hygienic behavior and/or disease resistance. 6. Put bee boxes at proper ventilated and clean place, these should not be placed at places with
Stone Brood	*Aspergillus flavus*	3. It only infects larvae that are three to four days old. 4. The larval body becomes harden and mummify.	

			higher humidity. 7. Thymol (0.7 % sol) can be used to prevent the disease. 8. 5 % sol of Formalin (40 %) can be used for disinfection of frames and equipments.
Viral Disease			
Sac Brood Virus (SBV) and Thai Sac Brood Virus (TSBV)	Disease symptoms for diagnosis of both the diseases are similar. SBV is infective on *Apis cerana,* while TSBV infects *Apis mellifera.*	1. Brood death in prepupal but in unsealed stage. 2. Dead larvae straightening out and lying on their backs, with tip of the head capsule turned upwards. 3. Dead pre-pupae that turn into sac like structure. 4. Affected larvae becoming yellow or grayish, later darkening to blackish; the change in colour first starts from mouth-parts and head. 5. Dead larvae and pre pupae drying up in brood cells forming loose scales.	1. For viral pathogens, there is no chemical control. 2. Affected colonies should be isolated beyond their flight range. 3. Check robbing, drifting and swarming. 4. Undertake selective breeding for natural resistance 5. 250 mg terramycin / 5 lt of sugar syrup should be given to diseased honey bees at weekly interval.

Adult diseases:

Disease	**Causal Organism**	**Symptoms**	**Management**
Protozoan Disease			
Nosema Disease	*Nosema apis* Zander	1. Bees become dysenteric with distended abdomens. 2. Young infected bees take up nursing duties as usual but soon stop rearing brood because food glands are affected and they shift to foraging. 3. Affected bees have disjointed wings and are found crawling in front of the hive. 4. Large number of spores can be observed in the mid gut contents of infected bees under microscope. 5. The disease is particularly severe	1. Provide upward ventilation to reduce humidity. 2. Feed bees with fumagillin @ 10 mg/ lt water in concentrated syrup. It inhibits DNA replication of the pathogen. And Gramicidin may also be used for its treatment. 3. Disinfect the empty hives with ethylene oxide or acetic acid fumigation @ 120 ml / hive. 4. Wash hands with soap before inspecting the box and disinfect all the beekeeping equipments with Formalin to prevent the infection. 5. This disease is mainly due to dirty water of rainy season. Provide clean water in a pot and put it over a stand. Make one hole in pot and fix cotton plug

		during spring and winter and there is depletion of strength	along with wooden stick in the hole so to distrupt the rapid flow of water and bees can easily take the water.
Amoeba Disease:	*Malpighamoeba mellifecae*		1. Scarp off the bottom board and disinfect it with 2% carbolic acid or acetic Acid. 2. Spores can be destroyed by temperature treatment at 49°C for 24hr. 3. Feed bees with Fumagillin @10 mg per liter of sugar syrup.
Mite diseases			
Varroasis	An Ectoparsitic mite,*Varroa destructor*	1. Parasitize immature drone and worker bees within their cells. 2. Colonies severely infested appear restless and weakened. 3. Only a few bees remain along with the queen 4. Mites tear the integuments of the adult bees and suck the haemolymph. 5. Reduced adult bee population in the infested colonies queen supersedure, spotty broods are common. 6. Affected young larvae turn in to light brown colour 7. The brood fails to develop in to adults or malformed adults are formed.	1. Screened bottom board with sticky board. 2. Application of formic acid (as vapor or pads). 3. Thymol powder @ 0.25g/ hive dusted in the passages of frames. 4. Thirty two grams of crystal oxalic acid (dehydrate) is thinned in one liter of sugar water (1:1). 5. Lactic acid (8 ml of 15 % acid per comb) is clearly better tolerated by bees and does not cause problems in warmer climatic zones.
Brood mite	An ectoparasitic mite, *Tropilaelaps clareae*		
Acarine diseases	Treacheal mite, *Acarapis woodi,* An endoparsitic mite	1. Mites pierce the wall of the tracheae and suck the haemolymph. 2. Infested bees have shorter longevity and reduced flight ability. 3. Irregular dark stains initially develop on the infested tracheae which ultimately blacken. 4. In severe cases, “K	1. Use of folbex strips (a mixture of potassium nitrate and chlorobenzilate) as a fumigant at the rate of 1-2 strips per colony. 2. Use of menthol crystals @ 50 g per hive or menthol strips. 3. Formic acid @ 5ml. per hive in glass vial.

		winged" shape can be is seen, where the two wings on one side of the thorax become unattached, such bees unable to fly.	

Enemies of honey bees:

Enemy	Important Features	Management
Wax Moth		
Greater wax moth (*Galleria mellonella*)	Observed throughout the year but its occurrence is severe during July to Oct and Nov to Dec. Empty combs, rendered wax, comb foundation and bee collected pollen, if not properly stored and left unattended, almost always suffer considerable damage from wax-moth infestation	1. The entrance should be reduced to avoid th entry of adult moths. 2. A water soluble concentrate of spores c *Bacillus thuringiensis* Serotype 7 provides a excellent protection of stored combs witho affecting the organoleptic properties of th honey. 3. Stack the empty combs in supers (up to 8- super) leaving some empty space in lower mo super. Make it airtight by using mixture of mu and dung. 4. Avoid fumigation with naphthalene, ethyler die-bromide and PDB 5. Fumigate the empty combs with sulphur powd @ 230g/m3 and after that seal them properly.
Lesser wax moth (*Achroia grisella*)	The lesser wax moth is generally smaller than the greater wax moth, except when the latter is dwarfed owing to poor diet during its larval stage.	
Wasps &Hornets (*Vespa orientalis, V.cincta, V. magnifera* etc)	They appear after spring and continue during monsoon season and cause maximum damage to colonies during July-September in Uttarakhand.	1. Keep the colonies strong and ensure prop food in the colonies. 2. Reduce the hive entrance or use queen gate c protective screens. 3. Destroy the wasp combs and use wasp trap with honey/ sugar/ Gur.
Ants	Ants may destroy whole colony within few hrs by robbing honey, pollen, predating on eggs, brood & adults. Attack is usually observed in rainy season.	1. Keep apiary clean by removing old and rotto woods, stones, weeds etc. 2. Place the hive stand post on the water fille bowl or earthen pots. And clean the bov regularly.

Other enemies :

1. Wax beetle, *Platybolium* sp. (Tenebrionid beetle) and small hive beelte, *Aethina tumida*.
2. Birds: King crow, *Dicrurus* sp; Bee eater, *Merops* sp.
3. Lizards, termites, toads and frogs.
4. Others like death's head hawk moth, *Acherontia styx;* robber flies; dragon flies, praying manids. Some mammals: bears, badgers and off course man

Migration management

Migration of bee colonies from one place to another where sufficient bee flora is available for the survival of bees and better honey production is an essential task in beekeeping. For example plains to forests, hills to farms and orchards in the adjacent plains in order to utilize the local bee flora and improve bee forage availability to bee colonies. Migratory beekeeping in the *Tarai* region of Uttarakhand could enhance honey production and colony multiplication. The suitable areas identified for migration in Tarai region are as follows:

Sl. No.	Location	Period	Honey crop
1.	Pantnagar	April, May and June	Papaya, Maize and Sunflower
2.	Haldi, N- block Pantnagar	December and January	Berseem and Mustard
3.	Pilibhit	November, December and January	Mustard
4.	Melaghat, Khatima	January – February	Eucalyptus
5.	Pattharchatta, Pantnagar and Ramnagar	March	Litchi
6.	Sitarganj	May- June	Jamun
7.	Moradabad	July	Maize
8.	Sambhal	August –October	Bajra

Preparing colonies for migration:

1. Provide proper ventilation by using entrance screens and even top screen in place of inner cover during hot weather
2. Nail all the movable parts of the hive properly or tie with migratory belts
3. Before packing the colony, remove frames of honey which are more than half sealed since honey combs cannot bear much jolts. However, the colonies should have sufficient food during the journey
4. Close the entrance in the evening when all bees have returned.
5. Colonies should be moved during night .For deciding migrating site, the beekeeper should have a detailed knowledge of honey flow sources and density of bee colonies in the surrounding area. Avoid areas which already have lot of bee colonies.
6. Migration can involve shifting of one truck load of bees up to 200 Km or even more. If journey cannot be undertaken in one night during hot periods then the truck should be parked in the shade during day, entrances opened and provision of water should be made. Journey can be started in the evening after closing hive entrance.
7. On arrival at the destination, colonies are unloaded and placed at the desired site. Then the entrance screens are removed

Other Management Practices for successful beekeeping

Practice judicious methods

1. Monitor colony strength and unite weak colonies.
2. Use logical services for ideal colony assessment.
3. Ensure frames of brood for planned strength to coincide with honey flow season.
4. Do not combine weak collapsing colonies with healthy colonies

Managing Stock:

1. Maintain genetic quality to meet out all objectives:
2. Maintain stocks that are prolific disease and pest resistant.
3. Encourage high drone densities to provide well-mated queens and genetically diverse colonies.
4. Discourage stocks that are excessively defensive.
5. Select stock by propagating colonies that flourish when other colonies exhibit symptoms of stress.

Hive Maintenance:

1. Keep your equipment in good condition.
2. Check apiary for hive condition.
3. Inspect for rotten, loose or broken boards and frames.
4. Reconstruct, tighten or replace frame parts.
5. Paint supers with light colors to beat summer heat.
6. Take advantage of the bee flora/honey season to do maintenance and prepare for the new season.

Hygiene:

1. Practice good hygiene with hands, gloves, and other equipment to reduce transmission of pathogens between colonies.
2. Replace comb with new foundation to minimize residual chemicals in old wax.
3. Develop a comb replacement schedule.

Hive Security: Hive security can minimize economic losses.

1. Be aware that the probability of theft has increased with the increased value of pollinating crops.
2. Secure a signed contract when entering into a honey flow season.
3. Practice discretion when showing where your hives are located.

Final steps

1. Inspection of surroundings to place the apiaries in appropriate areas.
2. Observation of quarantine measures for all new introductions that have to be made in the apiary.
3. Regular verification of the health status of the colonies during the year.
4. Frequent renewal of honeycombs (every 2 yrs) and regular replacement of queens (every 1-2 yrs).
5. Selection of queens who show resistance to diseases, hygienic behaviour, low tendency to swarm and high productivity.
6. Ensuring that hive capacity is sufficient to discourage swarming.
7. Preventing acts of looting (not having in apiary highly diseased, weakened colonies).
8. Feeding colonies having no food stocks or in case of unfavorable weather conditions.
9. Providing adequate water supplies particularly in hot periods.
10. Appropriate use of the bee smoker (respecting the bees welfare and avoiding using toxic material that can contaminate the honey).
11. Elimination of the use of toxic substances or paints for hives (e.g. disinfectants, chemical treatments for wood, etc.).
12. Exclusive application of drugs registered for use in bees respecting instructions, maintenance of beekeeping equipments in good order and cleaning and, when necessary, renewing the materials.

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:

2. **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.

II. Enabling Policies

1.A Existing policies related with agriculture and animal husbandry: KVK follow the policies of ICAR and GBPUAT, Pantnagar for transfer of technology among farming community.

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

Proper funding need to be provided to the KVK, Dehradun for large scale adoption of farmers friendly technologies at gross root level.

2.A Existing Institutions:

1. ICAR Institutes
2. Department of Agriculture, Horticulture, Animal Husbandry, Fisheries
3. ULDB
4. KVK
5. NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district: Existing institutions need to be strengthened particularly KVK, Dehradun to make it more effective, more responsible for the welfare of farming community in doubling their income.

3.A Existing Incentives: As per Govt. norms

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

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: Pradhanmanti fasal bima yojana

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

1.A Existing marketing facilities: Farmers sale their produce in local markets

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

1. Proper marketing facilities need to be developed in various region of the district do that farmers could get premium price of their produce.
2. It has been seen that despite of high production, farmers do not get remunerative price of their produce in the markets due to poor marketing system

2.A Existing grading facilities: Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

Proper infrastructure need to be developed for hi-tech grading especially for fruits, vegetables and spices.

A.For grains:

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

B.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:

I. Litchi and mongo are commercially important fruit crops of plains of Dehradun

II. Due to lack of processing unit, farmers sale their produce afresh in the market. Establishment of processing unit can help the farmers in doubling their income.

A.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

B.For horticultural crops:

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

Packing facilities need to be established in Kalsi and Chakrata block of Dehradun where tomato, chilli, ginger, vegetable pea, rajma are largely grown.

A.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

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

1. Problem of marketing is the biggest issue in the farmers.
2. In doubling income of farmers, role of proper marketing has immense importance.

3.Value addition is also important for which proper training, demonstrations, infrastructure need to be developed.

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: Internet and video conferencing etc.

2.A: Existing evaluation procedure: Manual

2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.

3.A: Existing monitoring system: Physical

3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.

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 video conferencing etc.

5.A: Existing reading system: Literature, Booklets, leaflets, folders

5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Hindi Extension Journals, film show, success stories, visit of farmers at regular interval etc.

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 the following crops in two blocks only namely *Chakrata & Kalsi*

   Wheat (VL *Gehun* 829, VL *Gehun* 892, VL *Gehun* 907, VL *Gehun* 953, HS 507, HPW 349 and UP 2572, UP 2628, UP 2554),

   Paddy (Spring rice - VL Dhan 208 and VL Dhan 209; Jethi rice - Vivek Dhan 154 and VL Dhan 157; Irrigated Rice - VL *Dhan 65,* VL Dhan 86, VL Dhan 68, VL *Dhan 85*), Pant Dhan-19, HKR-127 & PRH 10, Pant Dhan 4, PD 11);
2. Promotion of HYV of **Maize** (Vivek QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2, Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta) suitable for *Chakrata* & *Kalsi* blocks of district Dehradun
3. Promotion of high yielding varieties of **finger millets** (, VL Mandua 324, and VL Mandua 352, PRM1) and **Barnyard millet** (PRJ-1, VL *Madira* 172 and VL *Madira* 207) in *Chakrata & Kalsi* blocks
4. Amaranthus (VL Chua 44); Buckwheat (VL Ugal 7)
5. Promotion of high yielding variety of **lentil** (VL *Masoor* 125, VL *Masoor* 126, VL *Masoor* 507, VL Masoor 514 and **Pigeon pea** (VL *Arhar* 1) in *Chakrata* & *Kalsi* blocks of district Dehradun **.**
6. **Rajma (**VL Rajma-63, VL Rajma 125, PDR-14 (Udai), Chakrata local suitable for *Chakrata* & *Kalsi* blocks
7. **Tomato** (VL Tamatar 4, Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen 2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3 suitable for in *Chakrata* & *Kalsi* blocks
8. **Chilli** (DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani, VL Shimla Mirch 3) suitable for *Chakrata* & *Kalsi* blocks.
9. **Vegetable pea (**Vivek Matar 10, Vivek Matar 11 and Vivek Matar 12, Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, Arkle, Azad Matar-2, Arka Ajit, Kashi Udai suitable for in *Chakrata* & *Kalsi* blocks

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

Strengthening of traditional water storage structure

1. Various system of water harvesting depending upon the source of water supply may be

implemented like (a) in-situ rain water harvesting can be done through bunding and terracing, contour farming, mulching etc. (b) rain water / direct surface run off harvesting through roof top collection, dug out ponds, storage tank, diversion bunds /channel etc. (c) Stream flow or run off harvesting through nala bunding, waterharvesting dam, percolation tank/ ponds, (d) Sub surface flow harvesting in *Chakrata* & *Kalsi* blocks.

2. Conserve soil and water through in-situ moisture conservation, water harvesting and land management practices in *Chakrata* & *Kalsi* blocks
3. Regenerating natural resources base: conservation practices like plot border planting with terrace repair on-arable land and contour trenching on non-arable land for in-situ moisture conservation in *Chakrata* & *Kalsi* blocks
4. Strengthening of existing water storage structures like ponds in *Chakrata* & *Kalsi* blocks of district Dehradun and Naula and Check dam in *Chakrata* and *Kalsi* blocks.
5. Each and every field should be thought of as a recharge unit and it can be achieved by levelling of land and increase in bund height. This will help in water recharge and will stop overflow of water
6. Creation of rain water harvesting structure in private as well as government buildings in all the villages of the region so as to create awareness among the villagers.
7. Creation of trenches for high percolation of water in most of the area of *Chakrata and Kalsi* blocks.
8. Promotion of water conservation techniques like mulch, sprinkler and drip irrigation.
9. More crop per drop of water.
10. Roof Water Harvesting
11. There is an urgent need to generate alternate sources of irrigation to increase the net irrigated area, which in turn shall also increase the cropping intensity. These alternative sources can be rainwater harvesting, check dams, hydram for lift irrigation etc.
12. Technologies like drip irrigation, sprinklers etc. can also be used for better water management in *Chakrata* & *Kalsi* blocks.

Adoption of cluster approach for holistic development

1. Promotion of ginger cultivation in *Chakrata* and *Kalsi blocks of the region*.
2. Promotion of onion and garlic cultivation *Chakrata* and *Kalsi* blocks of Dehradun.
3. Promotion of off season vegetables (tomato, vegetable pea, chilli, capsicum, cole crops etc.,) cultivation in *Kalsi and Chakrata* blocks.
4. Promotion of production of tomato cultivation in *, Kalsi* and Chakrata blocks with the use of proper crop rotation.
5. Promotion of production of vegetable pea, okra inChakrata an*d Kalsi* blocks.

Management of wild animal problem

1. In Kalsi and Chakrata blocks there is a problem of wild boars. Electric fencing/normal fencing is required in these places. 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 cultivation of fruit crops in the forest areas so that wild animals do not come in the cultivated areas in Kalsi and Chakrarta block. 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. Farm mechanization will help in the timely sowing of crops. Mini harvesters should be developed so as to harvest on time.
3. Use of mechanized weeder in crops like maize will immensely help the farmers to do weeding on time and thus reduce drudgery of female farmers.
4. 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 hilly areas

1. Integrated Plant Nutrient Management (IPNM)- IPNM can be practiced by sensitizing area groups, creating awareness to farmers through publicity propaganda, organizing communities and training's. Demonstrations can beconducted on the lines of Farmers Field School (FFS).
2. Popularization of soil testing in intensive mode and distribution of soil health card to farmers for judicious use of fertilisers.
3. Reclamation of acidic soil by liming should be done in *Chakrata* & *Kalsi* blocks on a war footing
4. Popularization of biofertilizers like Rhizobium, Azotobacter, azospirillum, PSB, PSM, K solubilising micro-organism and use of these biofertilizers with FYM at the time of sowing.
5. Fortification of FYM with pseudomonas and trichoderma
6. Promotion of vermi composting unit
7. Introduction of one leguminous crop in a yearly crop rotation. Vegetable pea is a very popular crop in all the blocks of district Dehradun and this crop can be successfully included in the crop rotation.

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. The animals such as cow and buffalo in the hill region of district Dehradun and especially in *Chakrata* & *Kalsi* blocks belong to the nondescript breed and are very small in size as compared to the cattle in plains. Productivity of these animals in mountain areas is low as compared to the productivity of these animals in the plain areas of the district. Keeping in view these constraints, formulation and implementation of pragmatic policy to realize the potential of livestock population is an urgent need.
2. Promotion of high milk breeds of cows (Sahiwal, Red Sindhi & Jersey), buffaloes (Murrah) and goats (Beetal, Sirohi & Jamunapari) in *Kalsi* and *Chakrata block*, while promotion of wool yielding breeds of sheep in *Chakrata* block.
3. Establishment of feed Bank in *Kalsi* and Chakrata block to meet fodder requirement of area particularly during lean period. Establishment of fodder bank and ready -to- eat type of concept.
4. Establishment of milk chilling plant at *Kalsi* block.
5. Promotion of Urea, Molasses, and Mineral mixer blocks at *Nyaypanchayat* level at all the blocks of Dehradun.
6. Introduction of poultry breeds like CARI Devendra and CARI Nirbheek as back yard poultry breeds. These breeds are suitable for egg and meat purposes.
7. Establishment of hatcheries for need of broilor or croilor at district level to meet out the

requirement of chicks to the farmer's.

8. Strengthening of traditional water bodies/ rivulets with Mahaseer or carps at *Kalsi* block. The river Yamuna and Tonas can be used for fish farming.
9. Availability of feed material with low prices & Timely health check-ups of animals.
10. Introduction and promotion of Cross bred milch breed of animal for increasing income of marginal farmer.
11. Promote dairy by expanding milk processing capacity, expansion of intensive mini dairy and strengthening of distribution structure.
12. Plantation of feedstock trees like shatoot, Bhimal, chamlai and grasses like clover, talfatue. Mixed cropping will be emphasized in the villages.
13. Availability of Credit and/or financial assistance for allied activities such as animal husbandry, medicinal & aromatic plants, sericulture etc.

Strategy 3 : Integrating Farming system

Following Integrated farming system model may be developed:

Cropping system (Area 4000m^2)

rice-wheat-moong
maize-wheat-moog
rice-vegetable pea/ cauliflower/ cabbage
vegetable pea-wheat-maize
vegetable pea-ginger
vegetable pea-cauliflower-maize
rajma-vegetable pea
rajma-lentil
rajma-onion/garlic
tomato-maize-vegetable pea
tomato-chiili
tomato-cabbage
tomato-cauliflower

Horticulture

Apple /Peach/ Pear/ Lemon (100 plants)

Livestock

Cow (01)/ Buffalo(01)/goat (10) + Backyard Poultry (100)

Others

1. Vermi-composting (20m^2)
2. Fodder production in terrace risers and bunds.
3. Mushroon production
4. Bee keeping

Strategy 4 : Reducing post harvest losses and value addition

1. Chakrata and Kalsi blocks produce large varieties of cereals, fruits, vegetables and spices. Sizable quantities of this produce are wasted because of lack of storage, processing and packaging facilities. In order to develop and strengthen this sector, backward and forward linkages can be established by involving private sector and coordination with all concerned departments and agencies of the State and Central Government.
2. Establishment of Small & Medium Size Agro Parks, which provide common infrastructure facilities for storage, processing and marketing of surplus fruits and vegetables.
3. Establishment of fruit & vegetable based wineries.
4. Gravity ropeways to be constructed in Kalsi and Chakrata block to provide road head access to the farm produce need to be taken to be taken at a larger scale.
5. Private investment must also be encouraged in post harvest technology and infrastructure to bridge the gap in agricultural marketing.

6. Establishment of mini fruit grading plant for stone fruits at *Kalsi* block .
7. Establishment of Food Processing Units for tomato, ginger, turmeric, vegetable pea in *Kalsi and Chakrata* blocks.
8. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
9. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in in *Kalsi and Chakrata* blocks
10. Tertiary and value addition of citrus fruits, in in *Kalsi and Chakrata* blocks by establishment of small processing units.
11. Establishment of Food and Processing Units in *Kalsi and Chakrata* blocks fo*r* pickle making using *hill lemon*.
12. Promotion of common resources on custom hire basis viz. Power tiller, Mini wheat and Paddy thresher in in *Kalsi and Chakrata* blocks

Strategy 5 : Waste land development and waste water

1. As such there is no problem of wasteland and waste water in Kalsi and Chakrata blocks of District Dehradun. But where the slope is very steep, there is some problem of soil erosion. In the hills of Kalsi and Chakrata blocks Contour making for arable purpose in waste land in Kalsi block and other hill areas.
2. Afforestation of plants and perennial grasses in steep slope of more than 40% slope in Chakrata and Kalsi blocks.
3. Plantation of Mulberry plants, Wild fruit plants, Fodder trees (*Grewia*, *Alnus*, *Quercus* etc.) may be promoted in *Kalsi* and *Chakrata blocks*.
4. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all blocks.
5. Construction of tank for storage of water for lean season in all blocks.
6. Establishment of storage system for rain water in monsoon season.
7. Establishment of waste water treatment plants based on phycoremediation technique at sewer drainage points.

Strategy 6 : Reduced cultivation cost

1. Use of fortified FYM, vermicompost along with biofertilizers will increase the macro nutrient availability and thus will decrease the use of fertilizers. The soil organic matter content will increase and soil fertility will increase.
2. Foliar application of nutrients will also reduce the cultivation cost.
3. Provision of mechanization (Use of Power tillers, Power weeders, Paddy threshers, Wheat threshers, Maize Sheller, Wheel Hand hoe, Manual/ power operated Wheat/ Paddy reapers etc.)
4. Promotion of well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers in *Kalsi* and Chakrata blocks.
5. Promotion of line sowing and balanced fertilizers application in crops.
6. Promotion of recommended seed rate, spacing and depth.
7. Promotion of need based application of pesticides and other agricultural inputs. `
8. Promotion of hand tools in agricultural and horticultural operations.
9. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
10. Promotion of pressurized irrigation techniques in horticultural crops.

Strategy 7 : Off-farm income

1. Promotion of apiculture in Chakrata and Kalsi blocks , mushroom for small and landless farmers in Chakrata and Kalsi blocks.
2. Promotion of skill development like stitching, pickle , papad, candle, bag making in women and youth in Chakrata and Kalsi blocks
3. Creation of new SHGs in all villages of all blocks and linking them with NABARD or lead banks of that areas.

4. Encouragement to existing SHGs 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 *Chakrata* and *Kalsi* blocks .

Strategy 8 : Enabling Policies

Adequate and timely availability of inputs is essential for agricultural growth. A dynamic and growing, agricultural sector requires seed, fertilizer, plant protection chemicals, bio pesticides, agricultural machinery and credit at reasonable rates to the farmers.

1. Land consolidation (Chakbandi) is essentially required in *Chakrata* and *Kalsi* blocks. This will help in proper planning and execution of farming practices.
2. Buy back mechanism of the government should be strengthened and all produce of the farmer should be bought by the government.
3. Implementation of policies for control of wild animal menace in agricultural areas (by sterilization/castration/killing).
4. Implementation of Soil Health Card Scheme in each nyay panchayat of all blocks.
5. Providing quality inputs at right time to the farmers
6. Increasing institutional support by providing subsidises and incentives to small and marginal farmers in all blocks.
7. Popularization of Udyan cards and KCC for widespread use of government incentives/ subsidies to farmers.
8. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
9. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

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

Action points that need to be considered for closing in on the present marketing gaps are:-

1. Transportation is the major problem in hill regions and especially in *Chakrata* and *Kalsi* blocks. During rainy season the roads get blocked and perishable fruits and vegetables can not be transported to the markets. So, either procurement centre may be established in the area or some transportation subsidy may be introduced for improving profitability of the farmers.
2. The awareness among farmers about other post harvest management aspects such as grading, processing etc. needs to be created by the concern departments in *Chakrata* and *Kalsi* blocks.
3. For planning of marketing strategies, a data base on consumer behavior market competitiveness, strategies of potential rivals in export market, income and price response needs to be developed in the State.
4. Organization commodity specific growers‟ associations at village, market (AMC) and state level and integrating their functions in relation to market centric activity.
5. Govt. of Uttarakhand may tap Rural Infrastructure Development Fund from NABARD for all the AMCs projects on a comprehensive basis (new as well as modernization).
6. Involving Gram Panchayats to organize and manage markets at local level by undertaking remunerative schemes and improving their revenues.
7. Village level processing should be encouraged by providing appropriate technology and by organizing the marketing of such processed products.
8. Establishment of mini *mandies* at Block level.
9. For highly perishable vegetable and fruit crops like mango, litchi, tomato, capsicum etc creation of better transportation facilities with cool chain van at Block level.
10. Creation of direct linkages with food processing industries for better prices.
11. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.
12. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.

13. Installation of mini grading machines at village level.
14. Establishment of cold storage facilities in Chakrata and Kalsi blocks. Promotion of local Hatt at Tahsil level in all blocks.
15. 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. Linking up villages to local market; local market to regional/ state markets and state markets to national and international markets duly network them online (e. marketing).
3. Use of internet to increase knowledge and explore marketing possibilities
4. Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level.
5. Organization of monthly review meeting at district to solve theproblems related with farmers.
6. Promotion of use of community radio, TV talks and Whatsapp etc. for effective implementation of programme

Agro-ecological region: Region C (1500-2400)

A.General information about Agroeco-region
District: Dehradun
Agro-ecological region: Region C (1500-2400)
Main Blocks in Region: Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur, Doiwala
Main village cluster in blocks:
Rainfed Clusters:
Existing rain water management facilities:

1. Water harvesting tanks in few pockets of Chakrata, Kalsi and Raipur blocks
2. Diversion of perennial springs and streams through guhls
3. Storage tanks (Hauj)
4. Village pond (Taal and Chaal)
5. Collection from hill slope (Khaal)
6. Hydrum as lift device
7. Roof water harvesting but limited

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

1. Water harvesting tank
2. Low cost lining material to check seepage
3. Efficient water application systems (sprinkler and drip)
4. Rejuvenation and popularisation of traditional water harvesting systems
5. Cost effective lifting devices
6. Roof top water harvesting system

2. Existing practices for soil health improvement

1. Green manuring
2. Use of un-decomposed farmyard manure/ compost
3. Meagre use of biofertilizers
4. Imbalanced nutrient use
5. Meagre practice of green manuring in low land paddy
6. Use of raw/partially decomposed FYM
7. Meagre compost making/ recycling of crop residue

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

Management of soil acidity by liming

A. 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. Green manuring with Sesbania in low land paddy
4. Scientific preparation of FYM/ recycling of crop residue, weeds through composting and/or vermicomposting
5. Use of FYM @ 8-10 t/ha or application of 2.5-3.0 t vermicompost

B.Pulses

1. Seed with specific Rhizobium inoculant and 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 vermicompost

C.Vegetables and spices

1. Seed/ nursery soil inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture (each of 200 g/m2 for nursery soil inoculation; for seed inoculation quantity varies depending on seed size).
2. Seedling inoculation with Azotobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture at transplanting.
3. Soil test based balanced use of fertilizers; INM shall be preferred
4. Use of FYM @ 4-5 t/ha or application of 2.5-3.0 t vermicompost

D.Sugarcane

1. Set inoculation with Acetobacter/ Azospirillum inoculant and Phosphorus solubilising microbial culture.
2. Recycling of sugarcane trash through windrow composting
3. Soil test based use of balanced fertilizers
4. Use of FYM @10-12 t/ha or application of 3-4 t/ha vermicompost

Existing crop cultivation strategy being adopted under changing climatic condition

1. Occasional occurrence: Drought, heat wave, hail storm, cold wave and frost.
2. 50% area is irrigated where major crops like rice, wheat, sugarcane are being grown.
3. Vegetables and horticultural crops are being grown over very small area.1. Adjustment of sowing/planting date to coincide with monsoon
4. Mulching is done by the farmers in orchards to conserve the moisture
5. Drip irrigation is being used in some areas

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

1. High yielding varieties in vegetables, maize, rice, wheat, oilseed, pulses, spices
2. Short duration fruit crops and improved breed of poultry, dairy, goatry need to be introduced and demonstrated for their large scale adoption at gross root level.
3. Mindset of the farmers be changed by mobilizing them towards integrated crop management practices.
4. Post harvest management, processing units and proper marketing network need to be created to improve the income of the farmers.
5. Increasing area under pomegranate cultivation
6. Promotion of backyard poultry farming
7. Protected cultivation of floriculture
8. Poly tunnel technology for nursery raising in vegetable crops can be helped in doubling the income of the farmers.
9. Rajma, urd, moong, lentil, pigeon pea, vegetable pea, tomato, chilli, ginger cultivation need to be promoted on large scale.
10. The climatic projection suggesting increasing air temperature and erratic distribution of rainfall.
11. Therefore following strategy should be followed to increased income under changing climatic scenario.
12. The coverage of GKMS should be increased for enabling farmers to take farm decisions as per ensuing weather conditions.
13. Due to higher precipitation activities (approximately 2200 mm rainfall/annum) the rain water should be properly stored (in polythene tank, by forming bunds) and harvested for Kharif season crops.
14. There is a good demand of off season vegetables therefore area under off season vegetable should be increased at least double by the year 2022.

15. Imbalance use of fertilizer is in practise in lower part (Sub-tropical region) of Dehradun therefore Site Specific Nutrient management should be adopted for enhancing Nutrient use efficiency, water use efficiency and crop productivity.
16. According to the frost forecast the crop residue should be burnt around the vegetable crops to increase energy level and to create a layer of smog for retardation of outgoing radiation.
17. Soil erosion triggered by high rainfall intensity is the major issue of Dehradun. Therefore water and soil conservation techniques like terrace farming, bunding etc should be encouraged.
18. Climatic conditions are suitable for scented rice.
19. The proper canopy geometry of mango, litchi and apple should be maintained to avoid losses due to hail storm

6A. Name of Field Crop: Maize

i. Existing varieties being used: Kanchan, VL-Maize 16, VL-Maize 88, Navin, Shweta

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 QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2, Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta

iii. Existing package of practicesbeing used:

1. Farmers are not adopting high yielding varieties released for commercial cultivation in the recent years.
2. They also do not follow balance use of chemical fertilizers.
3. It is also observed that due to lack of knowledge
4. Most of the farmers adopt improper plant protection measures.

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

1. Green manuring must be followed before two months of sowing.
2. Moong can be grown during summer season to improve the soil health.
3. Line planting be done to minimize weed infestation, incidence of pests and diseases and for ideal vegetative growth of the plants.
4. Sowing should be done in Ist fortnight of June in plains and hills of Dehradun. Water harvesting tank need to be created in rain fed areas to provide timely irrigation.
5. Balanced use of nutrients to be applied in the soil as per the soil testing analysis. Quality seed of high yielding varieties should be preferred after that seed must be treated with carbendazim 2 g per kg of seed before sowing.
6. In order to avoid lodging problem in hilly areas, hybrids such as 9164 having dwarf in nature and provide yield up to 25 Q per acre should be preferred for commercial cultivation.

v. Major insect pests associated with crop: Stem borer,White grub

vi. IPM Module for management of insect pests:

Maize stem borer

1. Collection and burrying stubble and stalks or ploughing and destruction of crop residue.
2. Growing maize in association with various legumes.
3. Intercropping maize with soybean.

Maize stem borer: *Chilo partellus*

Name of the Insecticides	(gm/ml)/ha	Waiting period (days)
Thiamethoxam 30 FS (Seed Treatment/Kg)	2.4	8
Carbofuran 3 %CG	1000	33000
Carbaryl 85% WP	1500	1764
Carbaryl 4 %G	250	6250

Dimethoate 30% EC	200	660
Phorate 10% CG	1000	10000

For management of **white grub,** chlorpyriphos 2 ml per liter of water can be applied in the root zone of the plant on need basis.

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

viii. IPM Module for management of disease:

Blight

Mancozeb 75% WP	1125-1500	1500-2000
Ziram 75% WP	1125-1500	1500-2000

White rust:

1. Use of disease free certified seeds
2. Deep ploughing during summer
3. Crop rotation
4. Application of bio-agents:

a. Soil application (2.5 kg/ha) and spray @ 0.1% of *Trichoderma viride*

b. Seed treatment with *Trichoderma viride* (10g /kg seed) and *Psedumonas fluorescens* (10g /kg seed)

c. Their stimulation by the addition of amendments can be done.

5.Fertilizer application:

a. A fertilizer dose of 80 Kg N, 60 Kg P2O5, 40 Kg K2O is generally required.

b. Entire PK and 10% of N is applied as basal.

c. Remaining nitrogen is applied in 4 splits i.e. 20% at 4 leaf stage, 30% at 8 leaf stage, 30% at flowering stage and 10% at grain filling stage.

6.Row spacing:

a. Should be done at 60-75 cm & plant to plant spacing, 20-25 cm.

7.Cultural practices:

a. Sufficient availability of plant nutrients, optimum soil pH (6.2-7.0)

b. Adequate water in fields

c. Weed control

d. Optimum plant population

e. Use of disease free and high quality seeds are very helpful in reducing the damage caused by various diseases by reducing the plant stress.

Leaf blight of maize: *Stenocarpella maydis, Glomerella graminicola*

Name of the Fungicides	**(gm/ml)ha**
Mancozeb 75% WP	1500-2000
Ziram 75% WP	1500-2000

ix. Major weeds associated with crop: *Echinochloa, Laptocloa*, Sedges

x. IPM Module for management of weeds:

Bispyribac sodium 2 5 g ai per ha should be applied 15-20 days after planting for management of sedges.

Jungle rice: *Echinochloa* sp. (annual, monocot, narrow leaves, grass)

Name of the Herbicides	**(gm/ml)ha**	**Waiting period (days)**
Alachlor 50% EC	5000	90
Alachlor 10 %GR	15000-25000	
Atrazin 50 %WP	1000-2000	
Diuron 80 %WP	1000	
Paraquat dichloride 24% SL (Before sowing)	800-2000	90-120

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

1. Cropping pattern of maize-wheat-moong under irrigated condition.
2.Cropping pattern of maize-rajma-moog under irrigated condition.
3.Cropping pattern of maize-vegetable pea-moong under irrigated condition.
4.Cropping pattern of maize-sarson-moong under irrigated condition.
5.Cropping pattern of maize-cauliflower-moong under irrigated condition.
6.Cropping pattern of maize-cabbage-moong under irrigated condition.
7.Cropping pattern of maize-lentil-moong under irrigated condition.
8.Cropping pattern of maize-vegetable pea-tomato under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties and hybrids
2. Poor awareness on seed treatment
3. Poor weed management
4. Imbalanced use of chemical fertilizer
5. Lack of awareness about pest and disease management among farmers.
6. Lack of green manuring before sowing of maize
7. Farmers do not grow summer moong to improve the soil health and to get additional income from moong crop.

7A. Name of the Pulse crop: Rajma

i. **Existing varieties being used:** Chakrata 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: VL Rajma 63, VL Rajma 125, PDR-14 (Udai)

iii. Existing package of practices being used:

1. Almost all the farmers of mountain region grow unknown variety of Rajma which is popular in the name of Chakrata local.
2. Its quality is good but productivity is very low.
3. Demand of Chakrata local rajma is very high in the market.
4. The low yield of Chakrata rajma is due to several factors i.e. poor plant protection measures
5. Poor nutrient management adopted by the farmers
6. Rain fed condition also responsible for low yield due to poor monsoon.
7. Farmers do not follow seed treatment and soil treatment.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Water harvesting tank need to be created to provide irrigation during poor monsoon.

v. Major insect pests associated with crop: Pod borer,White grub

vi. IPM Module for management of insect pests:

1. . For management of pod borer, quinalphos 2 ml per liter of water or imidacloprid 0.75 ml per liter of water can be used judiciously
2. For management of white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after germination on need basis.

vii. Major disease associated with crop: Root rot, Anthracnose

viii. IPM Module for management of disease:

1. For management of root rot, carbendazim + mancozeb @ 2 g per liter of water may be applied in the root zone on need basis.

2. For management of anthracnose, copper oxy chloride 3 g per liter of water can be used according to need.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*,Sedges

x. IPM Module for management of weeds: Hand weeding and intercultural operations effectively reduced the weed infestation

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

1. Cropping pattern of rajma-vegetable pea under rain fed condition.
2. Cropping pattern of rajma-lentil under rain fed condition
3. Cropping pattern of rajma-onion under irrigated condition
4. Cropping pattern of rajma-garlic under irrigated condition
5. Cropping pattern of rajma-chickpea under rain fed conditionretain the medical efficacy of plants in their natural habitats

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers etc.
4. Poor irrigation facilities where rajma is grown in the kharif season of mountain region. It has been observed that sometimes poor monsoon affect its productivity.

8A. Name of the vegetable crop: Tomato

i. Existing varieties being used: Himsona, Manisha, Shahanshah, Avtar, Abhinav Private company varieties like Rakshhak 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 upto 1800m amsl , Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3

iii. Existing package of practices being used:

1. In hills of Dehradun, most of the farmers grow heamsohna hybrid of tomato from the last 10 years which has become susceptible against bacterial wilt.
2. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
3. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.

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

1. High yielding varieties and hybrids must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Mulching should be done as it has been fetching outstanding result particularly use of plastic mulch.
6. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
7. 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.
8. Use micronutrient including Ca, B and Mo
9. Crop rotation Tomato-cowpea-Early cauliflower.

v. Major insect pests associated with crop: Fruit borer, Cut worm,White grub

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

vii. Major disease associated with crop: Late blight, Fruit rot, Leaf curl disease

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

1. For management of late blight and fruit rot
2. Cymoxanil + mancozeb 2.5 g per liter of water may be applied on need basis.
3. For management of leaf curl disease, thiamethoxam 0.5 g per liter of water can be applied according to need.

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

Leaf curl disease

Thiamethoxam 0.5 g per liter of water can be applied according to need.

I. In Nursery

1. Soil Solarization of nursery bed by covering with polythene sheet (25 – 50 □□) for 45 to 60 days during April-June.
2. Use TH/PsF colonized compost
3. Seed biopriming with TH / PsF @ 10 g/kg seed.
4. Use resistant cultivars like Arka Rakshak, Arka Samrat, Ramya etc., if possible
5. Grow the nursery under tunnel of poly net of 50 mesh.

II.On Crop

1. Use TH/PsF colonized compost.
2. Use of healthy seedling.
3. Root dipping of seedlings in TH/PsF suspension (10 g/l water).
4. Roguing of virus infected plants and destruction of weeds followed by need based spraying of systemic insecticides for vector management
5. Remove all previous season tomato plants
6. Need based spraying of PsF + mancozeb (2 + 2 kg/ha) at 15 days interval.
7. For the management of soil borne diseases follow crop rotation and rotate crop with maize, rice, wheat, okra or cowpea.

ix. Major weeds associated with crop: *Echinochloa sp , Laptocloa sp.*, Sedges

x. IPM Module for management of weeds: Use of plastic mulch reduces weed infestation upto 80 per cent

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

1. Cropping pattern of tomato-maize-vegetable pea under irrigated condition.
2. Cropping pattern of tomato-grounnut-vegetable pea under irrigated condition.
3. Cropping pattern of tomato-moong-urd under irrigated condition.
4. Cropping pattern of tomato-chiili under irrigated condition.
5. Cropping pattern of tomato-brinjal under irrigated condition
6. Cropping pattern of tomato-cabbage under irrigated condition
7. Cropping pattern of tomato-cauflower under irrigated condition
8. Reduce number of spray of pesticides.
9. Raise nursery on treated soil.
10. Treat seed with fungicide before sowing.
11. Manage fog during fruiting period.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching and staking etc.
6. Imbalance use of fertilizes.
7. More numbers of pesticides' spay
8. Increase incidences of Bacterial wilt.

8B. Name of the vegetable crop: Chilli

i. **Existing varieties being used:** Laher, Soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani, 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:** DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit,

Divya Jyoti, Gopika, Kalyani, VL Shimla Mirch 3

iii. Existing package of practices being used:

1. In hills of Dehradun, most of the farmers grow old varieties of chilli from the last more than 10 years which has become susceptible against bacterial wilt.
2. Farmers also do not follow balanced dose of chemical fertilizers and judicious use of chemical pesticides for various pest and disease management.
3. They also do not use decomposed farm yard manure which is responsible for increasing incidence of soil borne pests.
4. Growing local varieties.
5. No line transplanting.
6. Generally they plant two over aged seedling at one place.
7. No or very less use of fertilizer.
8. Sowing of untreated seed.

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

1. High yielding varieties and hybrids must be adopted,
2. Use of organic manure should be promoted, balanced use of chemical fertilizers need to be done,
3. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
4. Mulching should be done as it has been fetching outstanding result particularly use of plastic mulch.
5. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
6. Grow high yielding varieties.
7. Treat the seed with copper containing fungicides before sowing.
8. Adopt soil testing.
9. Transplant one seedling at one place.
10. Transplant the seedlings when they attain 5-6 leaf stage.
11. Transplant the seedlings at proper spacing-
12. Dwarf varieties like Kashi Anmol at 45 x 30 cm
13. Tall varieties like Pusa Sadabahar, Pant C-1 at 50 x 50 cm.
14. 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 ,Cut worm ,White grub

vi. IPM Module for management of insect pests:

Management strategies sucking pests

A. Crop Hygiene

1. 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.
2. 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

Use proper pre-planting practices.

1. 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.
2. Avoid yellow clothing or utensils as these attract whitefly adults. Delay planting new fall crops as long as possible.
3. Do not plant new crops near or adjacent to old, infested crops.

Use proper post-planting practices.

1. Apply an effective insecticide to kill whitefly adults prior to cultural manipulations such as pruning, tying, etc.
2. 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.
3. Manage weeds within crops to minimize interference with spraying and to eliminate alternative whitefly and virus host plants.
4. Destroy old crops within 5 days after harvest, destroy whitefly infested abandoned crops.

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

vii. Major disease associated with crop: Leaf curl disease

viii. IPM Module for management of disease:

For management of leaf curl disease Thiamethoxam 0.5 g per liter of water can be applied according to need.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Use of plastic mulch reduces weed infestation upto 80 per cent.

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

1. Cropping pattern of chilli-vegetable pea-rajma under irrigated condition.
2. Cropping pattern of chilli-cauliflower-moong under irrigated condition.
3. Cropping pattern of chilli-cabbage-urd under irrigated condition.
4. Cropping pattern of chilli-broccoli-urd under irrigated condition
5. Cropping pattern of chilli-tomato under irrigated condition
6. Grow high yielding varieties.
7. Treat the seed with copper containing fungicides before sowing.
8. Adopt soil testing.

9. Transplant one seedling at one place.
10. Transplant the seedlings when they attain 5-6 leaf stage.
11. Transplant the seedlings at proper spacing.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers
5. Poor adoption of mulching etc.
6. Non availability of quality seed.
7. Less irrigation facilities.
8. High cost of hybrid seeds.
9. Unaware about the insect-pest management

8C. Name of the vegetable crop: Pea

i. **Existing varieties being used:** Arkle, PSM-3, Azad Matar-2, Azad Matar-3, Arka Ajit, VL Matar-7, Kashi Udai

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, and Vivek Matar 12, VL Ageti Matar 7, Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, Arkle, Azad Matar-2, Arka Ajit and Kashi Udai

iii. Existing package of practices being used:

1. Majority of the farmers in hills and plains of Dehradun using Arkle variety which is early but very old.
2. Its yield is also low as compared to other varieties released for commercial cultivation in the recent years.
3. Due to continuous cropping of Arkle variety, incidence of pests and diseases increased considerably.

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

1. High yielding varieties and hybrids must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.
5. Liquid fertilizers like NPK 18:18:18 and NPK 0:0:50 should be used judiciously.
6. 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).
7. Treating the seed with 2 g Thiram /kg of seed and rhizobium culture if being sown in field for first time and sow in October-November month.
8. 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.
9. Water the crop as per need especially during flowering and pod setting. Use Pendimethaline @ 1kg ai/ha as pre-emergence and one hoeing 25-30 days after sowing

v. Major insect pests associated with crop: Pod borer,White grub and cut worm

vi. IPM Module for management of insect pests:

1. For management of pod borer, quinalphos 2 ml per liter of water should be applied on need basis.
2. For management of cut worm and white grub, drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Powdery mildew

viii. IPM Module for management of disease:

For management of Powdery mildew, Thiophenate methyl 1 g per liter of water may be applied on need basis.

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: Chenopodium, Senji

x. IPM Module for management of weeds:

Hand weeding and application of pendi methalin @ 1.0kg/ha as pre emergence

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

1. Cropping pattern of vegetable pea-wheat-maize under irrigated condition.
2. Cropping pattern of vegetable pea-rajma-moong under irrigated condition.
3. Cropping pattern of vegetable pea-ginger under irrigated condition
4. Cropping pattern of vegetable pea-cabbage-urd under irrigated condition
5. Cropping pattern of vegetable pea-cauliflower-maize under irrigated condition.

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers
4. Poor use of liquid fertilizers etc.

8D. Name of the vegetable crop: Ginger

i. **Existing varieties being used:** Reo de genero, Varad

ii. High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region: Nadia, Reo de genero, Varad, Surbhi, Suruchi, Suprabha

iii. Existing package of practices being used:

1. Farmers do not adopt proper plant protection measures for management of rhizome rot which is a serious problem in ginger growing areas.
2. They use undecomposed farmyard manure due to which incidence of white grub become serious.
3. Farmers also unable to use high yielding varieties having high demand in the market. Most of the farmers do not adopt balanced use of chemical fertilizers.
4. Majority of the farmers grow ginger in rain fed areas. Sometimes poor monsoon affect its productivity.

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

1. High yielding varieties must be adopted
2. Use of organic manure should be promoted
3. Balanced use of chemical fertilizers need to be done
4. Judicious use of chemical pesticides should be used after pest and disease monitoring at regular interval.

v. Major insect pests associated with crop: White grub

vi. IPM Module for management of insect pests: Drenching with chlorpyriphos 1 ml per liter of water should be done in the root zone of the plant after 8-10 days of planting.

vii. Major disease associated with crop: Rhizome rot

viii. IPM Module for management of disease:

1. Drenching with copper oxy chloride @ 3 g per liter of water may be done in the root

zone on need basis.

2. Proper drainage facility should be followed as water logging condition in the field increases the incidence of rhizome rot disease.
3. In sick soil soil solarization by covering with polythene sheet (25 – 50 μ) for 45 to 60 days during April-June, if possible
4. Use *Trichodermaharzianum* colonized compost.
5. Dipping of rhizome in suspension of TH (10 g per liter + 10 g FYM powder). Cover treated rhizomes with polythene for 24 h before sowing.
6. Drenching near base of the plants with TH+ PsF (10 g/l) whenever symptoms appear in any plant. Drenching may be restricted to infected as well as a few surrounding plants only.
7. Need based spraying of PsF + mancozeb (2 + 2 kg/ha) at 15 days interval.

ix. Major weeds associated with crop: *Echinocloa, Laptocloa*, Sedges

x. IPM Module for management of weeds: Intercultural operations in the initial stage of the crop reduces weed infestation and mulching

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

1. Cropping pattern of ginger-cauliflower under irrigated condition.
2. Cropping pattern of ginger-vegetable pea under irrigated condition
3. Cropping pattern of ginger-vegetable pea under irrigated condition
4. Cropping pattern of ginger-lentil under irrigated condition
5. Cropping pattern of ginger-wheat under irrigated condition

xii. Production constraints in agro-ecological region:

1. Lack of quality seed of high yielding varieties
2. Imbalanced use of chemical fertilizer
3. Lack of awareness about pest and disease management among farmers

9A.Name of the fodder crop: Berseem

i. **Existing varieties being used:** Vardan, Maskavi , 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: Maskavi, BL-1

iii. Existing package of practices being used: Most of the farmers sow the berseem crop in zero tillage method after harvesting of the paddy crop in the month of November without treating any rhizobium culture.

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, Warden. BL-10, 22,42, 180, Pusa Gaint & Bundel Berseem 243
4. Seed rate: 25-30 kg/ha
5. Sowing method:
   Wet method-like rice in puddled field
   Dry method: Without puddled.
6. Sowing time: First an week of October
7. Fertilizer: 30:60:70:: N:P_2O_5 K_2O kg/ha
8. Irrigation: Field should remain at field capacity throughout the crop period after germination.
9. Weed control: Apply Pendimethalin @ 3.3 L/ha after crop sowing.
10. Cutting management: First cut -45-50 DAS
11. Other cutting at 25-30 days interval- total 5-6 cutting are taken
12. 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:** Most of the field of berseem crop affwcted with kasani weed which reduces the biomass yield of berseem resulted in causing bloat problem in dairy animals.
x. **IPM Module for management of weeds:** It is reccomended that berseem seed should be treated with rhizobium culture and 10 % solution of molasis/ gur and stiring for 15-20 minutes for removal of berseem weed i.e. kasani.
xi. **Specific workable and sustainable intensification capable of doubling agricultural income in specific agro-ecological region:**
1. Cropping pattern of berseem-maize-berseem
2. Cropping pattern of berseem-lobia-jwar-berseem
3. Berseem seed mixed with oat @ 100 g + 50 g musturd seed per kg of berseem seed during sowing to increase the biomass in first cutting.

xii. **Production constraints in agro-ecological region:** Berseem fodder crop damaged due to heavy frost affecting the crop in foot hills and valley areas

10A. Name of the Medicinal crop- Pili satawar

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:** CIM Sunhari, Local planting material
iii. **Existing package of practices being used:** No proper management
iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**
1. Viability of seed should be ensured.
2. Duration of the crop should be maintained at least for two year.
3. Earthing up is one of the important practice for increasing productivity of crop.
4. Intercropping of shallow rooted crops/vegetable is advisable during 1st year of crop cultivation.

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. Earthing up is one of the important practice for increasing productivity of crop.
2. Intercropping of shallow rooted crops/vegetable is advisable during 1st year of crop cultivation.

xii. **Production constraints in agro-ecological region:**
Lack of knowledge

10B. Name of the Medicinal crop- Lemon grass

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:** Krishna, Chirharit
iii. **Existing package of practices being used:** No proper management
iv. **Specific package of practices to be suggested for increasing yield in specific agro-**

ecological region:
Gap filling be done after observing mortality of plants in the initial period of planting for maintaining proper plant population and better productivity.

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:** Proper spacing
xii. **Production constraints in agro-ecological region:**
Lack of knowledge

10C. Name of the Medicinal crop- Tulsi

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:** Shyama Tulsi, Van Tulsi
iii. **Existing package of practices being used:** No proper management
iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**
1. Seed viability should be ensured and tested before going for cultivation.
2. Water logging should be avoided

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:** Proper spacing, Water logging should be avoided
xii. **Production constraints in agro-ecological region:**
Lack of knowledge

10D. Name of the Medicinal crop- Aloevera

i. **Existing varieties being used:** Local, *Aloe barbedensis*
ii. **High yielding varieties (the seed of which is available in the state) to be used for increasing yield in specific agro-ecological region:** CIM Sheetal, *Aloe barbedensis*
iii. **Existing package of practices being used:** No proper management
iv. **Specific package of practices to be suggested for increasing yield in specific agro-ecological region:**
1. Water logging should be avoided and light textured soils be preferred for better growth and productivity.
2. The crop should be protected from frost conditions by application of irrigation as and when required.
3. To get quality produce (Gel) post harvest arrangement before or just after harvest need to be ensured.

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: Proper spacing, Water logging should be avoided, Harvesting at proper time
xii. Production constraints in agro-ecological region:
Lack of knowledge

10E. Name of the Medicinal crop- Sarpgandha
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:** CIM Sheel, RS-1
iii. Existing package of practices being used: No proper management
iv. Specific package of practices to be suggested for increasing yield in specific agro-ecological region:
1. Viability of seed is the prime concern and be tested before going for nursery sowing.
2. Preferably crop should be harvested after 2 years of plantation.
3. Harvesting should be done during winter months to protect alkaloids.
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: Proper spacing, Harvesting at proper time
xii. Production constraints in agro-ecological region:
Lack of knowledge

C1. Livestock: Cattle
1.A Existing breeds available: Sahiwal cross with non descript local
1.B Specific breeds to be introduced: Sahiwal cross with non descript local
2.A Existing feeds being used:
1. Fodder tree leaves, forest grasses and paddy straw without chaffing.
2. Most of the farmers use maize grain flour, wheat flour i.e. atta and choker in dry condition.

2.B Specific feeds to be introduced / advised:
1. It is advised that use of fodder grasses at the time of blooming, chaffing the grasses and strovers of maize and paddy need to be introduced.
2. Commercialization of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras, Desmodium and temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye can be met the requirement of ruminants.

3.A Existing health services:
1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.

3.B Specific health services to be required/ advised for doubling income in specific agro-ecological region:
1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region

4.A Existing management practices:
1. Improper housing system without proper ventilation in animal shed

2. Floor of the cattle shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

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

1. At present most of the animals in all the three regions suffer from internal and external parasites
2. Bacterial and viral infection as well as infertility problem i.e. repeats breeding, dystocika, retention of placenta.
3. Lack of pure genetic breed
4. Lack of quantity and quality of feed and fodder
5. Poor housing and unhygienic conditions of animals.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.
3. Poor availability of quality fodder

C2. Livestock: Buffalo

1.A Existing breeds available: Murrah cross, Nili Ravi cross, Jafrabadi cross , Badawari cross

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding and artificial insemination with pure Murrah and Nili Ravi by using pure buffalo bulls

2.A Existing feeds being used:

1. Most of the farmers provide the fodder for their livestock as tree leaves, forest grasses and paddy straw without chaffing.
2. During milking farmers use as concentrate feed with dough of maize grain flour, wheat flour i.e. atta and choker in dry condition.

2.B Specific feeds to be introduced / advised:

1. It is advised that use of fodder grasses at the time of blooming, chaffing the grasses and strovers of maize and paddy need to be introduced.
2. Commercialization of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras. Desmodium and temperate fodder grasses i.e. Cocksfoot, Tallfascue, Italian rye can be met the requirement of ruminants.

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field.Other Disease Control Programs/ Health Camps (criteria, target): Infertility Camps

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Promotion of male calf rearing for future breed improvement of Murrah and Niliravi buffalo.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle in shed improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size
4. These existing practices are responsible for contamination of diseases.

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system-

1. Presently most of the animals are prone to internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.
3. High mortality in male buffalo calf due to deprive of milk.

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

1. Lack of local available good quality grains without socking in water to decrease the digestibility of the concentrate
2. Non availability of area specific mineral mixture and probiotics to reduce the fertility and productivity of animals.
3. Poor availability of quality fodder in Region C

C3. Livestock: Sheep

1.A Existing breeds available: Local & Merino Cross

1.B Specific breeds to be introduced: Merino

2.A Existing feeds being used: Fodder tree leaves, Forest grasses

2.B Specific feeds to be introduced / advised: Commercialization of proteinous fodder tree leaves i.e. Bhimal, Khadik, Moras,

3.A Existing health services:

1. Department of Animal Husbandry i.e. V.O., LEO, KVK
2. Paravets provide the suitable services and diagnostic advisement at farmers field

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed
2. Floor of the cattle shed in improper condition
3. Manger and standing passage of the paddock is very inconvenient in shape and size are commonly used for livestock management in all the three regions.
4. These existing practices are responsible for contamination of diseases

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

1. Proper housing space with suitable material
2. Proper scientific feeding management i.e required amount of dry matter
3. Concentrate and mineral mixture according to their body weight of the animal along

with three times deworming and vaccination practice round the year.

5.A Problems of Livestock system:

1. At present most of the animals in all the three regions suffer from internal and external parasites, bacterial and viral infection as well as infertility problem i.e. repeat breeding, dystocika, retention of placenta.
2. Lack of pure genetic breed, lack of quantity and quality of feed and fodder, poor housing and unhygienic conditions of animals.

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

Poor availability of quality fodder

C4. Livestock: Goat

1.A Existing breeds available: Gaddi, Cross Gaddi , Chaugarkha

1.B Specific breeds to be introduced: Scientific breeding required through natural breeding with selection of elite buck in existing stock of the herd and artificial insemination with pure Gaddi, Black Bangal, Jamunapari and Barbri fetch from the ICAR-CIRG, FARAH for breed improvement.

2.A Existing feeds being used: Farmers adopted only grazing system 5-6 hours in a day.

2.B Specific feeds to be introduced / advised:

1. It is advised grazed goat herd must be fed in concentrate @ 100-120 g of leguminous grains i.e. gram, soybean, rajma
2. Protineous geen fodder i.e morus leaves and ficus group trees leaves.
3. Mineral mixture must be fed @25-30 g per day per animal for maintain the proper health and fertility condition.

3.A Existing health services:

Most of the goat farmers reared their goats with their traditional methods for control of internal and external parasites, mites, flies and viral infestation i.e. FMD, PPR and protozoal infestation

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

1. Veterinary officer need to be appointed at nyay panchayat level.
2. Every KVK should have an animal scientist specialized in veterinary medicine and parasitology to overcome the emerging problems of the livestock in all the three region.
3. Farmers need to be educated on various issues of goat farming for doubling the income.

4.A Existing management practices:

1. Improper housing system without proper ventilation in animal shed therefore most of the goat flock suffer with respiratory problem,
2. Improper condition of the floor sheds,
3. Manger and standing passage of the paddock is very poor in shape and size.

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

1. Proper housing space with suitable material,
2. At the time of stall feeding and cleanliness management practices must be adopted to fulfil the required amount of dry matter as per their body weight ,
3. Concentrate and mineral mixture along with timely deworming and vaccination practice..

5.A Problems of Livestock system:

1. Lack of pure genetic breed in-breeding condition is high therefore the mortality of the kids and poor conception is high.
2. Most of the goat herd have very shortage of quantity and quality of concentrate feed and mineral mixture the productivity of goat is continuous deteriorated.

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which

income is not increasing:

1. Lack of local available good quality grains as concentrate feed reduce the health condition of the goat
2. Due to inbreeding and anorexia the morbidity and mortality is very high.

C5. Livestock: Poultry

1.A Existing breeds available:

1. Non descriptive, local for dual purpose
2. Synthetic strain for meat purpose

1.B Specific breeds to be introduced:

1. The popularization of Cari Devendra, RIR cross with Aseel, Kadaknath, Chibro breed for cross with RIR
2. Playmouthrock for dual purpose
3. Cari Dhanraja, Cari Mritunjay for meat purpose
4. Cari Priya, Cari Sonali for egg production in backyard condition
5. Synthetic stain and WLH, Red Cornish for organized sector

2.A Existing feeds being used: Majority of the poultry farmers reared the birds in range condition during the day time and night in battery cages

2.B Specific feeds to be introduced / advised:

For successful strengthening of the poultry sector must be provided balance concentrate feed i.e. pre starter, starter, grower

3.A Existing health services:

1. Most of the chicks died in brooding stage due to negligence of the management of the owner.
2. Unhygienic conditions of poultry farm increase the mortality percentage.

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

1. Proper brooding facilities
2. Proper vaccination schedule and techniques
3. Use of good quality liter material
4. Proper ventilated housing facilities
5. Awareness of the poultry growers for contagious disease transmitted one farm to another

4.A Existing management practices:

1. Non organized poultry growers in remote areas,
2. Lack of vaccination schedule,
3. Proper housing space and poor sanitation practices adopted in poultry shed.

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

1. Rearing of healthy DOC chicks,
2. Proper brooding system,
3. Suitable environmental condition and vaccination practices must be required.
4. Isolation and removal of morbit birds and liter material away from healthy stock in proper way.

5.A Problems of Livestock system:

1. Lack of pure DOC genetic stock
2. Bacterial and viral contamination is higher
3. Cost of feed is higher
4. Proper marketing facilities is not available
5. Non availability of suitable medicine and vaccines in local market

5.B Specific problems related with AH/ LS/Goatary/Poultry/Fisheries due to which

income is not increasing:

1. Due to less number of hatchery the quality of day old chicks having poor strain and low body weight which is one of the major cause for early mortality.
2. In poultry feed, the ingredients of animal protein are locally not available therefore the cost of concentrate poultry feed is higher.
3. Lack of organize market, most of the farmers suffer from the loss of the poultry farming.
4. Most of the farmers purchase poultry chicks from private hatchery, they are having poor genetic stock of poultry chicks
3. Cost of chicks is very high in private hatcheries but despite of that farmers are helpless to purchase the chicks from those hatcheries because of non availability of chicks in hatcheries of government organizations at regular interval.

D. Integrating Farming system

1.A Existing farming system:

Fruits + vegetables + goat + livestock

Spices + vegetable + livestock

1.B Specific farming system for doubling income in specific agro-ecological region:

Spices + livestock + poultry + goat + vegetables

Vegetables + fruits + goat + agroforestry + fisheries

E. Reducing post harvest losses and value addition

1.A Existing grading facilities:

Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

According to an estimate 6 grading centres be established in Kalsi and Chakrata blocks of Dehradun to promote vegetables and spices cultivation in the region.

A.For grains:

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

B.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: There are no processing facilities in District Dehradun.

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

I. Processing facilities need to be set up in Kalsi and Chakrata blocks of Dehradun as tomato, ginger, chilli, vegetable pea are largely grown but due to lack of processing facilities, farmers are bound to sale their produce as raw.

II. Besides, pomegranate, low chilling apple varieties are emerging crop of mountain region of Dehradun for which processing facilities need to be established.

III. Establishment of processing unit can help the farmers in doubling their income.

A.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

B.For horticultural crops:

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

1. There are no packing facilities.
2. Farmers use traditional method of packing.

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

I. Proper packing facilities i.e. packing in corrugated boxes need to be introduced as it significantly reduce the post harvest losses during transportation.
II. Packing facilities need to be established in Kalsi and Chakrata block of Dehradun where tomato, chilli, ginger, vegetable pea, rajma are largely grown.

A.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

B.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)

4.A Existing storage facilities: There are no storage facilities.

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

Storage facilities need to be set up in Kalsi and Chakrata block of Dehradun to store tomato, chilli, ginger, vegetable pea, caggabe, cauliflower, broccoli, coriander etc so that same could

be sold in the market during lean period of the produce in the markets when prices are high.

A.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

B.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. Farmers generally do bunding of their fields to check soil erosion, but occasional heavy rainfall destroys those bunds and soil erosion occurs.
2. Contour bunding and grading with levelling of land, plantation of fodder trees on bunds and wiring of slopes where there is extensive problem of land erosion.

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

1. Due to high rainfall in the upper hills of district Dehradun, the top most soil cover is lost, which tenders the soil barren and unproductive.
2. However due to judicious management of slope and selection of plant species like *Rhodendron* and *Quercus* vegetative cover can be attained in short time and management of wasteland is done.
3. It is also true that as such there is no problem of wasteland in district Dehradun as there is no salt affected or acidity affected area.
4. Treatment of wastewater in district Dehradun is also not a problem as there are no effluent emitting industries.

2.A Existing plantation: Conifers , Deciduous plants (Chir pine, deodar)

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. Not applicable as problem of wasteland and wastewater does not occur in district Dehradun.
2. However in some areas slope management, soil movement stabilization, contour farming and afforestation with suitable species like rhodendron and Quercus need to be encouraged to reduce soil erosion and management of wasteland.
3. Rejuvenation/repair of faulty/abandoned terraces;
4. Stabilization of eroded land using biological/engineering measures;
5. Plantation of suitable trees/brushes in waterlogged and eroded areas;
6. All agricultural operations should be done on contours i.e. across the existing land slope.
7. 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.
8. 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.

9. Diversion of runoff through ditches from upper slopes to safer places.
10. Gabion structures can be made along the hill roads as retaining wall, and along the stream banks for protection.
11. 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.
12. Contour trenching (staggered/continuous).
13. Domestic wastewater may be reclaimed at house hold level for use in kitchen gardens.
14. Industrial wastewater must be purified by the concerned industries at their factory level, and should not be thrown into the streams/rivers.
15. The discharge from perennial/seasonal natural water springs must be stored in tanks to ensure continuous water supply for drinking and domestic uses.
16. 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: Sorghum, Jwar, bajra, maize, oat, berseem, napier are grown by the farmers.

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:

Hybrid napier grass, perennial fodder grass i.e. cocksfoot, talfescue, Italian rye and fodder trees i.e. morus, khadik, bhimal can be promoted in mid and high hills whereas hybrid napier, berseem, sudan grass, saftal in plain and valley areas.

A.Guinea grass (Panicum maximum),

1. Seed rate(Kg/ha)-3-4
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management-60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

B.Setaria grass (Setaria anceps)

1. Seed rate(Kg/ha)-1.5 2.0
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 100:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

C.Spear grass (Hetropogon contortus)

1. Seed rate(Kg/ha)-4-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available..
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting

D.Rhode grass (Chloris gayana)

1. Seed rate(Kg/ha)-3-5
2. Spacing (cm)- 50cm x 50cm or 40000 rooted slips/ha Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)

3. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
4. Irrigation management-Crop must be irrigated after each cut provided water is available.
5. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

E.Marvel grass (Dicanthium annulatum)

1. Seed rate(Kg/ha)-4-6
2. Spacing (cm)- 50cm x 30cm
3. Sowing time-Onset of monsoon (rainfed) and February to July (Irrigated)
4. Fertilizer management- 60:50:40::N:P205:K20kg/ha (Basal) + 30kg N after each cut
5. Irrigation management-Crop must be irrigated after each cut provided water is available.
6. Harvesting management- First cut at 60-65 days after planting and subsequent cuts at 30 days interval (Irrigated). In rainfed, first cut may be taken after 3-4 months after planting.

4.A Type of waste water:

1. Effluent from kitchen and bathroom
2. Effluent from industries
3. Flowing springs

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. Domestic wastewater from kitchen and bathroom should be treated before being used for irrigation in vegetables and other crops.
2. 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.
3. Sewage water from cities should be treated by municipal corporations or other agencies.

G. Reduced cultivation cost

1.A Existing inputs being given:

Seeds of high yielding varieties and hybrids of various crops, quality pesticides effective for management of different pest and diseases are given to the farmers by the State Departments on subsidized ratres.

A.Rice-wheat/Sugarcane-Ratoon-wheat/Mustard /Toria,Maize-Pea wheat / Chickpea/Lentil

1. Annexure–II is enclosed for N,P and K.
2. In Zn deficient soils, application of 25 (sandy loam)- 50 (Clay loam) kg ZnSO4 (21% Zn) /ha or foliar spray of 0.5% ZnSO4 + 0.25% lime in standing crop.
3. Foliar spray of 1% FeSO4 in rice nursery and maize.
4. In Cu deficient soils, application of 4-5 kg CuSO4/ha or foliar spray of 0.25% CuSO4 + 0.125% lime in standing crop
5. In Mn deficient soils, application of 30 kg MnSO4/ha, if Mn deficiency exist in field or two foliar spray of 0.5% MnSO4 + 0.25% lime before first irrigation and one month after .

B.Mango/Litchi/Jack fruit

1. In deficient soils, application of 215 kg gypsum/ha, if S deficiency exist in field.
2. Two foliar spray of 0.2% ZnSO4 +0.2% MnSO4 + 0.1% CuSO4 + 0.25% Lime in Feb. & March.
3. Two foliar sprays of 0.2% Borax in April at fortnightly interval.
4. Apply FYM as per age of the plant.

1.B Soil test based inputs to be suggested in the specific agro-ecological region of district:

1. Soil health card need to be issued to all the farmers who are actively involved in the farming.

2. Accordingly, commercially important crops to be suggested for doubling their income by maintaining the sustainability.

2.A Existing mechanization:

Power tiller, Tractor and traditional method used

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

1. In hills of Dehradun, power tiller need to be promoted to reduce the cost of cultivation.
2. In valley areas and foot hills, small tractors of 15-20 HP can also be promoted to reduce the cost of cultivation.

3.A Existing collective inputs: Seed, fertilizers, pesticides

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

1. Seeds of high yielding varieties and hybrids of various crops
2. Quality pesticides effective for management of different pest and diseases has to be given to the farmers by the State Departments on subsidized rates in order to reduce the cost of cultivation.
3. Seed, fertilizers, pesticides, FYM, vermin compost, micro nutrients, herbicides, medicines, vaccines, dewormers etc.
4. Encourage furrow application of P and K fertilizer and half dose of nitrogenous fertilizers at sowing based on soil test value.
5. Avoid broadcasting of chemical fertilizers preferably spraying method should be followed for application of N and micronutrients.
6. Encourage use of organic manures and biofertilizers; reduce the dose of chemical fertilizers.
7. Need based application of insecticides and pesticides, preferably enhanced the use of bioagents.
8. Farmer should use high yielding variety seed and multiply at his own site for next 02-03 seasons.
9. Use optimum and recommended seed rate at optimum spacing and depth.
10. Encourage water harvest technology for irrigation.
11. Use sprinkler and drip method for irrigation should be encouraged.
12. Use of mulches and available composts/organic manures
13. Follow contour farming and grow perennial fodder crop on bunds to check soil erosion.
14. Promote reduced tillage operations.

Factors responsible for increasing cost of cultivation in the specific agro-ecological region of district:

1. Rain fed condition in Chakrata and Kalsi block of Dehradun also responsible for increasing cost of cultivation.
2. Manual weeding, manual intercultural operations, manual irrigation etc. also increased the cost of cultivation.
3. Heterogeneous soils – soils of each situation differ widely in their physical, physio-chemical characteristics as they are developed from a variety of rocks and minerals under joint influence of vegetation, physiography and climate.
4. Sloping lands with high rate of removal of soil and nutrients from surface through erosion resulting to depletion of soil fertility.
5. Scattered holding and marginal land size.
6. 90 % of area of mid and high hills is rainfed.
7. High rates of migration from hills to plains of males and young boys in search of jobs.
8. Women based farming system without technical know – how and inputs.
9. Low efficiency of conventional farm tools and implement.

10. Indigenous breed of livestock with low production and working efficiency.
11. Poor quality of FYM. The method of preparation and application of FYM are defective generally heaped in an open area resulting into loss of nutrients.
12. Mostly soils are slightly to strongly acidic in nature depending upon elevation, vegetation and development of soil from rocks and minerals causing nutrient imbalance in soil and impose hidden nutrient toxicity and deficiency symptoms in crops retard growth and yield.
13. Minimum use of fertilizers: farmers are mostly small and marginal economically backward, not able to apply recommended dosses of fertilizers. The average consumption is < 10 kg N:P:K.
14. Non availability of quality seeds of varieties recommended for rainfed upland situations.
15. The inputs are costly and therefore the small and marginal farmers are not able to adopt the improved technology.
16. Non availability of inputs at right time and right place.
17. Sowing of crops is at the mercy of rains which are erratic. Thus planting is delayed and not done on suitable time. Sowing are done more than once either because of insufficient moisture mostly in rabi crops or due to crust formation in kharif.
18. Farmers follow practice of dry sowing. In such situation the seeds are eaten by birds and grubs resulting in inadequate plant population.
19. Due to limited moisture and nutrient supply the growth of crops is not proper and vegetative phase of growth (flowering and fruiting) are advanced.
20. Improper/Inadequate seed bed preparation: in order to utilize moisture, the farmers do not wait for fine preparation of fields and rush for sowing.
21. This results in improper germination and infestation of weeds.
22. Severe infestation of insect-pest: white grubs and cut worms are the serious polyphagous pests, kill plants and reduce plant population up to 70-80 %.
23. Due to non availability of suitable plant protection chemicals as well as high cost they are beyond the reach of the farmers.
24. Beside, non availability of water for solution also pose problems.
25. Weeds; common weeds of the upland rainfed areas are Tipatiya (Oxalis latifolia), Pardeshi(Galensojaparviflora), Gajar grass (Parthenium Sp.)Kuni(Lantena camera) Kala bansa (Eupatorium sp.).The loss in general in food crops is high from 50-75 %.
26. Improper terrace management: most of terraces developed by farmers are on steep slopes with outward gradient.
27. Lack of proper drainage system for safe disposal of excess rainwater. The heavy runoff of water washes away the top fertile soil leady to steady depletion of nutrients and organic matter.
28. Coarse textured soils (charty/gravely) with low moisture and nutrient retention capacity.
29. Lack of proper storage facilities for crops (cold storage).
30. Lack of awareness for protected cultivation techniques and facilities for commercial high value crops (poly houses, poly tunnels, poly for raising nursery and cash crops.
31. No good marketing facilities.
32. Lack of proper irrigation facilities for minor irrigation and drip irrigation with fertigation.
33. Poor connectivity of road transport system.
32. Lack of farmer's participatory models for crop production technologies under hill agricultural system for the state.

H. off-farm income

1.A Existing SHGS operative in specific agro-ecological region of district:

SHGs are working but their impact is not visible among farming community

Hence SHGs need to be strengthened with modern development taking place in the field of agriculture and its allied sectors.

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

SHGs need to be created in large number with the help of NABARD by involving progressive farmers and farm women to increase the income of the farmers.

1.C SHG already formed and need to be encouraged: Not existing

1. 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.
2. 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.
3. Imparting the information to the groups about various govt. schemes regarding loan, trainings and marketing of the product.
4. 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.
5. 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.
6. Loan procedure should be made more flexible with less interest rate.
7. 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.
8. 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.
9. 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.
10. Enterprises need to be identified depending upon local resources- human and material.
11. Market linkages need to be developed so that people can sell their produce gainfully.
12. To encourage SHG's better planning, training and sustained efforts on long term basis are required.
13. 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.
11. It is seen in the survey that all individuals who took loan increase their livestock only that is their traditional work and did not start any other enterprises.

2.A Existing Micro-entrepreneur employment: Not existing

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

Micro-entrepreneur employment need to be generated with the help of NABARD in which involvement of innovative farmers and farm women must be compulsory.

3.A Existing skill development facilities:

Skill development facilities are done by KVKs and Line departments.

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies
2. Skill development facilities need to be created for practicable training.
3. For this purpose, KVK Dehradun may be selected by providing proper funding.

4.A Existing women skilling facilities:

Skill development facilities are done by KVKs , Line departments, NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected by providing sufficient funding.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

5.A Existing youth skilling facilities:

1. Skill development facilities are done by KVKs
2. Line departments
3. NGOs

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

1. In order to mobilize and sensitize the farmers towards farmers friendly technologies, skill development facilities need to be created for practicable training.
2. For this purpose, KVK Dehradun may be selected.
3. Training centres processing units, packaging units and market outlet as per the locally available resources

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:

3. **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

8*th 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).

3. 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.

4. 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.

III. Enabling Policies

1.A Existing policies related with agriculture and animal husbandry: KVK follow the policies of ICAR and GBPUAT, Pantnagar for transfer of technology among farming community.

1.B Policies to be suggested for doubling income in the specific agro-ecological region: Proper funding need to be provided to the KVK, Dehradun for large scale adoption of farmers friendly technologies at gross root level.

2.A Existing Institutions:

1. ICAR Institutes
2. Department of Agriculture, Horticulture, Animal Husbandry, Fisheries
3. ULDB
4. KVK
5. NGOs

2.B Institutions to be suggested for doubling income in the specific agro-ecological region of district: Existing institutions need to be strengthened particularly KVK, Dehradun to make it more effective, more responsible for the welfare of farming community in doubling their income.

3.A Existing Incentives: As per Govt. norms

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

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: Pradhanmanti fasal bima yojana

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

1.A Existing marketing facilities: Farmers sale their produce in local markets

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

1. Proper marketing facilities need to be developed in various region of the district do that farmers could get premium price of their produce.
2. It has been seen that despite of high production, farmers do not get remunerative price of their produce in the markets due to poor marketing system

2.A Existing grading facilities: Grading is done by the farmers only in fruits and vegetable crops but proper grading is not done as they do manually.

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

According to an estimate 6 grading centres be established in Kalsi and Chakrata blocks of Dehradun.

A.For grains:

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

B.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:

Processing facilities need to be set up in Kalsi and Chakrata blocks of Dehradun as tomato, ginger, chilli, vegetable pea are largely grown but due to lack of processing facilities, farmers are bound to sale their produce as raw.

Besides, pomegranate, low chilling apple varieties are emerging crop of mountain region of Dehradun for which processing facilities need to be established.

A.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

B.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 :

Packing facilities need to be established in Kalsi and Chakrata block of Dehradun where tomato, chilli, ginger, vegetable pea, rajma are largely grown.

A.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

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

1. Problem of marketing is the biggest issue in the farmers.
2. In doubling income of farmers, role of proper marketing has immense importance.
3. Value addition is also important for which proper training, demonstrations, infrastructure need to be developed.

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: Internet and video conferencing etc.

2.A: Existing evaluation procedure: Manual

2.B: Evaluation procedures required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.

3.A: Existing monitoring system: Physical

3.B: Monitoring procedures / system required for online management and evaluation in specific agro-climatic region of district: Internet and video conferencing etc.

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 video conferencing etc.

5.A: Existing reading system: Literature, Booklets, leaflets, folders

5.B: Reading system required for online management and evaluation in specific agro-climatic region of district: Hindi Extension Journals, film show, success stories, visit of farmers at regular interval etc.

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

In this region only two blocks Chakrata and Kalsi are located :

Promotion of high yielding varieties of the following crops in two blocks only namely *Chakrata & Kalsi*

1. **Wheat** (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)) and UP 2572, UP 2628, UP 2554),
2. **Paddy** (VL Dhan 86, Pant Dhan-19, HKR-127 & PRH 10, Pant Dhan 4, PD 11);
3. Promotion of HYV of Maize (Vivek QPM 9, Vivek Maize Hybrid 45, Vivek Maize Hybrid 53,CMVL Sweet Corn 1, CMVL Baby Corn 2(upto 2000m amsl), Maize hybrid-3396, Maize hybrid-3401, Maize hybrid-9144, Maize hybrid-9164 , Kanchan, Navin, Shweta) suitable for *Chakrata & Kalsi* blocks of district Dehradun
4. Promotion of high yielding varieties of finger millets (and VL Mandua 352 upto 2000m amsl) and Barnyard millet (PRJ-1, VL Madira 172 and VL Madira 207 upto 1800m amsl)

in *Chakrata & Kalsi* blocks.

5. **Rajma (**VL Rajma-63, VL Rajma 125, PDR-14 (Udai), Chakrata local suitable for *Chakrata* & *Kalsi* blocks
6. **Tomato** (VL Tamatar 4 upto 1800m amsl , Ayushman, Shaksham, Dipanker, Abhinav, Avtar, Aviral, Arka Rakshak, Himshikhar, Sampoorna, NS 504, Abhilash, 4223, 3428, 914, 3201, 999, 2853, 1458, Kashi amaan, Kashi abhimaan, Kashi vishesh, Naveen2000, Himsona, Pusa Sheetal, Pusa Gaurave, Pant T-3 suitable for in *Chakrata* & *Kalsi* blocks.
7. **Chilli** (DG-1701, Anokhi, Sagarika, Sakata-651, Tarika-2161, 078, 4884, VNR 305, Kalyani, Kranti, Kashi surkh, KA2, Kashi early,Kashi Anmol, Pant C-1, Tajwasni, Pusa Sadabhar, Punjab Lal, Panjab Surkh, CH-1 and CH-3, Laher, soldier, Pant Chilli-1, Pusa Jwala, Pusa Sadabahar, Arka Lohit, Divya Jyoti, Gopika, Kalyani, VL Shimla Mirch 3 upto 1800m amsl) suitable for *Chakrata* & *Kalsi* blocks.
8. **Vegetable pea (**Vivek Matar 11 for main season & VL Ageti Matar 7 for August sown , Sweet Pearl, PSM-3, GS-10, Azad Matar-3, VRP-5, VRP-6, VRP-7, Arkle, GS 10, and Arkle, Azad Matar-2, Arka Ajit, Kashi Udai suitable for in *Chakrata* & *Kalsi* blocks
9. Onion (VL Piaz 3 upto 2000m amsl); Garlic (VL Lahsun 2) suitable for in *Chakrata* & *Kalsi* blocks.

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

Strengthening of traditional water storage structure

1. In the *Chakrata* & *Kalsi* blocks various system of water harvesting depending upon the source of water supply may be implemented like (a) in-situ rain water harvesting can be done through bunding and terracing, contour farming, mulching etc. (b) rain water / direct surface run off harvesting through roof top collection, dug out ponds, storage tank, diversion bunds /channel etc. (c) Stream flow or run off harvesting through nala bunding, waterharvesting dam, percolation tank/ ponds, (d) Sub surface flow harvesting in *Chakrata* & *Kalsi* blocks.
2. Conserve soil and water through in-situ moisture conservation, water harvesting and land management practices in *Chakrata* & *Kalsi* blocks.
3. Regenerating natural resources base: conservation practices like plot border planting with terrace repair on-arable land and contour trenching on non-arable land for in-situ moisture conservation in *Chakrata* & *Kalsi* blocks.
4. Creation of rain water harvesting structure in private as well as government buildings in all the villages of the region so as to create awareness among the villagers.
5. Creation of trenches for high percolation of water in most of the area of *Chakrata and Kalsi* blocks.
6. Promotion of water conservation techniques like mulch, sprinkler and drip irrigation.
7. Roof Water Harvesting.
8. There is an urgent need to generate alternate sources of irrigation to increase the net irrigated area, which in turn shall also increase the cropping intensity. These alternative sources can be rainwater harvesting, check dams, hydram for lift irrigation etc.
9. Technologies like drip irrigation, sprinklers etc. can also be used for better water management in *Chakrata* & *Kalsi* blocks.

Adoption of cluster approach for holistic development

1. Promotion of **ginger and turmeric** cultivation in *Chakrata* and *Kalsi blocks of the region*.
2. Promotion of **onion and garlic** cultivation *Chakrata* and *Kalsi* blocks of Dehradun.
3. Promotion of off season vegetables (tomato, vegetable pea, chilli, capsicum, cole crops etc.,) cultivation in *Kalsi and Chakrata* blocks.

Management of wild animal problem

1. In Kalsi and Chakrata blocks there is a problem of wild boars. Electric fencing/normal

fencing is required in these places. 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. Relocation of wild animals. Replanattion of forestd with fruit trees etc.

2. Enacting legislative measures for protection of crop from wild animals.

Adoption of Farm mechanisation (Power tiller, thresher etc)

1. Farm mechanization will help in the timely sowing of crops. Mini harvesters should be developed so as to harvest on time.
2. Popularization of multi crop thresher and Power Tiller/ Mini Tractor at Nyay Panchayat level in *Chakrata* & *Kalsi* blocks .
3. Use of mechanized weeder in crops like maize
4. Promotion of improved sickle, Vivek Millet thresher cum pearler, VL Paddy thresher and Vivek small tool kit for reduction in drudgery of hill farmers.

Management of soil health in hilly areas

1. Integrated Plant Nutrient Management (IPNM)- IPNM
2. should be practiced by sensitizing area groups, creating awareness to farmers through publicity propaganda, organizing communities and training's.
3. Popularization of soil testing in intensive mode and distribution of soil health card to farmers for judicious use of fertilisers.
4. Reclamation of acidic soil by liming should be done in *Chakrata* & *Kalsi* blocks on a war footing
5. Popularization of biofertilizers like Rhizobium, Azotobacter, azospirillum, PSB, PSM, K solubilising micro-organism and use of these biofertilizers with FYM at the time of sowing.
6. Fortification of FYM with pseudomonas and trichoderma
7. Promotion of vermi composting unit
8. Introduction of one leguminous crop in a yearly crop rotation.

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. The animals such as cow and buffalo in the hill region of district Dehradun and especially in *Chakrata* & *Kalsi* blocks belong to the nondescript breed and are very small in size and low in productivity as compared to the cattle in plains.
2. Promotion of high milk breeds of cows (Sahiwal, Red Sindhi & Jersey), buffaloes (Murrah) and goats (Beetal, Sirohi & Jamunapari) in Kalsi and Chakrata block, while promotion of wool yielding breeds of sheep in Chakrata block.
3. Establishment of fodder bank and ready -to- eat type of concept in *Chakrata* & *Kalsi* blocks ..
4. Establishment of milk chilling plant in *Chakrata* & *Kalsi* blocks .
5. Promotion of Urea, Molasses, and Mineral mixer blocks at *Nyaypanchayat* level .
6. Introduction of poultry breeds like CARI Devendra and CARI Nirbheek as back yard poultry breeds. These breeds are suitable for egg and meat purposes.
7. Availability of feed material with low prices & Timely health check-ups of animals.

8. Introduction and promotion of Cross bred milch breed of animal for increasing income of marginal farmer.
9. Promote dairy by expanding milk processing capacity, expansion of intensive mini dairy and strengthening of distribution structure.
10. Plantation of feedstock trees like shatoot, Bhimal, chamlai and grasses like clover, talfatue. Mixed cropping will be emphasized in the villages.
11. Availability of Credit and/or financial assistance for allied activities such as animal husbandry, medicinal & aromatic plants, sericulture etc.

Strategy 3 : Integrating Farming system

Following Integrated farming system model may be developed:

Cropping system (Area 4000m^2)

rice-wheat-moong
maize-wheat-moog
rice-vegetable pea/ cauliflower/ cabbage
vegetable pea-wheat-maize
vegetable pea-ginger
vegetable pea-cauliflower-maize
rajma-vegetable pea
rajma-lentil
rajma-onion/garlic
tomato-maize-vegetable pea
tomato-chiili
tomato-cabbage
tomato-cauliflower

Horticulture

Apple /Peach/ Pear/ Lemon (100 plants)

Livestock

Cow (01)/ Buffalo(01)/goat (10) + Backyard Poultry (100)

Others

1. Vermi-composting (20m^2)
2. Fodder production in terrace risers and bunds.
3. Mushroon production
4. Bee keeping

Strategy 4 : Reducing post harvest losses and value addition

1. Chakrata and Kalsi blocks produce large varieties of cereals, fruits, vegetables and spices. A sizable quantities of this produce are wasted because of lack of transportation, storage, processing and packaging facilities.
2. Establishment of Small & Medium Size Agro Parks, which provide common infrastructure facilities for storage, processing and marketing of surplus fruits and vegetables.
3. Establishment of fruit & vegetable based wineries.
4. Gravity ropeways to be constructed in *Kalsi and Chakrata* block to provide road head access to the farm produce need to be taken to be taken at a larger scale.
5. Establishment of mini fruit grading plant for stone fruits in *Chakrata* & *Kalsi* blocks .
6. Establishment of Food Processing Units for tomato, ginger, turmeric, vegetable pea in *Kalsi and Chakrata* blocks.
7. Promotion of cluster approach for efficient procurement and disposal of surplus fruits and vegetables in all the blocks.
8. Promotion of common resources on custom hire basis viz. Power tiller, Mini Thresher and other equipments at Nyay Panchayat level in in *Kalsi and Chakrata* blocks

9. Tertiary and value addition of citrus fruits, in in *Kalsi and Chakrata* blocks by establishment of small processing units.
10. Establishment of Food and Processing Units in *Kalsi and Chakrata* blocks fo*r* pickle making using *hill lemon*.

Strategy 5 : Waste land development and waste water

1. As such there is no problem of wasteland and waste water in Kalsi and Chakrata blocks of District Dehradun. But where the slope is very steep, there is some problem of soil erosion. In the hills of Kalsi and Chakrata blocks Contour making for arable purpose in waste land in Kalsi block and other hill areas.
2. Afforestation of plants and perennial grasses in steep slope of more than 40% slope inChakrata and Kalsi blocks.
3. Plantation of Mulberry (*Morus*) plants, Wild fruit plants, Fodder trees (*Grewia*, *Alnus*, *Quercus* etc.) may be promoted in *Kalsi* and *Chakrata* blocks.
4. Popularization of soil bunds to save excessive loss of nutrients in wasteland of all blocks.
5. Construction of tank for storage of water for lean season in all blocks.
6. Establishment of storage system for rain water in monsoon season.
7. Establishment of waste water treatment plants based on phycoremediation technique at sewer drainage points.

Strategy 6 : Reduced cultivation cost

1. Use of fortified FYM, vermicompost along with biofertilizers will increase the macro nutrient availability and thus will decrease the use of fertilizers. The soil organic matter content will increase and soil fertility will increase.
2. Foliar application of nutrients will also reduce the cultivation cost.
3. Provision of mechanization (Use of Power tillers, Power weeders, Paddy threshers, Wheat threshers, Maize Sheller, Wheel Hand hoe, Manual/ power operated Wheat/Paddy reapers etc.).
4. Promotion of well decomposed FYM, Vermicompost and Biofertilizers to minimize the use of chemical fertilizers in *Kalsi* and Chakrata blocks.
5. Promotion of line sowing and balanced fertilizers application in crops.
6. Promotion of recommended seed rate, spacing and depth.
7. Promotion of need based application of pesticides and other agricultural inputs.
8. Promotion of hand tools in agricultural and horticultural operations.
9. Promotion of mulching (bio or degradable plastic) to maintain moisture and reduce intercultural operation cost.
10. Promotion of pressurized irrigation techniques in horticultural crops.

Strategy 7 : Off-farm income

1. Promotion of apiculture in Chakrata and Kalsi blocks , mushroom for small and landless farmers in Chakrata and Kalsi blocks.
2. Promotion of skill development like stitching, pickle , papad, candle, bag making in women and youth in Chakrata and Kalsi blocks
3. Creation of new SHGs in all villages of all blocks and linking them with NABARD or lead banks of that areas.
4. Encouragement to existing SHGs 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 *Chakrata* and *Kalsi* blocks .

Strategy 8 : Enabling Policies

1. Adequate and timely availability of inputs is essential for agricultural growth. A dynamic and growing, agricultural sector requires seed, fertilizer, plant protection chemicals, bio pesticides, agricultural machinery and credit at reasonable rates to the farmers.
2. Land consolidation (Chakbandi) is essentially required in *Chakrata* and *Kalsi* blocks.

This will help in proper planning and execution of farming practices.

3. Buy back mechanism of the government should be strengthened and all produce of the farmer should be bought by the government.
4. Implementation of policies for control of wild animal menace in agricultural areas (by sterilization/castration/killing).
5. Implementation of Soil Health Card Scheme in each nyay panchayat of all blocks.
6. Providing quality inputs at right time to the farmers
7. Increasing institutional support by providing subsidises and incentives to small and marginal farmers in all blocks.
8. Popularization of Udyan cards and KCC for widespread use of government incentives/ subsidies to farmers.
9. Implementation of effective and workable Nursery Act to avoid spurious or unreliable planting material in the state.
10. Ensure sustainable agriculture through more efficient utilization of land, water and other resources.

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

Action points that need to be considered for closing in on the present marketing gaps are:-

1. Transportation is the major problem in hill regions and especially in *Chakrata* and *Kalsi* blocks. During rainy season the roads get blocked and perishable fruits and vegetables can not be transported to the markets. So, either procurement centre may be established in the area or some transportation subsidy may be introduced for improving profitability of the farmers.
2. The awareness among farmers about other post harvest management aspects such as grading, processing etc. needs to be created by the concern departments in *Chakrata* and *Kalsi* blocks.
3. For planning of marketing strategies, a data base on consumer behavior market competitiveness, strategies of potential rivals in export market, income and price response needs to be developed in the State.
4. Organization commodity specific growers‟ associations at village, market (AMC) and state level and integrating their functions in relation to market centric activity.
5. Govt. of Uttarakhand may tap Rural Infrastructure Development Fund from NABARD for all the AMCs projects on a comprehensive basis (new as well as modernization).
6. Involving Gram Panchayats to organize and manage markets at local level by undertaking remunerative schemes and improving their revenues.
7. Village level processing should be encouraged by providing appropriate technology and by organizing the marketing of such processed products.
8. Establishment of mini *mandies* at Block level.
9. For highly perishable vegetable and fruit crops like mango, litchi, tomato, capsicum etc creation of better transportation facilities with cool chain van at Block level.
10. Creation of direct linkages with food processing industries for better prices.
11. Establishment of strong linkages with various stack holders to furnish information on crop produce and surplus.
12. Establishment of procurement and collection centre at *Nyaypanchyat* level for agricultural surplus with proper labelling.
13. Installation of mini grading machines at village level.
14. Establishment of cold storage facilities in Chakrata and Kalsi blocks. Promotion of local Hatt at Tahsil level in all blocks.
15. 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. Linking up villages to local market; local market to regional/ state markets and state markets to national and international markets duly network them online (e. marketing).
3. Use of internet to increase knowledge and explore marketing possibilities
4. Development of e-Marketing and kiosk at district level to have information of surplus commodities at block level.
5. Organization of monthly review meeting at district to solve the problems related with farmers.
6. Promotion of use of community radio, TV talks and Whatsapp etc. for effective implementation of programme.