Sustainable livelihood generation through CSIR-IHBT technologies in aspirational district Chamba of Himachal Pradesh

Detailed project proposal and action plan

Submitted by

CSIR- Institute of Himalayan Bioresource Technology
Palampur – 176061
Himachal Pradesh

Executive Summary

Chamba is located in the North Western part of Himachal Pradesh and is identified as an aspirational district by NITI Aayog, Government of India (GoI). Chamba is completely landlocked with mountainous terrain. High altitude and prolonged winter with glaciers have reduced the accessibility of the region to the fast growing economy of the country. Some of the major issues faced by the region are

1. Lack of storage facilities for agri-horti produces
2. Poor industrial access and lack of processing facility
3. Poor communication and transportation
4. Poor access to healthcare
5. Unemployment

All the aforesaid issues are interlinked and need a sustainable solution through effective utilization of natural resources and their value addition. Deployment of scientific and technological (S&T) solutions becomes necessary for a sustainable growth. In this context, CSIR- Institute of Himalayan Bioresource Technology, a constituent laboratory of Council of Scientific and Industrial Research, GoI envisages deployment of S&T solutions that utilizes local bioresources and diversify agricultural practices in new avenues such as floriculture, apiculture, cultivation of medicinal and aromatic plants (MAP), precision agriculture, mushroom cultivation, food processing technologies for sustainable economic returns and employment generation.

The document provides a detailed work plan and deliverables under seven different themes viz.,

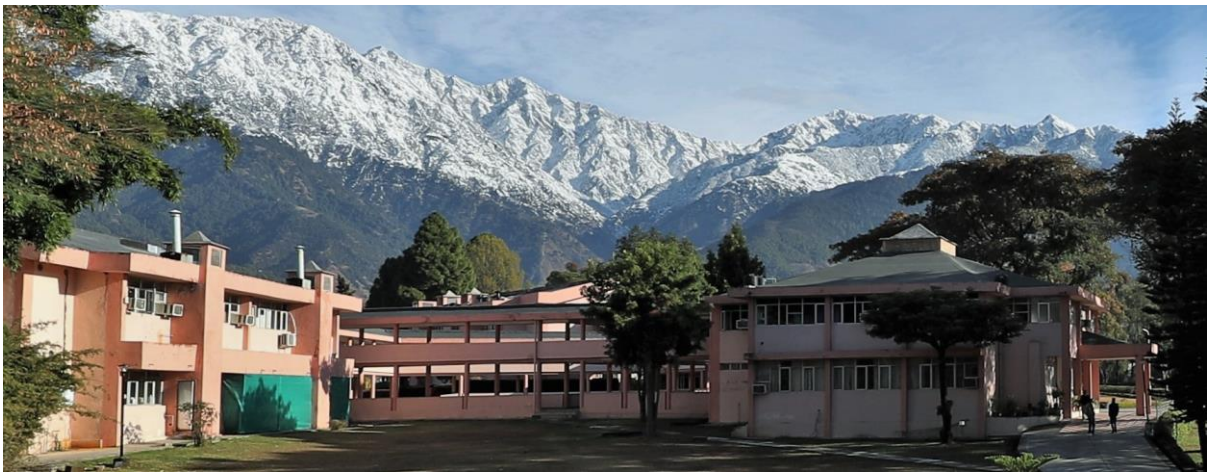
1. Agricultural diversification with medicinal and aromatic plants and floriculture crops
2. Integrated floriculture and apiculture for enhanced income
3. Precision agriculture with Hydroponics/Aeroponics technology
4. Food processing technologies for agri-horti crops and produce
5. Vitamin D2 enriched Shiitake mushroom cultivation and processing
6. Compost production suitable for cold regions
7. Waste to wealth – Herbal incense cones from waste temple flowers

The technologies shortlisted for deployment are mature in terms of technologies readiness level (TRL) and are either already commercialized or ready for commercialization. In addition to S&T interventions, CSIR IHBT would offer capacity building services such as training to farmers, local youths and entrepreneurs towards implementation of technologies and offer incubation support through various government schemes.

Introduction to CSIR-IHBT

CSIR-Institute of Himalayan Bioresource Technology situated in the lap of Dauladhar mountain range is a state of the art research institution with the mission to discover, develop and commercialize processes and products from Himalayan bioresources using cutting edge science and technology.

Understanding the importance of bio-wealth and the infinite possibilities to utilize them, the institute has constantly endeavoured to developed wide range of technologies catering to the needs of industry and common man such as personal hygiene products, agro-technology protocols, nutraceuticals, aromatic oils, textile fibres and natural colours and value added ready to eat foods products. These technologies are relevant under various national missions such as Make in India, Swachh Bharat and Swasth Bharat. The institute is working towards entrepreneurship development through these technologies by working closely with micro, small and medium enterprises (MSMEs) and start-ups, and by incubating entrepreneurs in its facility for creating a self-reliant India (Atmanirbhar Bharat). In addition, the institute offers training and conduct capacity building programs to farmers, students and interested entrepreneurs for wider outreach and proper dissemination of knowledge.



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1. Introduction

India is characterized by a different agro climatic zones, favouring production of a variety of agricultural, horticultural and industrial crops. Among them, high value economical plants *viz*., aromatic crops, floriculture crops, high value crop saffron, plays a valuable and important role in economic, social, cultural and ecological aspects of local communities. The medicinal and aromatic crops (MAPs) are firmly emerging on the scene in Indian agriculture from different perspectives. Moreover, the global trade of MAPs has also been growing exponentially and is likely to touch a scale of five trillion US$ by 2050 with an annual growth rate of 15%. On the other hand, it is estimated that the annual turnover of perfumery, cosmetic and flavour industry will exceed US$ 10 billion in the world over. In spite of huge demand, the spread of MAPs, industrial, high value floriculture and commercially important plants is not picking up in the country due to lack of sufficient supply of quality planting material/seedling. In this context, we have identified major problems persistent in Chamba and envisage to provide R&D based solutions to the farmers and entrepreneurs to tackle these issues end to end and promote rural development.

Diversification of agriculture has become the most important tool for realising higher income and employment from small holdings. Chamba is the north-western-most district of Himachal P r a d e s h which is bounded on north-west by Jammu and Kashmir, on the north-east and east by Ladakh and Lahaul and Bara-Bangal area of Himachal Pradesh, on the south-east and south by District Kangra of Himachal Pradesh and Gurdaspur District of Punjab. Chamba District is situated between north latitude 32° 11’ 30” and 33° 13’ 6” and east longitude 75°49 and 77° 3’ 30”, with an estimated area of 6,528 square Kilometres and is surrounded on all sides by lofty hill ranges. The soil is generally loamy in texture with a little more per centage of clay on the higher altitude as well as on the lower elevations. The soil is well supplied with organic matter. Its extent is low at mid-elevation and minimum at low-lying valleys. Agriculture is the mainstay of the majority of the population in the district. Generally, two crops are taken from the land. Maize is the main crop of the Kharif *season* while potato and paddy are also sown, where the conditions so permit. Wheat and barley are the major Rabi
crops.

District Chamba is known as the repository of medicinal and aromatic plants and plenty of these grow under natural conditions. There exists potential to domesticate and cultivate wide variety of medicinal species on commercial scale. The important medicinal species found in

different parts of Chamba district are: kalazeera, salampanja, karu, patish, ratanjot, diascoria, dhoop and many other species. There is a dire need to conserve these high value herbs and to develop and standardise their cultivation techniques. Recently, some efforts are being made to popularize cultivation of aromatic plants mainly wild marigold, lavender, mushkbala by CSIR-IHBT in Chamba.

In this context, we envisage to deploy CSIR-IHBT technologies with end to end solutions from providing initial planting material, employment opportunities, processing and marketing of produce.

Objectives:

i. Cultivation and value addition of economic plants in Chamba for crop diversification and capacity building on agro-technologies and post-harvest management of cut flower crops, aromatic crops and value addition

ii. Integrating apiculture with floriculture and aromatic crops for income enhancement

iii. Food processing technologies for Chamba and Bharmour region

iv. Hydroponics/ Aeroponics technology

v. Vitamin D2 enriched Shiitake mushroom production and processing

vi. Development of efficient psychrotrophic bacterial formulation for preparation of enriched compost/ vermicompost in cold hilly region

vii. Herbal incense cones from temple waste flowers

2. Agricultural diversification with medicinal and aromatic plants and floriculture crops

Cultivation and value addition of economic plants in Chamba for crop diversification and capacity building on agro-technologies and post-harvest management of cut flower crops, aromatic crops and value addition

Cultivation of high value commercially important plants viz., damask rose (*Rosa damascena*), lavender (*Lavandula officinalis*), rose-scented geranium (*Pelargonium graveolens*), rosemary (*Rosmarinus officinalis*), Indian valerian (*Valeriana jatamansi*), *Hing* i.e. asafoetida (*Ferula assa-foetida*), saffron (*Crocus sativus*), wild marigold (*Tagetes minuta*), African marigold (*Tagetes erecta*), French marigold (*Tagetes patula*), chamomile (*Matricaria chamomilla*), Mushkbala (*Valeriana jatamansi*) and natural sweetener crop viz., monk fruit will be promoted under the program. Similarly, floriculture crops such as gerbera, alstroemeria, tulips, gladiolus, chrysanthemum, rose, lilium, calla lily and indoor pollution abating plants will be deployed in different regions of the district of Chamba as per their climatic requirements (Table 1).

Table 1. Suitable regions for commercially important crops and quality planting material (QPM) requirements

Crop(s)	**Altitude** (m amsl)	**Suitable areas (Development blocks)**	**Climatic conditions**	**Targeted area (in ha)**	**Planting material required (seed/rooted plants)**	**Planting material required (seed/rooted plants)**	**Processing unit required**
Wild Marigold	1000-2500	Chamba, Holi, Bhatiyat, Sihunta, Salooni, Tissa	Subtropical and temperate well drained soil	100	June-July	300 kg seed	2
Lavender	2000-3000	Salooni, Tissa	Sub temperate to temperate, cool summer	10	April	2,22,000 rooted plants	1 (5 q SS)
Rosemary	1000-2500	Bharmaur, Churah, Salooni, Dalhousie	Subtropical and temperate well drained soil	10	April	2,80,000 rooted plants	1

Damask rose	500-2500 m amsl	Chamba, Holi, Bhatiyat, Sihunta,, Bharmaur, Salooni, Dalhousie	Subtropical and temperate, Open sunny conditions	10	Dec July	70,000 rooted plants	1
Mushkbala	1200-3000	Bharmaur, Holi	Shady and moist area (suitable for intercropping in orchards/ forest)	10	July	5,00,000 rooted plants	1
Scented geranium	1000-2500 m amsl	Salooni, Holi Sihunta,		5	April	2,50,000 rooted plants	1
Monk fruit	Up to 1500	Salooni, Chamba	Open-field, Humid and subtropical climate	0.4	April	2000 plants	-
Saffron	2000-3000	Bharmaur, Churah, Salooni, Dalhousie	Sub temperate to temperate, cool summer	0.1	September	bulbs	-
Hing	2000-3000	Bharmaur, Churah, Salooni	Sub temperate to temperate, cool & dry summer	1	March - April	10000 Plants	-
German chamomile	200-2000	Chamba, Holi, Bhatiyat, Sihunta,, Bharmaur, Salooni, Dalhousie	Open-field, Humid and subtropical climate	5.5	Dec July	5 kg seeds	-

Bamboo	200-2000	Chamba, Holi, Bhatiyat, Sihunta,, Bharmaur, Salooni, Dalhousie	Open-field, Humid and subtropical climate	10	July	10,000 plants	-
			Total area (ha)	162.0		Processing units	7

Details of action plan for floriculture crops

Crop(s)	**Suitable areas**	**Conditions**	**Targeted area (in ha)**	**Planting time**	**Planting material required (seed/rooted plants)**	**Beneficiary (Nos.)**
Marigold	Chamba, Holi, Bhatal, Bhatiyat, Shunta	Open field	50.00	All year	50 lakh seedlings	250 (2000 sqm each)
Calla lily	Chamba, Dalhousie	Open field	5.00	Sept	50,000 plants	25 (2000 sqm each)
Gladiolus	Bharmaur, Pangi, Chaurah, Bhramaur, Saluni, Dalhousie	Open field	5.00	Oct	3.00 lakh corms	25 (2000 sqm each)
Rose/ Carnation/ Gerbera/ Alstroemeria / Orchids	Chamba, Holi, Bhatiyat, Shunta, Bharmaur, Saluni, Dalhousie	Polyhouse	2.00	June July	Rose (24,000 cuttings); Carnation (80,000 cuttings); Gerbera (26,000 plants); Alstroemeria (25,000 plants); Orchid (30,000 plants)	40 (500 sqm each)

Lilium/ Tulip	Bharmaur , Pangi, Chaurah, Bhramaur , Saluni, Dalhousie	Open-field/ Shade net	1.00	Oct-Nov	4.00 lakh bulbs	40 (250 sqm each)
			63.00			380

Details of economics for aromatic crops:

Mushkbala (two years production cycle):

Yield	Dry rhizomes yield: 10 q/ha, E. oil yield: 10 kg/ha
Essential oil price at farmer's field	Dry rhizomes : Rs. 300-350/kg Essential oil : Rs. 24,000-26,000/kg
Gross returns	Rs 1.5 lakh/ha for 2 yr
Cost of cultivation	Rs 3.0-3.5 lakh/ha after 2 years
Net returns	Rs 1.5-2.0 lakh/ha after 2 years

Damask rose (perennial; production from 3rd year onwards):

Yield	25-30 q/ha/yr
Essential oil price at farmer's field	Rs.7-8 lakh /kg
Gross returns	Rs 5.00 lakh
Cost of cultivation	Rs 2.00 lakh
Net returns	Rs 3.00 lakh

Wild marigold (5 months):

Yield	36-45 kg /ha/yr
Essential oil price at farmer's field	Rs.7000-8000/kg
Gross returns	Rs 2.5-3.00 lakh/ha/yr
Cost of cultivation	Rs 0.85-1.00 lakh/ha/yr
Net returns	Rs1.50-2.00 lakh/ha/yr

Rosemary (perennial; production from second year onwards):

Yield	80-100 kg/ha/yr

Essential oil price at farmer's field	4500-5000/kg
Gross returns	Rs 3.50 lakh/ha/yr
Cost of cultivation	Rs 1.50 lakh/ha/yr
Net returns	Rs 2.00 lakh/ha/yr

Lavender (perennial; production from second year onwards):

Plant spacing	75 cm x 75 cm
Yield	40-50 kg/ha/yr
Essential oil price at farmer's field	10000-12000/kg
Gross returns	Rs 4.00 lakh/ha/yr
Cost of cultivation	Rs 1.50 lakh/ha/yr
Net returns	Rs 2.50 lakh/ha/yr

German chamomile (5 months):

Yield	10 kg/ha/yr
Essential oil price at farmer's field	42000-46000/kg
Gross returns	Rs 4.20 lakh/ha/yr
Cost of cultivation	Rs 1.50 lakh/ha/yr
Net returns	Rs 2.70 lakh/ha/yr

The perennial crops *viz.*, damask rose, lavender, rosemary, scented geranium are suitable for area uncultivated land and can be inter cropped in orchards but with sufficient sunlight. Annual crops *viz*., wild marigold (*Tagetes minuta*) can be grown in cultivated land as a sole crop from June to November or it can be inter cropped with maize. Likewise, chamomile can be grown as sole crop from November to May. Mushkbala (*Valeriana jatamansi*) can be grown as intercrop in orchards as it is shade loving crop. Saffron is to be grown as sole crop in specific niches with cold and dry climate *viz*., Bharmour, Salooni, Tissa and Pangi areas.

If the farmers want to earn maximum returns from aromatic crops and there is provision of processing unit, he can go for cultivation of aromatic crops on large scale. One processing unit of 5 q capacity require at least 5-10 ha area under aromatic crops with in that village or panchayat so that it can become economically viable. Since most of the farmers are small and marginal farmers in HP hence group of farmers can join and they can form one cluster and can cultivate particular crop in that cluster.

Detailed economics of floricultural crops

Crop	Area	Total Investment)Rs. in lakhs(	Gross Returns)Rs. in lakhs)	Net Returns (Rs. in lakhs)	Market value
Marigold	1 ha	5.09	7.50	2.40	Rs. 40/ kg
Calla lily	2000 m^2	2.52	6.40	3.88	Rs. 15-20/ stem
Gladiolus	4000 m^2	5.26	6.00	1.20	Rs. 4-5/ stem
Rose	500 m^2	2.68	4.51	1.83	Rs. 7-10/ stem
Carnation	500 m^2	3.13	5.23	2.10	Rs. 10-12/ stem
Gerbera	500 m^2	2.78	4.62	1.84	Rs. 3-5/ stem
Alstroemeria	500 m^2	3.01	5.74	2.73	Rs. 20-25/ stem
Lilium	500 m^2	2.08	3.50	1.42	Rs. 30-50/ stem
Tulip	500 m^2	5.25	10.20	4.95	Rs. 25-30/ stem

Figures are calculated on average per year basis after growing for 3 years

Generation of quality planting material of target plant species

Generation of quality planting material (QPM) of target plant species will be the top priority of the program. The proposed plants which are vegetatively propagated are damask rose (*Rosa damascena*), lavender (*Lavandula officinalis*), rose-scented geranium (*Pelargonium graveolens*), rosemary (*Rosmarinus officinalis*), Indian valerian (*Valeriana jatamansi*) and natural sweetener crops viz., monk fruit. Plant species which are raised from seeds/corms are hing (*Ferula assa-foetida*), saffron (*Crocus sativus*), wild marigold (*Tagetes minuta*), African marigold (*Tagetes erecta*), French marigold (*Tagetes patula*), chamomile (*Matricaria chamomilla*) and Mushkbala (*Valeriana jatamansi*). The proposed QPM production of commercially important plants, is presented in Table 1. Presently, CSIR-IHBT is undertaking production of QPM of saffron, *Hing* and bamboos under on-going collaborative projects with Department of Agriculture Himachal Pradesh.

Objectives:

- Setting-up of large scale nurseries for generation of QPM
- Technical support for cultivation of targeted crops
- Training to farmers on nursery management techniques

Plan of activity

Project Activity	**6**	**12**	**18**	**24**	**30**	**36**	**42**	**48**	**54**	**60**
Generation of quality planting martial of target plant species in farmers field										
Cultivation of economic plants in farmers field										
Processing of aromatic crops										
Integrating apiculture with floriculture and aromatic crops for income enhancement										
Capacity building of entrepreneurs and farmers										
Development of value-added products from flower waste										

Activity Focus:

Activities Focus	Benefits expected
Generation of target plant species	Support to farmers/entrepreneurs for raising of quality planting material of target crops

Cultivation of crops by seed *viz.*, saffron, wild marigold, chamomile etc. Proposed area to be covered: 145.4 ha	Income generation through sale of flower produce/essential oil
Value addition of targeted crops	Processing of aromatic crops Extraction of essential oil Soap making, incense making
Integrating apiculture with floriculture and aromatic crops for income generation Proposed beneficiaries:	Additional income generation
Imparting training to the farmers and entrepreneurs: 400 trainees	Entrepreneurship development
Development of value added products from unutilized flowers	Additional income generation Utilization of waste flowers from farmer's field Support to farmers

Business Plan:

Entrepreneurship among villagers will be developed. Farmers will raise the quality planting material of high value aromatic plants, saffron, floriculture crops under the supervision and guidance of CSIR-IHBT scientists. Quality planting material will also be purchased by the institute to cover the target under CSIR-Aroma mission at pre decided rates. Large number of planting material is required to meet the demand of aroma sector, floriculture industry and pharma industry. Farmers will also cultivate the high value crops and their value addition will also be done like extraction of essential oil and then soap making and incense making from waste. The source of revenue will be in form of sale of farm produce, sale of quality planting material to new growers, sale of processed and extracted material in local markets, sale of industrial product after value addition in wholesale/retail markets. New start-ups will be promoted to take up these activities for wider outreach.

The following action to be taken for strengthening the business model:

1. Linkage between farmers and markets will be established to eliminate the middleman
2. Publicity and awareness programmes will be organized on value addition of target plants.

Outputs:

- Total number of beneficiaries: 500
- Number of trainings & awareness programmes: 20

Action Plan for District Chamba (MAPs and Floriculture) Role and responsibility of CSIR-IHBT

- The planting material (seed/saplings) of the MAPs and floricultural crops will be

provided by CSIR-IHBT under CSIR-Mission project (Aroma Floriculture).

- Processing units for extraction of essential oil will be set up under CSIR-Aroma mission
- Technical guidance for extraction of essential oil will be provide by CSIR-IHBT
- CSIR-IHBT will provide marketing tie-ups or linkages for farmers.
- Minimum support price (MSP) will be set by buyer seller meet.
- Under MSME SFURTI cluster development project, CSIR-IHBT will be act as Technical agency for floriculture
- IEC material will be prepared in local language/Hindi

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department will provide name, address and location of farmers in respective blocks.
- On or off campus training will be sponsored by Department of Agriculture/ Horticulture and provided by CSIR-IHBT.
- Horticulture shall provide necessary assistance through Prakritik Kheti Khushshal Kissan Yojana (PKKKY) ,MEHAK & Himachal Pushp Kranti Yojana (HPKY)
- Sub divisional Soil Conservation Officers (SDSCO) will provide any irrigation facility like tank, MIS, Etc. Assistance of *Rural Development Department* for provision of such units can also be taken.
- Department of Horticulture will provide subsidy to farmers for erecting Polyhouses.
- Under MSME SFURTI cluster development project, Department of Horticulture itself act as Implementing agency or provide list of NGO's, cooperatives, FPO's or any other non-profit organization for Implementing agency.

Propagation of commercially important bamboo species through conventional and tissue culture techniques

Bamboo is a multipurpose plant used in the making of several products such as agarbatti, paper and pulp, etc. However, raw material is not easily available in India, and is dependent on other countries like China for their import. The import value of bamboo stands at 170 million dollars for the year 2019-20. To reduce the dependency on other countries for the supply of raw bamboo materials, India has initiated a National Bamboo Mission. One of the major goals is to increase bamboo plantation in the country, which in turn can provide raw materials to the local bamboo industry. CSIR-IHBT has been at the forefront of bamboo research in India and has continuously been supplying bamboo planting material to different private and government agencies throughout the country. In addition, CSIR-IHBT has been conducting trainings and workshops on 'propagation and nursery practices of bamboo'. With this vast experience at its disposal, CSIR-IHBT can promote the cultivation of bamboo in the Chamba district of Himachal Pradesh. This can help increase farmers' income through plantation and subsequent sale to the local bamboo industry and reduce the import of bamboo material and make India 'self-reliant'.

Objective

To promote the cultivation of commercially important bamboo species in Chamba district of Himachal Pradesh

Business plan

CSIR-IHBT will provide quality bamboo planting material to the local farmers and supervised its cultivation. Farmers can generate income through the sale of the produce. Value addition of bamboo will also be encouraged to benefit the farmers.

Target area

1. Waste and barren land
2. Slopy land

Details of action plan for bamboo

Crop(s)	**Altitude** (m amsl)	**Conditions**	**Targeted area (in ha)**	**Planting time**	**Planting material required (seed/rooted plants)**	**Beneficiary (Nos.)**
Bamboo (*D. hamiltonii*, *D. asper*, *B. nutans*, *B. tulda*, etc.)	Upto 2000	Open barren field	10	March-August	50000 rooted plants	100

Outputs:

- Total number of beneficiaries: 100
- Number of trainings & awareness programmes: 10

Action Plan for District Chamba

Role and responsibility of CSIR-IHBT

- The planting material will be provided by CSIR-IHBT under Nationaal Bamboo Mission
- Technical guidance for cultivation and utilization will be provide by CSIR-IHBT
- CSIR-IHBT will provide marketing tie-ups or linkages for farmers.
- IEC material will be prepared in local language/Hindi

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department will provide name, address and location of farmers in respective blocks.
- On or off campus training will be sponsored by Department of Agriculture/ Horticulture and provided by CSIR-IHBT.

Locations targeted:

Different Development blocks in district Chamba will be covered in consultation with State Department officials.

Agrotechnology of *Hing*

Ferula assa-foetida (*Hing*) is one of the top condiment and medicinal plant traded in India. Raw asafoetida (*Hing*) is extracted from the fleshy roots of *Ferula assa-foetida* as an oleo-gum resin. It is native to Iran, Afghanistan and Uzbekistan. There is no availability of *Ferula assa-foetida* plants in India. Thus, availability of characterized quality planting material and identification of suitable location for its cultivation is one of the major bottlenecks in cultivation of this crop. The agrotechnology of this crop is totally unknown. There are about 130 species of Ferula found in the world and a wild species, *F. jaeschkeana* Vatke is reported from Kashmir and Lahaul valley from India which is not economically important species. India imports about 1145 tonnes of asafoetida annually from Afghanistan, Iran and Uzbekistan and spends approximately 77 million USD per year on import of asafoetida. To meet our domestic demand, 25000 ha of land is required to be cultivated under this crop. With the goal to promote its wide spread cultivation, CSIR-IHBT introduced *Hing* seeds (six accessions) for the first time in the country from Iran through ICAR-NBPGR, New Delhi vide import permit Nos. 318/2018 & 409/2018. Presently, the Institute is growing these seeds at CeHAB, Ribling, Lahaul & Spiti, H.P. under the vigil of NBPGR. The plant prefers cold and dry conditions for its growth, therefore regions in Indian Himalayas with cold desert climatic conditions will be suitable for cultivation of *Hing*.

Objective

To promote the cultivation of *Hing* in Chamba district of Himachal Pradesh

Business plan

CSIR-IHBT will provide quality planting material to the local farmers and supervise its cultivation. Farmers can generate income through the sale of the produce. Value addition of *Hing* will also be encouraged to benefit the farmers. The key points of the plan are:

- Utilization of waste lands for *Hing* cultivation
- Employment for the farmers/growers through repeated cultivation year after year
- Indigenous production of *Hing* in the country
- Generation of income through sale of raw *Hing* produce for livelihood
- Value addition of *Hing* through product development

Target area

Waste, barren and slopy land where cold and dry conditions prevail are suitable for cultivation of *Hing*

Outputs:

- Total number of beneficiaries: 500
- Number of trainings & awareness programmes: 20

Action Plan for District Chamba

Role and responsibility of CSIR-IHBT

- The planting material will be provided by CSIR-IHBT under ongoing project on cultivation of *Hing* funded by Department of Agriculture, Himachal Pradesh
- Technical guidance for cultivation will be provided by CSIR-IHBT
- CSIR-IHBT will provide marketing tie-ups or linkages for farmers.
- IEC material will be prepared in local language/Hindi

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department will provide name, address and location of farmers in respective blocks.
- **On or off campus training will be sponsored by Department of Agriculture/ Horticulture and provided by CSIR-IHBT.**

Locations targeted:

Different Development blocks in district Chamba will be covered in consultation with State Department officials.

Agrotechnology of Saffron

Saffron is the costliest spice in world. Saffron is a low input demanding crop in terms of energy, water and nutrients. It can be grown in temperate region ranging from 1200-3000 m amsl. Sunny days during the flowering period is favourable for good yield. Saffron requires medium textured soil with good drainage capacity and pH should be near to 7. The annual demand of saffron in India is 100 tonnes while production is around four tonnes annually. Therefore, import of saffron is done to meet the high annual demand. Using data of climatic requirements of saffron cultivation and niche modelling approach, CSIR-IHBT is identifying new areas where saffron cultivation can be done under temperate conditions of Himalayan region. Trials have also been laid out in Bharmour area of Chamba district to assess suitability of doing saffron cultivation in the region with encouraging results in trials.

Objective

To promote the cultivation of saffron in Chamba district of Himachal Pradesh

Business plan

CSIR-IHBT will provide quality planting material to the local farmers and supervise its cultivation. Farmers can generate income through the sale of the produce. The key points of the plan are:

- Employment for the farmers/growers through cultivation
- Indigenous production of saffron in the country
- Generation of income through sale of saffron produce for livelihood

Target area

High altitude regions of Himalayas where cold conditions prevail are suitable for cultivation of saffron

Outputs:

- Total number of beneficiaries: 100
- Number of trainings & awareness programmes: 10

Action Plan of CSIR-IHBT for District Chamba Role and responsibility

of CSIR-IHBT

- The planting material will be provided by CSIR-IHBT under ongoing project on cultivation of saffron funded by Department of Agriculture, Himachal Pradesh
- Technical guidance for cultivation will be provided by CSIR-IHBT
- CSIR-IHBT will provide marketing tie-ups or linkages for farmers.
- IEC material will be prepared in local language/Hindi

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department will provide name, address and location of farmers in respective blocks.
- **On or off campus training will be sponsored by Department of Agriculture/ Horticulture and provided by CSIR-IHBT.**

Locations targeted:

Different Development blocks in district Chamba will be covered in consultation with State Department officials.

3. Integrated floriculture and apiculture for enhanced income

Integrating apiculture (improved bee hive) with floriculture and aromatic crops for enhancement of livelihood and additional income generation

Integration of apiculture with floriculture, medicinal, aromatic plants, horticultural/ agricultural crops/ wild plants consists of creation of clusters in the villages, distribution of beehives/colonies to farmers in order to produce honey for additional income and enhancement of livelihood. Importance will be given for value addition of honey and by products of bee keeping. Branding of honey will be given importance to harvest honey from different nectar yielding plants (e.g. Thyme honey). Thrust also given for production of organic honey without using pesticides to get higher market price. The improved bee hive developed by CSIR-IHBT and CSIR-CSIO will be distributed and deployed in the field for quality and hygienic extraction of honey without disturbing honey bees and to get higher market price. In addition, training and demonstrations will be given to farmers for scientific bee keeping and its management, harvesting/extraction of honey.

Objectives

- Promoting improved bee hive for quality and hygienic harvesting of honey.
- To increase the pollination, high yield and providing additional income/employment opportunities for the livelihood of farmers.

Business plan

- Employment for the farmers/growers on year-round through bee keeping.
- Production of honey in year-round (all the seasons) by migration of bee hives during off season (winter).
- Generation of income through sale of honey for livelihood.
- Value addition of honey and its byproducts.

Action plan for apiculture

Crop(s)	Distribution of bee hives	Beneficiaries
Medicinal and aromatic plants and floriculture crops	150	100 farmers

Role and responsibility of CSIR-IHBT

- The bee-hives will be provided by CSIR-IHBT under CSIR-Mission projects
- Technical guidance for extraction of honey will be provide by CSIR-IHBT
- CSIR-IHBT will provide marketing tie-ups or linkages for farmers.
- IEC material will be prepared in local language/Hindi

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Sub divisional Soil Conservation Officers (SDSCO) will provide any irrigation facility like tank, MIS, Etc. Assistance of *Rural Development Department* for provision of such units can also be taken.
- Horticulture will converge under *Mukhayamantari Moun Vikas Yojana (MMVY)*

Some other important points:

- Distribution of improved bee hives will be done in a phased manner.
- Contribution from selected beneficiaries will not be required at the initiation stage.

4. Precision agriculture with Hydroponics/Aeroponics technology

Hydroponics and Aeroponics Technology

Objectives:

- Setting-up of commercial hydroponic and aeroponic facility at Chamba
- Technical support for cultivation of targeted crops
- Training to entrepreneurs on hydroponic and aeroponic techniques

Plan of activity

Project Activity	**6**	**12**	**18**	**24**	**30**	**36**	**42**	**48**	**54**	**60**
Setting-up of commercial hydroponic and aeroponic facility at Chamba										
Technical support for cultivation of targeted crops										
Training to entrepreneurs on hydroponic and aeroponic techniques										

Locations targeted:

Development blocks of district Chamba: Chamba, Mehla, Bharmour, Tissa, Salooni, Chowari and Pangi will be covered in consultation with State Department officials.

Business plan and linkages plan

Entrepreneurship among villagers will be developed. Farmers will raise the quality planting material of high value plants, medicinal plants, exotic vegetables and flowers under the supervision and guidance of CSIR-IHBT scientists. Quality planting material will also be purchased by the institute to cover the target under CSIR-Floriculture Mission at pre decided rates. The source of revenue will be in form of sale of produce, sale of quality planting material to new growers, sale of processed and extracted material in local markets, sale of industrial product after value addition in wholesale/retail markets. New start-ups will be promoted to take up these activities for wider outreach.

The following action to be taken for strengthening the business model:

1. Linkage between farmers and markets will be established to eliminate the middleman
2. Publicity and awareness programmes will be organized on value addition of target plants.

Action plan by CSIR-IHBT (role of CSIR-IHBT)

- Facility design, sensor network, and establishment of hydroponic and aeroponic facility at different locations
- Training and technical know-how transfer
- IEC material will be prepared in local language/Hindi

Role of Chamba district authorities

- Department will provide name, address and location of farmers in respective blocks
- On or off campus training will be sponsored by Department of Agriculture/Horticulture and provided by CSIR-IHBT.
- Sub divisional Soil Conservation Officers (SDSCO) will provide any irrigation facility like tank, MIS, Etc. Assistance of *Rural Development Department* for provision of such units can also be taken.
- Department of Horticulture will provide subsidy to farmers for establishing hydroponic/aeroponic system through various scheme of National Horticulture Board.

Details of economics for hydroponics and aeroponics:

Approximate budget requirement to set up facility for respective technologies (Rs. 177 In Lakhs)

Detailed economics of lilium and tulip in 100 sqm polycarbonate hydroponic greenhouse

Capital cost (Rs.)	Gross returns (Rs)	Net returns (Rs)	ROI	Market value (Rs.)
25,00,000	780000	493659.8	18.63	Lilium: 40/ stick Tulip: Rs. 30/ stick

Figures are calculated based on average of three years

Detailed economics of vegetables in 100 sqm polycarbonate hydroponic greenhouse

Crop	Capital cost (Rs.)	Gross returns (Rs)	Net returns (Rs)	Market value (Rs.)
Lettuce	25,00,000	7,20,000	4,33,660	60/ Kg
Tomato	25,00,000	9,00,000	6,13,660	18/ Kg
Capsicum	25,00,000	12,20,000	9,13,660	30/ Kg

Figures are calculated based on average of three years

Detailed economics of spice and medicinal crops in 100 sqm polycarbonate hydroponic greenhouse

Crop	Capital cost (Rs.)	Gross returns (Rs)	Net returns (Rs)	Market value (Rs.)
Spice crops (Oregano, Basil, Parsley)	25,00,000	6,00,000	3,13,660	300/ Kg
Medicinal (Picrorhiza, Valeriana)	25,00,000	6,00,000	3,13,660	1000/ Kg

Figures are calculated based on average of three years

5. Food processing technologies for agri-horti crops and produce

The proposed technologies offer following solutions *viz.*, (i) to prevent glutting of crops (ii) enhanced value addition and economic returns to farmers (iii) novel products meeting global standards. The products developed at CSIR-IHBT as per the Food Safety Standards guidelines issued by FSSAI, GoI, 2016. The products have been tested for their bio-efficacy in preclinical and laboratory trials.

A. Cereal grains processing and value addition technologies

Target crops: Rice, Wheat, Maize, Millets, Pulses, Oil seeds

Following technologies can be deployed for processing of excess cereals/grains and development of novel products.

Potential products – Multigrain protein beverage mix

Target crops – Red Rice/Wheat/Small millets (finger & foxtail)/Oil seeds

100% natural beverage mix made of cereals, pulses, millets and nuts.

Product Highlights/Features

- High energy >200kcal per serving
- 6-7 g proteins per serving
- 4 g dietary fibre per serving
- 100% Natural high energy drink
- Non-hygroscopic – ease of storage
- No malt extract or any processed sugar like fructose syrup, corn syrup
- Ready to mix and drink similar to any malt drink – No cooking required

Target customer/consumer groups

1. Anganwadi/mid-day meal schemes
2. Government hospitals
3. Open market through government co-operative societies

Value addition from machinery

1. Supply of processed/dehulled grains for open market/retailers/whole sellers

2. Supply of cereal/pulses grain flours to open market/retailers/whole sellers

3. Third party production for big private firms

Land requirement

Open area – 1000 sq. meter Building

area – 750 sq. meter **Facility**

erection time – 45 days

Approximate cost of machinery – 45.00 Lakhs

B. Fruit processing technologies

Target crops: Guava, Mango, Papaya, Apple

Following technologies can be deployed for processing excess fruit crops

Potential products – Fruit Bar/burfis, fruit pulp concentrates and juices

The technology utilizes fruit pulp and converts it to delicious bar or burfi. Since the fruits are perishable and have short seasonal availability the present technology helps in producing products that can generate better revenues.

Salient Features of the Technology

- Products provides 25-30% RDA of bioavailable iron per 30g serving
- Utilizes natural bio-resources such as crop residues and spice mixes
- Free from additives and preservatives
- Shelf life of the products is upto 6months.

Target customer/consumer groups

1. Anganwadi/mid-day meal schemes
2. Government hospitals
3. Open market through government co-operative societies

Value addition from machinery

1. Supply of purees and concentrates to industries
2.Mixed fruit pulps and concentrates

Land requirement

Open area – 1000 sq. meter
Building area – 750 sq. meter

Facility erection time – 45 days (latest by 60 days)
Approximate cost of machinery – 40.00 Lakhs

C. Crispy fruits and freeze drying of sensitive fruits

Target crops: Any perishable fruit

Major fruit crops: Mango, Apple, Guava, Papaya, Sapota, Apricot, Litchi, Pomegranate, Plum

Potential products – Whole dehydrated fruits, dehydrated fruit powders

Target customer/consumer groups

1. Hotel and service industry
2. Food processing industries
3. Open market and online food aggregators

Land requirement

Open area – 750 sq. meter
Building area – 500 sq. meter
Facility erection time – 45-60 days
Approximate cost of machinery – 150 Lakhs

D. <u>Simultaneous Fruits and Vegetable processing centre – Dehydration plant</u>

Target Fruit crops: Orange,Apple, Peach, Banana, and Pomegranate

Target vegetable crops: Peas, Cabbage, Cauliflower, Tomato, Beans, Okra

Dehydration of vegetables

Potential products – Dehydrated vegetables/fruits such as cubes, rings, powders

Target customer/consumer industries

1. Instant food industries **-** Soups, beverage/smoothie mixes, ready to cook food manufacturers
2. Pharma and nutraceutical industries

Land requirement

Open area – 750 sq. meter
Building area – 500 sq. Meter
Facility erection time – 45 days
Approximate cost of machinery – 25.00 Lakhs

E. <u>Retort/canning of fruits and vegetables</u>

Target Fruit crops: Pears, Cherries, Mangoes, Apricots

Target vegetable crops: Peas, Cabbage, Cauliflower, Tomato, Beans, Mixed vegetables, Carrots, Beets

Potential products – Canned vegetables, Brined vegetables, Syrup cut fruits

Target customer/consumer industries

1. Ready to eat foods industries
2. Hotel industries
3. Export market
4. Online food/FMCG aggregators

Land requirement

Open area – 750 sq. meter
Building area – 500 sq. meter;

Facility erection time – 45-60 days
Approximate cost of machinery – 65.00 Lakhs

F. Value added Buckwheat products

Target crops: Buckwheat

Potential products – Flour, Noodles and snacks

Target customer/consumer industries

1. Ready to eat foods industries
2. Gluten free food segment
3. Export market
4. Online food/FMCG aggregators

Land requirement

Open area – 550 sq. meter
Building area – 600 sq. meter;
Facility erection time – 45-60 days
Approximate cost of machinery – 55.00 Lakhs

Common utilities required for all products

1. Diesel generator – 120 HP input
2. Fork lift – 500 kg
3. Crate packing machine
4. Carton stripping machine
5. Infra-red scanner
6. Air curtains
7. Automatic floor scrubber and cleaner machine
8. Personal hygiene unit
9. Strip curtains
10. UV exposure cabinets
11. SS trolleys/SS drum trolleys
12. Milk freezers
13. Dehumidifiers
14. Air Handling Units – AHU for core processing areas
15. Almonard fans

16. Sorting tables

Mandatory licenses required

1. FSSAI

2. FPO – Fruit Product/Process Order certification

3. APEDA NPOP organic certification (if organic crops are processed)

Additional certifications

1. HACCP – Food Safety Standards Certification – FSSC 22000 (ISO 22000)

2. GMP – Good Manufacturing Practice

Plan of activity

Project Activity	**6**	**12**	**18**	**24**	**30**	**36**	**42**	**48**	**54**	**60**
Identification of suitable technologies and training of the SHGs/FPOs/Co-op societies/Entrepreneurs										
Deployment of selected processing technologies										
Food processing plant erection and machinery commissioning										
Capacity building of entrepreneurs and farmers										
Validation and market launch										

Locations targeted:

Development blocks of district Chamba: Chamba, Mehla, Bharmour, Tissa, Salooni, Chowari and Pangi will be covered in consultation with State Department officials.

Business Plan:

Entrepreneurship among villagers will be developed. FPOs/SHGs/NGOs/Co-operative societies will identify potential food crops and technologies suitable for the selected region. CSIR-IHBT will train the interested groups in basics of food processing and hygiene and also aboput the deployment of technologies. The source of revenue will be in form of sale of food

products, raw materials generated from the identified agri-horti produces of the region. Assistance in identifying local markets (B2C), sale of industrial product after value addition in wholesale/retail markets (B2B) will be provided by CSIR-IHBT for enahcned livelihood and income generation. New start-ups will be promoted to take up these activities for wider outreach.

The following action to be taken for strengthening the business model:

1. Linkage between FPOs/SHGs/NGOs/Startups/MSEs and markets will be established for new product launch
2. Publicity and awareness programmes will be organized on value addition of target agri-horti produce.

Outputs:

- Technology deployment (Nos) : 6-8 nos.
- Number of trainings & awareness programmes: 3 nos. per year

Action Plan of CSIR-IHBT for District Chamba (Food processing)

Role and responsibility of CSIR-IHBT

1. Assistance in obtaining and finalizing technical specifications for machinery
2. Quality validation of machinery
3. Trials and process standardization
4. Nutritional analysis and shelf life analysis of the products
5. Preparation of process reports/ technical reports
6. Training man power

Role and responsibility of Department of Agriculture/Horticulture/MSME/DC office (District Chamba)

- Department will provide name, address and location of farmers produce organizations (FPOs) /interested entrepreneurs/ co-operative societies/Self-help Groups (SHGs) an in respective blocks.
- On or off campus training will be sponsored by Department of Agriculture/Horticulture and provided by CSIR-IHBT.
- Under MSME SFURTI cluster development project, Department of Horticulture itself act as Implementing agency or provide list of NGO's, cooperatives, FPO's or any other non-profit organization for Implementing agency.
- General Manager District Industries Centre (GM DIC) will identify industrial plots for establishment of processing plant.

Funding opportunities for establishing food processing facilities

1. MSME SFURTI clusters for processing and value addition of vegetables and fruits with CSIR-IHBT as technical agency
2. PM Formalisation of Micro Food Processing Enterprises Scheme supporting MSMEs and ODOP – One District One Product scheme with CSIR-IHBT as technical agency
3. MukhyaMantri Swavlamban Yojana (MMSY) & Prime Minister Employment Generation Programme (PMEGP) will also be used for financial assistance.

Some other important points:

Market linkages and licensing formalities:

- CSIR-IHBT will provide support with respect to preparation of legal documents w.r.to packaging, brochure preparation, marketing documents, technical documents such as certificate of analysis, quality control manual, nutritional and analytical reports as required.
- CSIR-IHBT will prominently display the products manufactured by the state department in exhibitions, trade fairs and other marketing avenues and host the product details in CSIR websites.
- CSIR-IHBT will assist the Food Business Operator (FBO) such as co-operative societies, FPOs and SHGs that adopt CSIR-IHBT technologies in obtaining FSSAI license with respect to technical component only. However, licensing and legal documentation is the responsibility of the proposed FBO as identified by state departments.
- CSIR-IHBT will not obtain licenses in its name on behalf of state departments for any manufacturing/ marketing activity.

Related to CSIR-IHBT technologies:

- CSIR-IHBT has developed various value added products specific to different food crops and geographies.
- The proposed products pertaining Chamba district is specific and demands identification of suitable processing lines and associated technologies.
- CSIR-IHBT through its know how will identify necessary processing technologies and products that are marketable.
- CSIR-IHBT will assist state department in identifying suitable machinery/equipment from available indigenous resources.
- CSIR-IHBT will demonstrate already developed products with respect to crops available at Chamba.
- CSIR-IHBT will provide technical assistance in new product development as mutually agreed by departments and also provide detailed process manuals for deployment.
- CSIR-IHBT will provide analytical services to the product developed as requested by state department.

6. Vitamin D_2 enriched *Shiitake* mushroom production and processing

The salient features and applications of the *shiitake* mushroom production and processing technology are as following:

- *Shiitake* and its value added products may cater to the population affected with vitamin D deficiency. For vegetarians, mushrooms are the only food source of Vitamin D.
- Fresh and dried shiitake mushroom is popular for its meaty texture and smoky flavour.
- Shorter production time of 2 months (typically takes 8-12 months).
- Capsule of 350 mg shiitake powder meets 100% RDA of Vitamin D.
- Vitamin D_2 enriched shiitake powder may be used to prepare a range of value added products like *Shiitake* pickles, *shiitake* soups, Shiitake drinks, Shiitake chocolates, etc.

Vitamin D deficiency is prevalent in >70% of Indian population. Beyond bone health, the deficiency is associated with cancer, autoimmune diseases, infections, type 2 diabetes, hypertension, cardiovascular disease, etc. For vegetarians, mushrooms are the only food source of Vitamin D. Mostly in the Himalayan States *Shiitake* is produced in natural conditions as the climate is suitable for its cultivation. However, in natural conditions *shiitake* mushroom cultivation is done in wooden logs and it takes 8-12 months for fruiting, it requires large area and it has poor yield due to excess contamination. To cope up with the challenges faced by natural production of Shiitake mushroom, CSIR-IHBT has developed the technology of production of Vitamin D_2 enriched *Shiitake* mushroom in captive conditions by utilizing the sawdust substrate available as waste from timber industry. Shiitake mushroom can be produced in record 2 months' duration hence harvesting can be done throughout the year. The yield of fresh mushroom is 0.5-0.6 kg per 1 kg dry weight of sawdust substrate. *Shiitake* mushroom are rich in vitamin D precursor ergosterol, and with optimized photo conversion experiments Vitamin D_2 concentration can be considerably enhanced. Shiitake mushroom are popular edible mushroom rich in vitamin D precursor ergosterol.

The raw material to produce *shiitake* mushroom under captive cultivation is cheap hard wood broad leaf saw dust substrate available locally in different timber houses. For additional supply of raw materials paper mills, large timber houses can be contacted for supply of sawdust substrates from nearby region. Other requirements for spawn and *shiitake* production such as wheat grains, wheat bran, etc. can be locally procured from local traders.

Business Plan:

Conventional mushroom growers will be targeted for capacity building programme of advanced technology of captive production of *Shiitake* mushroom production, its enrichment with Vitamin D and processing. Implementing the cluster is earmarked as three years. Awareness camp and other trainings will be planned for the mushroom growers for processing and marketing skills. Forward and backward linkages will be established for organized cluster and better market reach.

Expected Outputs:

- Targeted number of beneficiaries: 250
- Number of trainings & awareness programmes: 20

Projected Products

Following product mix are targeted:

a) *Shiitake* mushroom Commercial spawn
b) Fresh *shiitake* mushroom
c) Dried *shiitake* mushroom
d) Vitamin D_2enriched *shiitake* powder
e) Value added *shiitake* products (pickles, soup, chocolates etc.)

Utility and other overheads

Shiitake mushroom production can be carried out in any location of the district. Farmers have to collect the specific type of saw dust from nearby available timber mills. After the production further processing and packaging will be carried out at specific location or a common facility center.

Requirements:

Area of 1500 sq. feet would be needed to cover a fruiting room (300 sq. feet), incubation room (300 sq. feet), culture room (300 sq. feet), storage room and open veranda (for installation of autoclave). Five such facilities would be required to cover 250 beneficiaries.

The Working Capital is required for purchase of equipment (The total estimate for required equipment is Rs 25,00,000/-) and for salary to the manpower involving in spawn production/ mushroom production/ mushroom Processing and Packaging.

Financial Projections:

Production in Tones

Total Production (in tons)			Total Sales		
I year	**II Year**	**III Year**	**I Year**	**II Year**	**III Year**
30	**37.5**	**37.5**	**30**	**37.5**	**37.5**

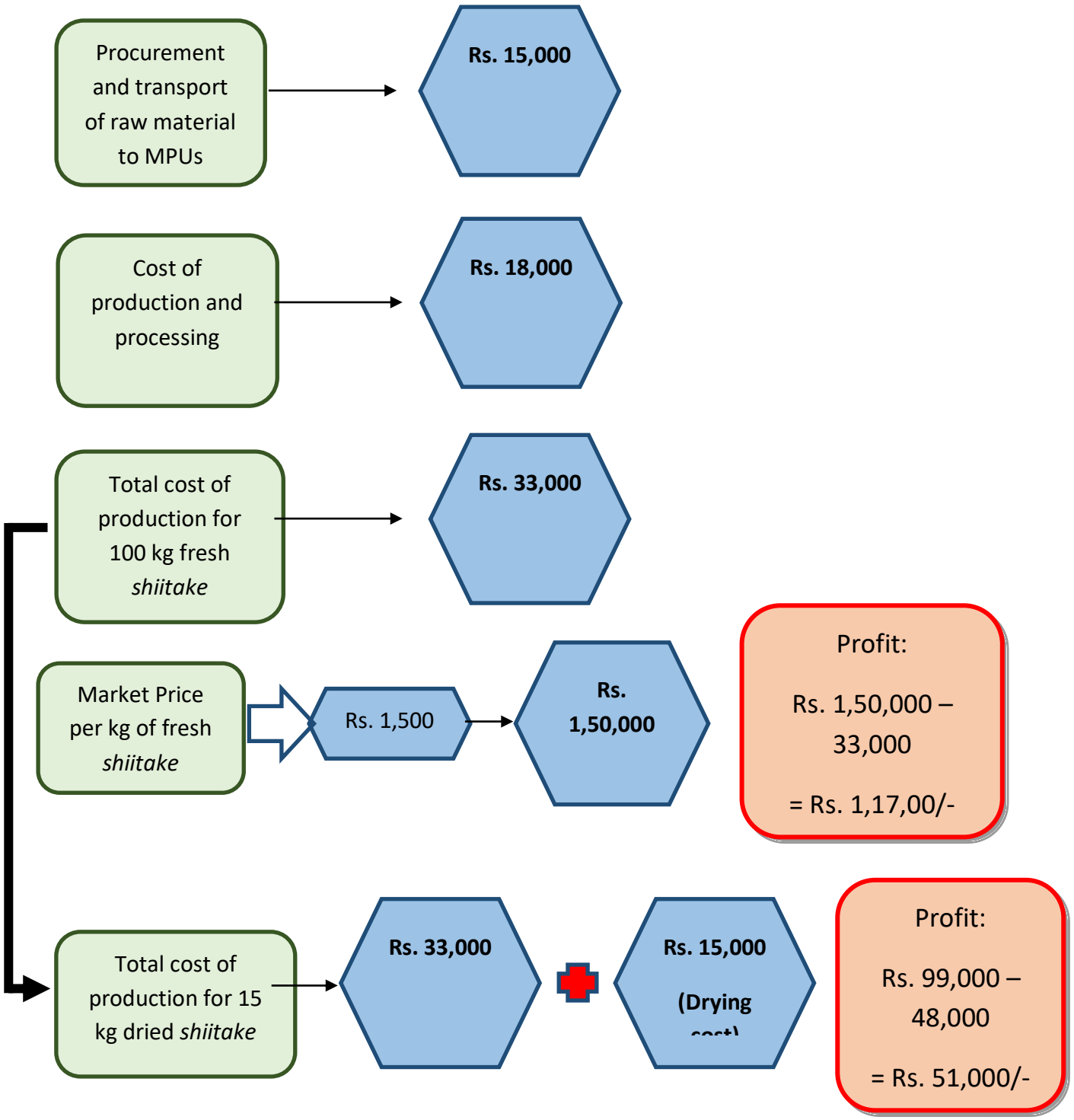
Sales Income Estimate Rs. in Lakhs

Total Production			Total Sales		
I year	**II Year**	**III Year**	**I Year**	**II Year**	**III Year**
450	**562.50**	**562.50**	**450.00**	**562.50**	**562.50**

Profitability Estimate Rs. in Lakhs

Year	Production in Tones	Cost	Sales	Sales before Cluster Activity	Profit
I Year	**30**	**Rs. 1,500**	**450.00**	**99.00**	**351.00**
II Year	**37.5**	**Rs. 1,500**	**562.50**	**123.75**	**438.75**
III Year	**37.5**	**Rs. 1,500**	**562.50**	**123.75**	**438.75**

Value chain analysis for 100 kg fresh and dried *shiitake* production



Plan of activities:

Sl. No.	Particulars	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12
1	Construction of mushroom Shed												
2	Procurment of equipments												
3	Spawn production training in Common Facility Center												
4	Mushroom production training												
5	Training on Processing and Packaging Making												
6	Conducting Marketing Management, Group Formation, Package, License, ISO and etc.												
7	Participating in Exhibition & Seminars												
8	Exit Plan												

Action Plan between CSIR-IHBT and District Chamba:

Role and responsibility of CSIR-IHBT

- Technical inputs on captive production of *Shiitake* mushroom, its enrichment and processing at desired facility.
- IEC material will be prepared in local language/Hindi
- Help in forward market linkages for the developed products
- As a impanelled Technical Agency under MoMSME SFURTI programme, CSIR-IHBT can help in development of rural organised cluster in collaboration with a non-profit making organization. A common facility centre can be developed with all the desired facilities.
    - In this regard, action has already been taken for the identification of an NGO- "Collective Efforts for Voluntary Action (CEVA)" having its registered Office at Village Phindru, Post Office Sach, Tehsil Pangi, Distt. Chamba (H.P). All the desired documents for the development of cluster have been submitted to state KVIC office and physical verification by the officials of KVIC has been completed. (Dr Rakshak Kumar, concerned scientist has communicated the district authority in this regard)

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department may help in identifying the non-profit making organizations for development of desired clusters
- Horticulture Department will provide assistance under Rashtriya Krishi Vikas Yojana (RKVY)
- On or off campus training may be sponsored by concerned departments and technical inputs will be given by CSIR-IHBT

Locations targeted:

Development blocks of district Chamba: Chamba, Mehla, Bharmour, Tissa, Salooni, Chowari and Pangi will be covered in consultation with State Department officials.

Proposed SFURTI enriched composting/ vermicomposting cluster is covering gram-panchayats: Udaipur, Paliyur, Rinda, Kiani, Kolka

Some other important points:

Details of working capital are as under:

Component 1:
Technology transfer fee of vitamin D_2 enriched *shiitake* mushroom (plus 18% GST): Rs 5.90 lakhs.

Component 2:
Machineries and equipment required for set-up of *shiitake* mushroom facility:

S. No.	Name of the equipment & Machineries	Nos.	Cost (Rs. In lakhs)
1	Boiling Pan	2	0.39
2	Gas stove and mesh	1	0.11
3	Horizontal Rectangular Autoclave double door	1	10.00
4	Laminar Air Flow (horizontal)	2	1.4
5	Refrigerator for culture storage	2	1
6	BOD incubator	1	1.60
7	Racks	20	1.20
8	High wall Split AC	06	3.00
9	Humidifier	02	0.40
	Total		19.1

Grand Total for the working capital (Component 1 + Component 2) = Rs. 25 lakhs

7. Compost production suitable for cold regions

Composting is the most prevalent and inexpensive means of treatment of organic waste practised worldwide. Composting is conversion of organic matter into humus-like substance called compost by the biochemical action of heterotrophic microorganisms like bacteria and fungi. The process of composting is dependent upon multiple parameters viz. temperature, moisture, microbial population. In the cold hilly regions, due to low ambient temperature, low availability of moisture and low innate microbial population, the process of composting is slower as compared to other regions of the country; Composting, as a biological process, is driven by the microorganisms that release enzymes to breakdown the organic biomass and convert it into nutrient for plants. In the cold climate of the region, such microorganisms become metabolically inactive; hence they are not able to bring about the proper breakdown of the biomass. Consequently, the compost obtained at the end is of inferior quality and sometimes not suitable for agricultural application. Given the amount of generation of solid organic waste in the region and lack of the state of the art technology, the concern of organic waste pollution is a serious one. Keeping this in view, CSIR-IHBT developed consortium of psychrotrophic bacteria possess plant growth promoting attributes and efficient hydrolytic enzyme production that help in the breakdown of biomass at even colder temperatures and thus accelerate the process of composting. This intervention not only reduces the time of the process but also improves the quality of the end product as more nutrients are broken down by the action of psychrotrophic bacteria. The thermophilic phase is longer than under normal conditions and the maximum temperature attained is also higher. Thus, a better quality of compost enriched with plant growth promoting attributes is obtained. During a field trial of composting of forest and agricultural residues, we observed that our consortia performed better against the control and compost with higher values of available nitrogen, phosphorus and potassium was obtained. Also, the enriched compost had a lower C/N ratio compared to the control, which is another parameter of compost maturity. The success in the microbial intervention using psychrotrophic bacteria for rapid degradation of organic waste is encouraging and it has led us bring out this unique product called “Compost Booster”. The product can be applied to range of waste substrates such as kitchen waste, human/animal waste and agro-residues. The product contains cold tolerant efficient hydrolytic bacteria for accelerated degradation. It is also supplemented with biofertilizers and the product has effective carrier material that completely minimizes the foul odor during composting process.

The salient features of the product are:

i. Ready to use formulation
ii. Contains cold tolerant hydrolytic bacteria
iii. Supplemented with biofertilizer
iv. Bacteria encapsulated with effective carrier material
v. Enhanced nitrogen fixing, phosphate solubilization and potash mobilization properties
vi. Effective carrier material: reduced foul odour during composting process

Business Plan:

The traditional practice of production of the vermicompost results in low compost productivity. There is no quality check, which is affecting the selling price. There is a need to make them aware of use of advanced technologies in digging, bed making, sieving, grading, packing etc. Conducting training programs on proportionate mix, water usage is very much essential. Establishment of a common facilities centre where efficient compost/vermicompost with value addition of compost will be created. Awareness camps and trainings will be conducted on the processing of vermicompost/compost, obtaining vermin wash and advantages of organic farming. The establishment of forward and backward linkages will be organized for farmers and better market reach.

Expected Outputs:

- Targeted number of beneficiaries: 200
- Number of trainings & awareness programmes: 20

Projected Products

Following products can be targeted:

i) Bidegrader: Bacterial formulation for efficient decomposition in cold region
ii) Compost Booster: Accelerates the composting process
iii) Enriched Compost/ Vermicompost
iv) Vermiwash

Financial Projections: Production in Tons

Vermicompost, Enrich Compost and Vermiwash

Total Production (in tons)				Total Sales(in tons)		
Product	**I year**	**II Year**	**III Year**	**I Year**	**II Year**	**III Year**
Vermicompost	1500	1550	1650	1200	1300	1450
Enrich compost	150	180	200	120	150	150
Vermiwash	1500	2000	2500	700	900	1000

Financial Projections: Sales Income Estimate Rs. in Lakhs

Total Production(in tons)				Total Sales (in Lakhs)		
Product	**I year**	**II Year**	**III Year**	**I Year**	**II Year**	**III Year**
Vermicompost	1200	1300	1450	96.00	104.00	116.00
Enrich compost	150	150	150	24.00	30.00	30.00
Vermiwash	1000	1200	1500	1.00	1.20	1.50
				121.00	**135.20**	**147.50**

Financial Projections: Profittability Estimate Rs. in Lakhs

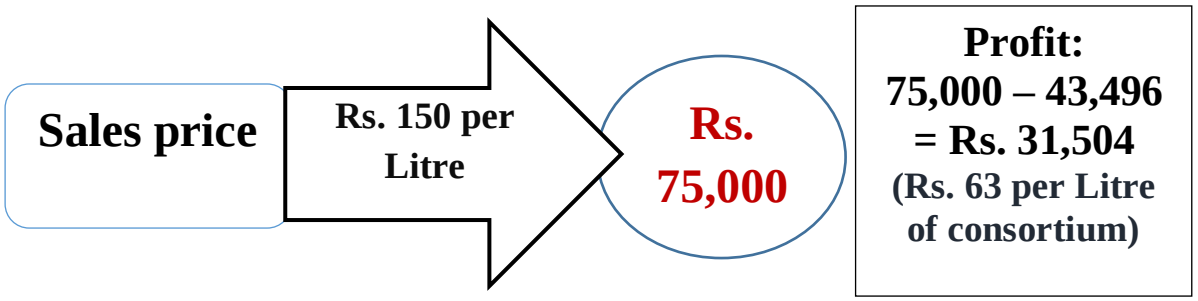
The artisans are concentrated only on vermicomposting before the cluster activities whatever the vermicompost produced in small quantity used in their own field and have no little knowledges regarding enrich composting.

Year	Production (in Tones)	Cost (in Rs.) (Per Kg vermicompost)	Sales (in Lakhs)	Sales before Cluster Activity (in Lakhs)	Profit (in Lakhs)
I Year	1200	8	96.00	36.00	60.00
II Year	1300	8	104.00	39.00	65.00
III Year	1450	8	116.00	43.50	72.50

Value Chain Analysis

Value chain analysis for 500 litre Bacterial Consortium (For CFC)

Activity	**Cost (in Rs.)**
Cost of Nutrient Medium	30,446
Electricity cost of running the bioreactor per batch	12,960
Electricity cost of distillation unit (2.5 KWH @Rs 6 for 6 hrs)	90
Total cost	**43,496**



Value chain analysis for one time rearing of earthworm

Cost of biomass – Rs 200/-

Cost of 1kg cocoon + earthworm mixture – Rs 300/-

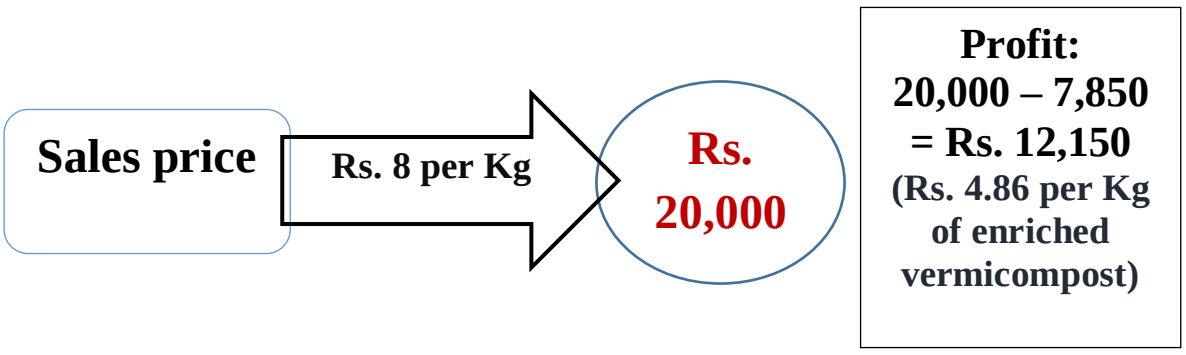
1 kg mix of cocoon + earthworm yields 12 kg of earthworms.

Value of 12 kg earthworms @Rs 300/kg – Rs 3600/-

Profit per kg earthworm + cocoon mix sold – Rs 281/-

Value chain analysis for production of 2500 kg enriched vermicomposting:

Activity	Cost (in Rs.)
Bedding material collection cost	2,000
Bed preparation cost	2,000
Cost of 5 litre Bacterial Consortium	435
Cost of 120 litre Enrichment Solution	165
Gunny Bag	1,000
Packaging bags	750
Packaging and labeling	500
Head load	1,000
Total	**7,850**



Plan of activities:

Sl. No.	Particulars	Q 1	Q 2	Q 3	Q 4	Q 5	Q 6	Q 7	Q 8	Q 9	Q 10	Q 11	Q 12
1	Construction of composting Shed												
2	Procurement of equipments												
3	Bacterial formulation preparation and maintenance at the common facility center												
4	Vermiculture preparation and maintenance at common facility center												
5	Training on process of preparation of enriched composting/ vermicomposting												
6	Conducting Marketing Management, Group Formation, Package, License, ISO and etc.												
7	Participating in Exhibition & Seminars												
8	Exit Plan												

Action Plan between CSIR-IHBT and District Chamba:

Role and responsibility of CSIR-IHBT

- Technical inputs on bacterial formulation and enriched compost/vermicompost, and vermiwash preparation, its enrichment and processing at desired facility.
- Help in forward market linkages for the developed products
- IEC material will be prepared in local language/Hindi
- As a impanelled Technical Agency under MoMSME SFURTI programme, CSIR-IHBT can help in development of rural organised cluster in collaboration with a non-profit making organization. A common facility centre can be developed with all the desired facilities.
    - In this regard, action has already been taken for the identification of an NGO- "Collective Efforts for Voluntary Action (CEVA)" having its registered

Office at Village Phindru, Post Office Sach, Tehsil Pangi, Distt. Chamba (H.P). All the desired documents for the development of Enriched Composting/ Vermicomposting cluster have been approved by the designated nodal agency and it awaits Scheme Steering Commitree meeting of MoMSME for the final approval. (Dr Rakshak Kumar, concerned scientist has communicated the district authority in this regard)

Role and responsibility of Department of Agriculture/Horticulture (District Chamba)

- Department may help in identifying the non-profit making organizations for development of desired clusters
- On or off campus training may be sponsored by concerned departments and technical inputs will be given by CSIR-IHBT

Locations targeted:

Development blocks of district Chamba: Chamba, Mehla, Bharmour, Tissa, Salooni, Chowari and Pangi will be covered in consultation with State Department officials.

Proposed SFURTI enriched composting/ vermicomposting cluster is covering gram-panchayats: Saho, Palyur,Jadera, Udaipur, Saru, Baror, Sungal

8. Waste to Wealth

Herbal incense cones from temple waste flowers

Salient feature/advantages

- Natural formulation
- Phthalate free
- Charcoal free
- No artificial aroma added
- Variety of incense cones-Dhoop, Loban, Rose, Sandalwood, Guggal etc.
- Incense cones showed inhibition against aerial microorganisms in lab and washroom areas.

Target customer/consumer groups

1. Temples
2. Household
3. Religious ceremonies

Equipment required	**Machinery availability**
Dhoop cone machine	Immediate
Incense stick machine	Immediate
Mechanical drier	Immediate
Pulveriser	Immediate
Mixer	Immediate

Role of CSIR-IHBT

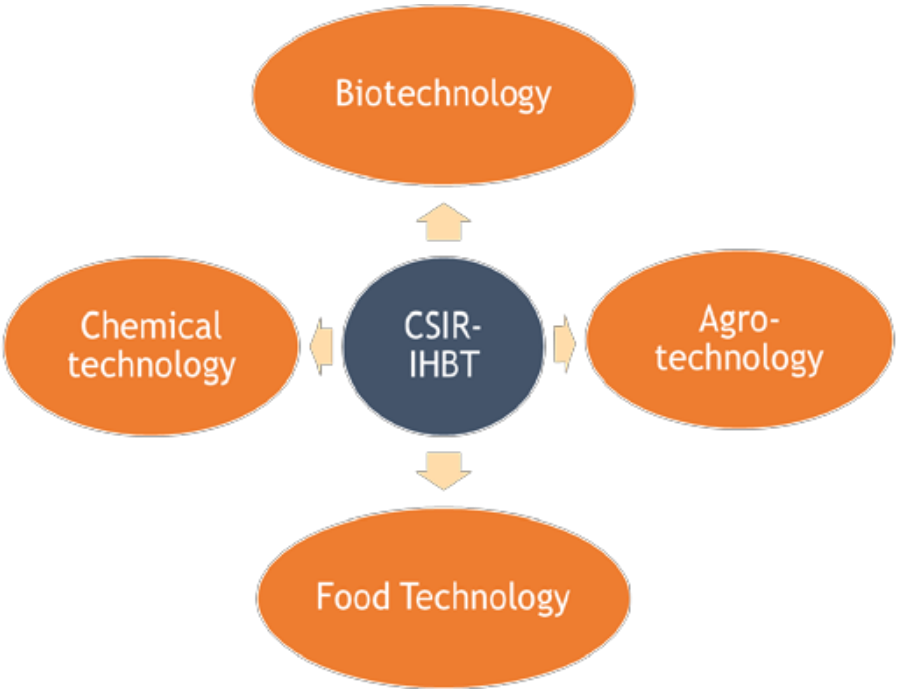
- Assistance in obtaining and finalizing technical specifications for machinery
- Quality validation of machinery
- Trials and process standardization
- Quality analysis of the products
- Preparation of process reports/ technical reports
- Training man power
- IEC material will be prepared in local language/Hindi

Locations targeted:

Development blocks of district Chamba: Chamba, Mehla, Bharmour, Tissa, Salooni, Chowari and Pangi will be covered in consultation with State Department officials.

9. Technologies developed at CSIR-Institute of Bioresource Technology

CSIR-IHBT has developed number of technologies in 4 major categories namely (i) Food Technology, (ii) Biotechnology, (iii) Agro-Technology and (iv) Chemical Technology. The technologies range from micronutrient enriched foods to combat malnutrition, value addition to agri- and horticulture crops, ready to eat foods, high value nutraceuticals, micro-propagation technologies, agro-technologies for medicinal and aromatic crops and chemical technologies to produce hygiene products and value added commodity chemicals.



List of technologies developed at CSIR-IHBT

S.No.	Title of technologies
	Food Technology
1.	*Shitake* mushroom: vitamin D_2 enriched
2.	Gluten-free foods from buckwheat
3.	Iron and zinc enriched spirulina based bars
4.	Iron enriched fruit bars and candies
5.	Multigrain high protein mix
6.	Protein & fibre enriched cereal bars
7.	Tea catechins
8.	Tea wine

9.	Ready to serve tea concentrates
10.	Ready to eat crispy fruits & vegetables
11.	Canning technology for ready to eat (RTE) foods
12.	Food products from bamboo
13.	Technology for dietary fibre extraction from apple pomace
14.	Roasted barley grain based beverages
15.	Low calorie herbal mukhwash
16.	Value added food products based on honey
17.	Value added food products and technologies based on sohiong (*Prunusnepalensis*)
18.	Value added food products and technologies based on seabuckthorn (*Hippophaerhamnoides*)
19.	Protein and micronutrients enriched ready to cook foods
20.	Tea based synbiotic nutraceutical
21.	Tea vinegar
22.	Herbal formulation for immunity modulation
	Biotechnology
23.	Superoxide dismutase: an enzyme for diversified industrial applications
24.	L-Asparaginase (HimAsnase™): an enzyme with application in food processing
25.	DNA barcode technology for plant authentication
26.	(GEPROTED)™: gel processing and transfer device
27.	iRIS™ : a solution for easy isolation of RNA
28.	Steriflow™: mini laminar flow unit
29.	Culture vessel for rooting of microshoots
30.	*In vitro* production system for naphthoquinones (red colour) from *Arnebiaeuchroma*
31.	Simultaneous production of biodegradable bioplastic
32.	Tissue culture protocol for mass production of quality corms of saffron
33.	Mass production of *Nardostachysjatamansi*– a critically endangered high
34.	Technology with short cultivation cycle for production of adventitious roots as a source of valepotriates
35.	Compost booster for cold regions
36.	Technology for shortened flowering cycle and year round production of
37.	Technology for year round cultivation of quality spice crops
38.	Mass production of *Diplazium maximum*: A nutritious ethnic food of
	Agro-technology
39.	Stevia: agro- and processing technology
40.	Monk fruit *(Siraitiagrosvenorii):* low calorie natural sweetner
41.	Heeng*(ferula assa-foetida):* agrotechnology
42.	China hybrid tea (*Camellia sinensis*): agrotechnologypacakage
43.	Damask rose (*Rosa damascene*): agro-and processing technology

44.	Wild marigold (*TagetusMinuta*): agro-and processing technology
45.	Lavender (*Lavandulaofficinalis*): agro- and processing technology
46.	Rosemary (*Rosmarinusofficinalis*L.): agro and processing technology
47.	Agro-technology for mass production of saffron (*Crocus sativus* L.)
48.	German chamomile (*Matricariachamomilla*L.): agro and process
49.	Improved bee hive for quality and hygienic extraction of honey
50.	Lilium: agrotechnology
51.	Calla lily: agrotechnology
52.	Gerbera: agrotechnology
53.	Agro-technology of carnations
54.	Alstroemeria: agrotechnology
55.	Cut-roses: agrotechnology
56.	Chrysanthemum: agrotechnology
57.	Vertical gardening
58.	Indoor air pollution abatement plants
59.	Micropropagation protocols: industrially important crop plants
60.	Micropropagation protocols for *PicrorhizaKurroa*
61.	Production technology for quality rootstock for apple
62.	Biofertilizers
	Chemical Technologies
63.	Technology for the production of aescin from horse-chestnut
64.	Process for cyclohexane-1, 3- dionesynthesis
65.	Process for 5-hydroxymethylfurfural (5-HMF) production from biomass
66.	Natural colours from plants/vegetable sources
67.	Green process for nanocurcumin synthesis with increased solubility
68.	Bamboo charcoal
69.	Formulation of herbal incense cones from herbs and flowers
70.	Tea based hand sanitizer
71.	Tea based mouthwash
72.	Process for 5-methylfurfuryl alcohol (MFA) production from biomass
73.	Scalable process for production of 4-alkyl resorcinols
74.	Eco-friendly process for textile fibre from plant resources for various
75.	Herbal based liquid hand wash
76.	Chemical free herbal soap
77.	Herbal oil for dandruff prevention
78.	Herbal lipsticks
79.	Formulation promoting cartilage health
80.	Natural perfumes
81.	Lip balm
82.	Air freshners
83.	Mosquito repellents