Technology Intervention for Mountain Eco-system (TIME)

A collective efforts to share field experience amongst different stakeholders to evolve and bring in practice affordable and appropriate technological solutions for nurturing and revival of Himalayan Ecosystem and Local Livelihoods under Core Support programme of SEED, DST, GoI.

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INSIDE

Editorial

Mountain ecosystem in Himalayas is different from the rest part of the country. There are multiple problems like melting of glaciers, land and ecosystem degradation due to indiscriminate felling of trees. Invasion of weed in larger area, decline of livestock products due to mechanization in agriculture, habitat degradation resulting biodiversity loss, man animal conflicts are other limiting factors. NTFP loss, forest fire, prevalence of insect pest and diseases in Agriculture and Forestry, threat of landslides and floods are becoming major factors. Variability in river water discharge due to degradation of catchment areas, wild animal damaging agriculture leading to food insecurity and promoting mass migration of people from mountains to plain areas in search of employment and livelihood opportunities are current challenges.

To arrest the migration of people from mountain, it is necessary to promote livelihood opportunities for people living on mountains, the technology interventions for mountain ecosystem a programme launched by DST, New Delhi has been playing a major role in improving the socio-economic status of people mainly by improving agriculture productivity. It is supported by good marketing opportunities for over 70% rural population who are totally depending on Agriculture for their livelihood on mountains. This effort by the Department of Science & Technology, New Delhi is being popularized through the TIME Magazine highlighting the success stories for adoption by others.

Comments/Suggestions welcome at website:
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NATURAL FACE MOISTURIZER

Face Moisturizer

Today's cosmetic industry is based on high technology & most of the cosmetic products contain various chemicals which may be harmful to our skin / health, although both high technology cosmetics & natural cosmetics have their drawbacks & benefits. High technology cosmetics are too expensive to produce on small scale and many ingredients are too difficult and expensive to obtain. Natural products usually do not have as long shelf life as highly processed and preserved products and are also therefore, limited in access to long distance markets. On the other hand natural products can often be obtained locally which means lower prices, their freshness may be easy to confirm and people are already familiar with such ingredients. The freshness of such natural material and of the final product can be additional selling point. As natural/herbal products will not only retain the natural moisture of your skin but will also hydrate your skin. In order to produce products based on natural materials / ingredients and to give them the appearance & consistency of high products, using a minimum of technology, high quality ingredients & specialized knowledge are required. Quality of cosmetic products for the consumer means the performance of a product according to its purpose and lack of undesirable side effects. As for most part of the year except some months of rainy season, most of the area in Himachal Pradesh remains cold & dry; it is desirable to use local moisturizing cream during this period.

Keeping in view the above facts, efforts were made to develop some cosmetic products based on local & natural ingredients / materials. It was tried to prepare some formulations based on wild apricot oil, honey, beeswax & aloevera gel etc. which are locally available in the area.

The basic objective this work was to develop a Face Moisturizer made from local natural ingredients.

Technology Package: Methodology

Broad methodology was as follows:

1) **Procurement of ingredients:** Wild apricot oil, Aloevera gel, honey & beeswax were procured from FARMER'S fruit processing unit and farmers.
2) **Formulation of Moisturizer:** Samples of moisturizers were formulated using desired ingredients and methods as per requirements and legal specifications. Various formulations were tried & made. The optimum formulation meeting quality & legal standard was standardized and given below:

Recipe:

S.N.	Items	Quantity (gm/ml)
1.	Beeswax	80gm
2.	Wild apricot oil	300ml
3.	Aloevera gel	120ml
4.	Honey	15gm
5.	Glycerin	30ml
6.	Rose water	20ml
7.	Sodium Benzoate	2.5gm

Procedure:

1. In a jar decided quantity of aloevera gel is kept allowing it to reach to room temperature.
2. Added grated beeswax & wild apricot oil in another Borosil glass jar. This jar was placed in a small pot of water or on water bath and brings water to a gentle heat. It was heated stirred occasionally, until bees wax was completely melted, then carefully removed the glass jar from pot.

Material Scaling

3. Now poured it in to the blender and allow cooling.
4. In another jar with aloevera gel, honey, glycerin & sodium benzoate is added. This mixture is heated to about 50-60^{o}C i.e. the temperature of the melted mixture of beeswax & oil.
5. Once cooled, (but is still soft). Remove top of blender and pour aloevera gel mixture in to it.

Blending and cooling

6. Now run the blender on lowest speed.
7. Stop blender as often as needed to run a spatula around the sides to incorporate ingredients. This will take 5-7 minutes until desired consistency is reached.
8. Pour the cream into a clean and preferably sterilized container.
9. The moisterizer is ready for use.

Face Moisturizer product

Storage study: As the shelf life is the main factor to have commercial production & marketing, thus to assess the shelf life of moisturizer, storage study was carried out at 2 different temperature conditions.

(1) At ambient/ room temperature i.e. 15-32°C

(2) At accelerated conditions i.e. 35-37°C for both formulations.

Since, quality for the consumer means the performance of a product according to its purpose and lack of its undesirable side effects, this natural / herbal creams do not contain any chemicals, thus comparably shelf life will be short. It becomes important to study the storage life of these natural creams, to assess their quality during storage for longer periods.

Among quality parameters like syneresis or 'Weeping', Texture, Oxidation, effectiveness of cream, side effect on skin & overall acceptability are some important parameters which were studied during storage.

A panel of 7 semi-trained users was used to assess these quality parameters. There are assessed to rate the product by giving scores from 1-10. The scores were recorded and average of the score given was calculated and rated accordingly. Score 7 and above is considered to be acceptable.

Observations & Results:

It was found that product can be kept at acceptable level for up to 1 year at both temperature conditions i.e. room temperature as well as accelerated conditions.

Certification: Quality evaluation and scientific validation was also carried out at Shri Ram Institute for Industrial Research, Delhi and found it in compliance with legal specifications**.**

Cost-benefit analysis (per batch) (input)

S.N.	Items	Quantity(kg/ltr)	Rate (Rs.) (kg/ltr)	Total (Rs.)
1.	Bees wax	0.60	300	180
2.	Wild apricot oil	2.25	600	1350
3.	Aloevera gel	0.90	50	45
4.	Honey	0.125	500	63
5.	Glycerin	0.25	400	100
6.	Rose water	0.15	500	75
7.	Sodium benzoate	0.02	200	4
8.	Labour@Rs.200/day		200	200
9.	Packing cost including labels	12.0	85	1020
	Subtotal (Rs.)			**3037**
10.	Depreciation @5%			152
11.	Total cost of production			3189
12.	Cost of production / pack			37

Final product 4.3kg (85packs of 50gm each rate @50/piece)Output

S.N.	Items	Quantity (No. of Piece)	Rate (Per Piece)	Total (Rs.)
1.	Sales value	85	50	4250
2.	Gross income (Rs.)			4250
3.	Gross expenditure			3189
4.	Gross profit			1061
5.	Market overhead@10%			104
6.	Net profit per batch (Rs.) Gross profit-overhead(1061-104)			957

Benefits:

- No side/harmful effect on skin.
- Not only retain the natural moisturizer of skin but will also hydrate your skin.
- Also have antiseptic affect on minor problems on skin.
- Can be prepared easily at home using locally available material ingredients.

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ENHANCING LIVELIHOOD OPPORTUNITIES IN ECO-FRAGILE MOUNTAINOUS TRIBAL AREAS THROUGH ORGANIC CULTIVATION OF PULSES &SPICES IN KALSI & CHAKRATA BLOCKS OF DISTRICT DEHRADUN OF UTTARAKHAND

INTRODUCTION:

The project namely;"Enhancing Livelihood Opportunities in Eco-fragile Mountainous Tribal Areas through Improved Agricultural Package of Practices in Low Volume and High Value Organic Crops of Pulses & Spices in Rainfed and Irrigated Pockets of Selected 10 Villages in Kalsi and Chakarata Blocks i.e. Jaunsar area of District Dehradun of Uttarakhand" was sponsored in the year 2014 by DST, SEED Division for three years.

The economy of Jaunsari community is mainly based on agriculture in the form of (dry land and irrigated fields) terrace cultivation in their hilly areas of habitations highly dependent on forest land for many purposes. As the forest cover and grassland in the area is gradually decreasing, it is becoming difficult for the people especially women to cater the need of fodder for their cattle. The rural women face gruesome situation. Besides sharing major responsibilities towards performing various conventional agricultural operations, they are required to collect daily needs of fodder and fuel, that being domestic essential of priority. Moreover, the area is facing an acute crisis as the youth is losing interest in cultivation of traditional food grains and other agriculture products, which is neither sufficient nor adequately valuable to be en-cashed for sustaining the expectations of the youth of the region. Out migration of youth from the region is causing devastation against for the sustainability of agrarian ecosystem of the region. The weak extension service limits any modernization of the traditional cropping pattern. In the wake of such situation there was need to facilitate these farmers to uplift techno-economically that is why the need was felt by DST for technical intervention for their livelihood enhancement.

PROJECT AREA:

Chakarata known for its serene environs and pollution-free atmosphere is at an elevation of about 7000ft. (2118 mtrs.). It is fascinating landscape for trekkers and nature lovers. Virgin forests of conifers, rhododendrons and oaks are best suited for long walks. A vast dense forest, dotted with attractive villages of the Jaunsari tribe, the area has the 10000ft. (3084 mtrs.) high peak of Kharamba. On its northern slopes is situated Mundali 9000ft. (2776 mtrs.) where from the months of November to April skiers can enjoy skiing?

The location of the project area (Kalsi & Chakarata Block) represents mid hill situation on an altitude ranging from 1200 mtrs to 1800 mtrs above mean sea level. Farming system of the area is generally food grains and rearing and breeding of livestock. Land holdings are small and scattered

undulated and rain fed. Pulses and Spices are being cultivated in an un-systematic manner and is also not a common practice in the area. However, agro-climatically the area is highly suitable for cultivation of Pulses and Spices i.e. highly nutritive, remunerative and labour intensive crops.

PROBLEMS FACED BY THE FARMERS:

Following problems are faced by village farmers in the area:

- Less productivity of the land
- Low fertility of soil in the area
- Very less use of bio-fertilizers by the farmers
- Use of local varieties of seeds and non availability of high yielding varieties;
- Small and fragmented land holdings
- Lack of appropriate technical knows how
- Non availability of physical inputs like: seeds, organic fertilizer, manure, far
- Machineries, improved agriculture implements etc.
- Non availability of farm advisory services and information system
- Non availability of safe and assured transportation facilities for market simulations
- Lack of post-harvest management technology

OBJECTIVES OF THE PROJECT:

- To provide hands on training to the selected 90 small and marginal farmers of the project villages in preparation of land, nursery raising techniques, protected organic cultivation techniques, constructions of poly house/poly tunnels/walking tunnels, post harvesting, value addition, packaging and labeling, market simulations etc.
- To cultivate and demonstrate the vitality of Pulses and Spices in protected conditions as low volume and high value cropping in the farmers field for an alternate livelihoods option for 90 Jaunsari Scheduled Tribe families of Kalsi and Chakarata Blocks of District Dehradun of Uttarakhand.
- To establish 10 masters' poly houses in the land of the farmers in each of the selected villages for preparation of seed and seedlings and planting material and to construct 90 poly tunnels / walking tunnels in the land of the farmers for cultivation of Pulses and Spices in protected conditions.
- To establish the seed bank and agro service center in the project villages for providing agriculture inputs to the farmers such as hybrid seed and seedlings, planting material, organic fertilizer and manure, improved agriculture implements, poly sheets, bio pesticides and insecticides etc.
- To demonstrate and disseminate the organic way of cultivation by constructing 90 vermi compost pits through adopting internal control system as per organic farming manual.

- To provide package of practices of mass scale production of pulses and Spices and establish technical support system for value addition of the produces such as sorting, grading, processing, packaging and labeling, marketing etc.
- To raise the living standard of community by involving the women as main programme stakeholders and adding other ancillaries as per the gender priorities of the families in tribal community.

BENEFICIERIES BACKGROUND CASTE & OCCUPATION:

The target group/beneficiaries are mostly of vulnerable sections, mainly constituting of the schedule tribes. The Jaunsari population mainly consists of Khasas comprising Rajputs (mainly Rai, Rana, Chauhans, Tomars, Rawats, Negis, Rathores etc.) and Brahmins (mainly Sharmas, Joshis, Nautiyals etc.) as high caste, Luhar, Bajgi as the middle caste and the Dom comprising Dalit, Kolta as the low caste. The Rajput and Brahmins are the landowners. The Luhars are the artisans working as ironsmiths as well as the goldsmith. The Bajgi offers drum music at all the religious, social and cultural functions. Kolta is a landless labourer and he works in the field and house of the Khasa people. They are taken as untouchables by the higher caste people because they work as menials.

The direct beneficiaries are the women and weaker sections of tribal families who have remained occupied with the agriculture and have adopted this because of inheritance from their forefathers. Ecological, economic and financial factors have kept such families in rut of poverty. They are made direct beneficiaries because they are living with a much restricted growth that forced them to life of deprivation and want for decades.

ACTIVITIES AND ACHIEVEMENTS:

Achievements against the work plan in project area are mentioned as follows;

- Baseline survey in 10 project villages was done. The benchmark of survey was socio-economic condition and farming behavior of the community. The experts were interacted on issues concerned to the social, economic and occupational needs of farmers. During the interaction, the needs of farmers were identified and strategies were planned. The data were complied with resource, seasonal cropping practices, livestock; irrigation pattern schooling, energy availability,

transport and other infrastructures were observed.

- ❖ Again in 2016, three days training on land preparation for farm activities, seed testing, treatment and seed sowing, posts sowing care, surveillance, pre-harvest scientific care, demonstration on crop harvest technology and essential post harvest package of practices have been carried out with the help of KVK Dhakrani, Dehradun. Following training points were covered under this as;
    - Nursery raising techniques.
    - Establishment of seed nurseries.
    - Polyhouse establishment.
    - Seed production technology.
    - Better transplantation techniques.
    - Establishment of demonstrational facilities.
    - Grading and sorting of produces

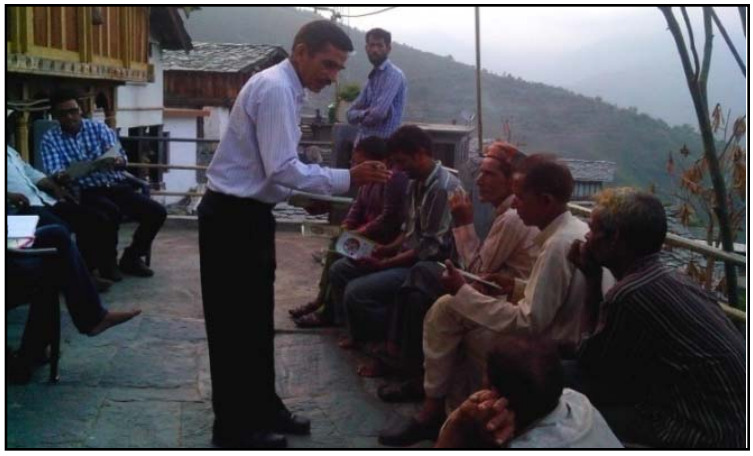
- ❖ Six days practical training on demonstration and establishing the biological measures such as bio-dynamic composting and vermi-composting units with improved tools and technologies have been completed.
- ❖ 90 vermi compost pits were constructed for composting of organic manure, so far. Agriculture residue and cow dung was laid in layers as 1.5 m wide and 0.5-0.9 m high beds in the chamber/pit constructed by farmers previously. Cow dung containing composting earthworm procured from market were introduced in between the layers at the rate of 250-350m3 of bed volume. Moisture contain was maintained about 40-50% and temperature of 20-30^{o}C by sprinkling water over the beds. One worm that weighs 0.5-0.6 gm. consumes almost equal amount of excreta to its body weight. It was advised the producer groups to utilize it before onset of rainy season as it does water logging in compost trenches however unutilized or spared compost was preserved by over covering the trenches by poly sheets. In addition to

crop improvement spared compost was sold to compensate their incidental expenses. If, it is properly packed & branded to get higher support price for the same.

- Ninety low cost poly-tunnels, walking tunnels have been installed for production of quality planting materials, production of organic seeds, in 90 farmer's field up to second year of project implementation in the aforementioned villages. The structure of poly tunnels were assembled by the farmers by local bamboos, covering over the structure, the poly sheet was facilitated by HIFEED under the project in project area. The plants of Pahari Rajama, Kulath, Soyabeen, Masoor, Urd, Lobia, Tor) in pulse commodity Ginger, Garlic, Coriander, Chilly, Turmeric, Onion, Cumin, Methi) were roped and transplanted inside the poly tunnels. That year there is rain havoc in the project area, so, success of such tunnel is very vital for the crop production that remained almost successful excepting a few instances of torrential rains & cloudbursts in Chakarata block.

- One seed bank and agro service center was established for supply of agriculture inputs to the farmers. Spices grinding and processing machine was already functional at the centre and other agricultural implements & machines were made available at the centre. More high yielding varieties of seeds of spices & traditional variety of Pulses were made available at the centre. After post harvest of crops 30-40% produces were kept for seed purpose. Spare compost was planned to procure at the center. Pesticides were available for urgent use. Organic pesticide made up of neem and tried for their efficiency. This way a seed bank was created in 3rd year to ensure adequate seed availability of viable cum nutritious and gene pool preservation indirectly and in form of gene pool to preserve germ plasm indirectly. Seed bank needs, seed treatment and its safe storage. To meet out the need of storage eco-friendly storage structures were required. However, the Agro service center is equipped with tool & equipment for storage of organic pulse seeds (Pahari Rajama, Kulath, Masoor, Urd, Lobia, and Tor) and spice seeds (Ginger, Garlic, Coriander, Chilly, Turmeric, Onion, Cumin, Methi). The inoculum of bio fertilizers was also made available to the farmers in agro service center. Further, the farmers were facilitated by more hybrid seed and seedlings, planting material, organic fertilizer and manure, bio-pesticides and insecticides for better cropping of pulses and spices.

- In consultation with horticulture experts, the ten master poly houses of sizes (5mx10m) 50 square meters were installed for demonstration. The frame for poly houses were structured by the expert agency, during developing the structure of master poly houses, the fabricated structure was assembled in the presence of farmers, so the farmers could able to follow and skilled up for



installation of poly houses at their own farm site. Nurseries had been raised in 10 master poly houses for supply of quality seedling for transplantation. Tending operations like weeding, harrowing, pruning, water sprinkling and spraying was done continuously till the seedlings were ready for transplantation.

- ❖ Ten Farmer Clubs (Kisan Club) were formed. Activities of the kisan club was holding meetings to plan their physical and financial goals, discuss their agenda of action plan and review their progress or action taken so far. To make proposal and sanctions of particular task, chalk out their difficulties and further roadmap. They contribute and maintain their club's account. Also maintain a common activity log/meeting register assisted by field facilitator.

INNOVATIONS:

- Organic way of cultivation of pulses and spices were introduced. Raw spices are being processed, packed, labeled and marketed by providing FSSAI license and also applied for organic certification of pulses and spices from Uttarakhand Organic Commodity Board (UOCB).
- Application of vermi composting.
- Application of protected cultivation of crops through introducing master poly tunnels and allied structures.
- Planned tapping of water for irrigation from nearby springs traversing through village forest and rain-fed farms.
- Publicized the brand as HIFEED organic pulses and spices.
- Marketing linkages are in process with TRIFED, Dehradun.

OUTCOMES:

Manifold enhancement in livelihood, health, education and awareness was observed after implementation of the project in the area. Tribal community is heading towards become progressive marketers. Before the inception of the project average income per family was below Rs. 5,000 per annum that has shoot up to Rs. 20,000 to as much as more than Rs.1,00,000/annum /family (joint family). Moreover, recently it is seen that reverse migration of youth to place in some cases by taking interest in organic way of crop production and income generation. Thus, the very exercise can be a replicable success story for other communities as well.

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INTEGRATED DEVELOPMENT AND ENHANCEMENT OF LIVELIHOOD SECURITY OF 500 TRIBAL FAMILIES IN FIVE VILLGES OF BHATWDI AND DUNDA DEVELOPMENT BLOCK OF UTTARKASHI DISTRICT THROUGH, WADI DEVELOPMENT APPROACH

The project was taken up to improve the quality of life of 500 tribal families through 'Wadi and Non-wadi Development approach. This project was implemented in six village of Uttarkashi district of Uttarakhand state two villages falls under Dunda develop block and 4 Tribal villages under Bhatwari development block out of six. The Bhotiyas are an ethno-linguistic group of people living in the trans-Himalayan region that divides India from Tibet. They are closely related to the Tibetans and their name Bhotiya, derived from the word Bode, which is the Classical Tibetan name for Tibet. Those tribes living in Uttarakhand are generally referred to as Bhotiya. Bhotiya more commonly means the related people of Sikkim and the Indian constitution recognizes them as Bhotiya.

Two major programmes categorized under TDP were 1. Wadi and 2. Non-Wadi

Livelihood development through WADI activities: - About 150 farmers have been benefited through WADI development in 75 Acre, among of which 25 acre new WADI and 50 Acre rejuvenation operated by organization and the project was operated over a period of 6 year. Under WADI activities barbed wire fencing, construction of tank and pipes of irrigation, quality planting material, 115 sets of Grafting kits, power spray pump, medicine, manure etc were distributed among farmers and regular input was given in the orchard (WADI) were monitored by organization.

Non-wadi Programme: - About 65% families of tribal are landless, they only have 3 or 4 room houses where they live. However, they are actively involved in Goat/Sheep rearing, Weaving, livestock rearing (Cow, buffalo, mule and Pony) and Carpet designing. They were helped through following income generative activities.

- **Cow rearing: -** 60 cows were distributed for livelihood enhancement.
- **Income generation from Mule:-** Total 25 mules were distributed for livelihood enhancement, at all the six villages.
- **Installation of Handloom and Bageshwari Charkha:**– Under this head 160 Bageshwari Charkha and 50 handlooms distributed.

- **Work shed Construction: -** 55 people of the selected villages were supported for constitution of their Work shed. The estimated cost of per work shed is Rs.25,000.

- **Livestock Support for Goat and Sheep rearing:-** Goats and sheep provide a dependable source of income to the tribal population of below poverty line. Through this project, 115 families were distributed Sheep / goats for rearing. Each family provided one set of goat/sheep that means 10 female and one male sheep/goat.

- **Capacity Building Programme:-** Carpet Designing Training- Targeted trainings were regularly given to these selected villages like Product innovation, training for woolen cloths, Goat / Sheep rearing, Marketing Support training etc.

- **Exposure Visit:-** Two Exposure Visit were conducted as per requirement of WADI and NONWADI activities of the community. One exposure visit was conducted for carpet designing and hosiery cloths development at Ludhiana and another conducted at Dr. Y. S. Parmar University of Horticulture & Forestry, Solan, Himachal Pradesh for pruning / grafting, nursery marketing, grading, packing and orchard development.

Our Woolen Emporium at Uttarkashi District Headquarter Visited by Dr. Sunil Agrawal Sir from DST

- **Women's Care:-** There was a need to take care of women health & their sanitation for the women and child welfare Health / Sanitation awareness programme, food and nutrition training etc was given by Organization through medical checkup health camp, timely checkup, of their health by Doctors and the subsequent follow up had improved the women and child health. General awareness about sanitation, hygiene, clean drinking water, immunization programmes were also conducted by organization.




Outcomes: Through the intervention of this project the income of the farmers had increased twice. The health and sanitation status of the woman and children has improved many folds.

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EMPOWERMENT OF ARTISANS IN MOUNTAIN ECOSYSTEM THROUGH S&T INTERVENTION: SEED, DST-HESCO INITIATIVE

OVERVIEW: There has always been job insecurity and it is a major problem of the artisans. The major work force migrates to urban areas to the demand of their families. Such a grim situation has further become more serious when local resource availability becomes scarce. Mountain communities strikingly is known for its' inter and intra-dependence among different villages particularly in case of human resources. The most important example is of Artisans. Within each and every community, there has always been one or other kind of artisanal services. These services included masonry, carpentry, black-smithy etc. It was on the basis of exchange with agriculture produces. The local resources for such services were available within community.

In course of time, new developments adversely hit occupation of these artisans. Many of their produce due to lack of appropriate machinery were replaced with the products made in urban areas. Design and other inputs were largely absent in local artisans and therefore other market produce took their place. Moreover, these were cheaper also. Slowly, artisans especially blacksmith and carpenters began to lose their jobs. In case of masonry, stonework was massively replaced with bricks. This took away jobs of masons too.

Thus, the major factors that snatched jobs from artisans were two, (a) Poor skill and in competitive knowledge, (b) Resource crunch and lack of alternative material and mechanism. The

above two factors pushed socio-economic status of artisans at low level. Keeping these points in view, the present programme was initiated with the following objectives.

MISSION:

- To create Artisanal network for social, economic and ecological benefit through Science & Technology
- To source and involve technologies and expertise available with different institutes
- Downsizing / upgrading technologies as per artisans need and market in participatory mode
- Alternative resource material for artisans
- Promotion of Artisanal education through training cum demonstration

Trades	Beneficiaries (Direct)	Content
Mason	161	Brick construction, concrete roofing, rain water harvesting tank, retrofitting
Carpenter	151	Furniture, show rooms, door, window, poly house structure, economic use of wood.
Blacksmith	135	Agriculture tool, plough, harrow, window frame, weedier, tiller, trolley, gas welding, arc welding, lathe machine operation

Project Sites, Partners, Technical Back-Up Support and Linkages Established with S&T Institutions

S.N.	District	Block	Village	Linkages with S&T institutions
1	Dehradun	Sahaspur	Shuklapur	• G. B. Pant University of Agriculture and Technology, Pant Nagar, Uddamsingh Nagar, Uttarakhand • Amar Ujjala Foundation, Noida, Uttar Pradesh • HOPE, Vill./P.O. – Pilkholi, Block Ranikhet, Distt-Almora, U.K. • Himalayan Paryavaran Jadi-Buti Agro Sansthan, P.O., Josiyada block- Dunda, Uttarkashi, Uttarakhand • Central Building Research Institutes, Roorkee, Uttarakhand
2	Uttarkashi	Dunda	Loharkha	
3	Bageshwar	Kapkot	Loharkhet	

CREATION OF HUBS:

As per project objective, artisanal workshops (Common facility centre) have been established in three locations in Uttarakhand to train the artisans (Masons, Blacksmith & Carpenters) on modern technologies to enhance the livelihood support. These three centers were :

Uttarkashi:

This center is located in village Loharka near Dhontri, (Uttarkashi): The workshop was well equipped with the necessary tools and machinery (Blower, Hammer & Chisel fork, Iron block, Binding unit, Electric sawing and Cutting machine with motor, Hand saw set, Electric drill, Router, Chisel, Trowels, Cutter machine, Plumber bob, Aluminum plain and Sprit level) and is being used as training-cum-production centers by the artisans.


Dehradun:

This center is located in village Shuklapur Block-Sahaspur, Dehradun. The workshop has all necessary tools and equipments (Blower, hammer & Chisel fork, Iron block, Binding unit, Electric sawing and cutting machine with motor, Hand saw set, Electric drill, Router, chisel, Trowels, cutter machine, Plumber bob, Aluminum plain and sprit level) the center is being used as training-cum-production centers by the artisans.

Bageshwar:

This center is located in village Loharkhet, Bageshwar. The workshop is also equipped with the necessary tools and machinery (Blower, hammer & Chisel fork, Iron block, Binding unit, Electric sawing and cutting machine with motor, Hand saw set, Electric drill, Router, Chisel, Trowels, Cutter machine, Plumber bob, Aluminum plain and Sprit level). This functions as training-cum-production centers by the artisans. As the project site is closed to Bageshwar city, artisans are in demand from city areas as well and masons are being hired by the contractors in semi-urban areas.

All Artisanal centers are now being run by the artisans and regular training programmes are being conducted at these centers.

PEOPLE'S PARTICIPATION:

The total project was participatory in nature. Artisanal communities because of poor caste face social and economical isolation and were deprived of many development advantages. It was then increasingly recognized that improvement of traditional artisans who had been unable to keep pace with development was immensely required in the interest of the artisans. This programme is helping them to identify for better knowledge and market inputs. This gave them an opportunity to strengthen their occupation for future generation also. Skill available with them is adequate enough to step into second generation of knowledge and technology. Their basic training on Artisanal work helped them to gain fast new wisdom. The whole programme was participation in nature. In each step and decision of artisans was involved. This developed a mutual faith between community and project team. This also brought confidence in community.

IMPACT ANALYSIS WITH INDICATORS:

The impact of the programme can be observed by four major indicators

- Increased income of groups vary from Rs 10,000 to Rs 1,00,000 annually.
- Better knowledge based on S&T.
- Confidence building on the trade.
- Organizational capabilities for collective effort.
- More opportunities of the job

SPECIAL FEATURES:

The special feature of this programme were envisaged by following point

- It was resource based enterprise which promote resource also
- It was upgradation of existing knowledge and enterprise
- Local skill, resource and market inclusive
- Promotion of local innovation

S. N.	Sector	Traditional	Innovation
1	Mason	Only Stone based work	Brick construction, rain water harvesting tank, Retrofitting
2	Carpenter	Only Hand Based tools and work.	Furniture, show rooms, door, window, poly house structure, economic use of wood.
3	Blacksmith	Repair and maintenance of the metallic tools	Agriculture tool, plough, harrow, window frame, weedier, tiller, trolley, gas welding, arc welding, lathe machine operation

Outcomes: The overall impact of the project is long lasting as the artisans of the project area are now well equipped with modern tools and technologies. They have now improved their skill and trade and earning more wages as compared to the time before launching the project. This model has given opportunities to artisans of other villages also to improve their skill by getting training from those artisans who were trained under this project.

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SOLAR TECHNOLOGY FOR THE DRYING OF CROP PRODUCE IN WESTERN HIMALAYAN REGION

Abstract: Some fruits, vegetables, seeds and medicinal plants are dried before its marketing. After harvesting 10 to 30% crops are damaged due to perishable nature, bad weather or lack of transportation facilities and damage by wild animals resulting in huge loss to the farmers. About 90 % of women of hilly areas remain engaged in the drying of products in the traditional way and they spent at least 2 hours daily in the drying which costs at least Rs 50 per day as labour input. Depending upon the type of crop and climatic conditions, the time taken in the drying of products by traditional methods ranged from 5 to 15 days. The solar drier technology has reduced not only drying time but also increase in the prices of the dried products in the local markets ranged from 29% to 200%.

Keywords: Drying of crops, solar dryer, field testing, hilly region

Introduction:

The Himachal Pradesh is a hilly and mountainous state known as fruit bowl of India. Large quantities of fruits and vegetables are damaged due to perishable nature/bad weather or lack of transportation facilities resulting in economic loss to the farmers. About 20% tomatoes, 10% ginger, 10% mushroom, 30% amla (*Emblica officinalis*) and 5% apples are generally damaged / waste a year. People in the state dry fruits like apple, peach, palm, nut, and vegetables chilly, turmeric, ginger and pomegranate under open sun resulting poor quality of the dried product due to dust, fungus, infection, insects, sudden rains, wild animals particularly monkeys and wild boar due to which the farmers have shifted from farming to some other work. The perishable crop like tomatoes and pomegranate produced during rainy season are destroyed due to bad weather.

This gives low return to the farmers and requires more time and labour to carry products inside to outside. Solar drying of fruits and vegetables can reduce the losses, better food preservation technology and improve the quality of product for better price in the market. The solar drier has closed chamber with preventing product from outside effects.

Various solar driers have been developed using different types of material but they could not adopted by the farmers. The special solar collectors have used as an indirect solar thermal energy source, the drying of red pepper known as "Baklouti" have studied and analysed by three different solar processes, an efficient drier has been designed and constructed through which the solar energy can be tapped and stored in batteries and the drier can be continuously run during cloudy days and even at nights. The drying efficiency of 50.4% has been estimated for drying of 100kg of paddy which shows the effectiveness of the technology but has not been in the field. A detailed description, fundamental and previous work performed on solar dryers and solar air heaters have been presented as the vital element for the indirect and mixed modes of solar dryers. The difference between simulation performance and field trial is within the acceptable limit of 10%. This leads to our efforts without simulation analysis.

Baseline survey:

Before designing the solar drier a need based survey was carried to identify the verities of products are being dried traditionally in the region. The status of crops dried during the course of the year was presented in Table 1.

Table 1 Calendar of drying of various commercial products

S.N.	Month	Individual farmers	Self Help Groups
1.	January		Baris
2.	February	Coriander, Bottle guard	
3.	March	Fenugreek(Methi)	Coriander, Methi, Sarson and Rye
4.	April	Sarson	
5.	May	Apricot, Barley, Wheat	Apricot
6.	June	Coriander, almonds	Nashasta
7	July	Wild apricot, apple, peach, pear, beans, garlic, plum, cauliflower	Apple, Tomato, bitter gourd, bottle gourd, lady finger, cauliflower.
8.	August	Red chili, garlic, pudeena, mushroom	Vegetables for pickle, Red chili,
9.	September	Anardana, grapes, chili	Anardana,
10.	October	Red chillis, almonds, maize, chilgoza, walnuts	Pulses, Nutry, til, bean
11.	November	Walnut, turmeric, ginger	Ginger, turmeric
12.	December	Guchhi	

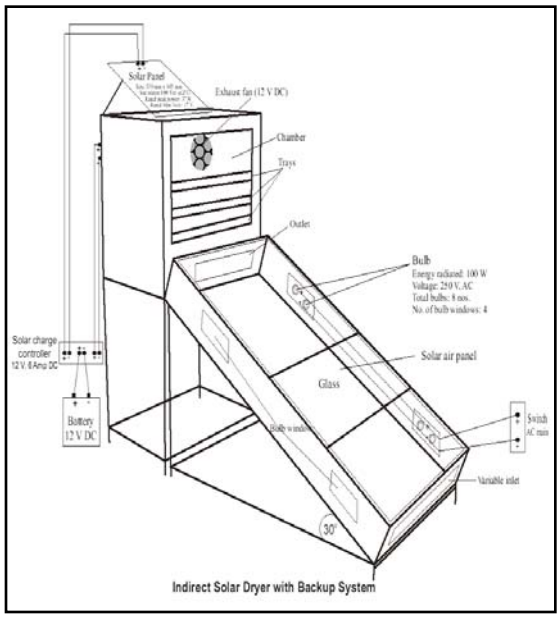
The other salient points came to light during survey were as under:

- 90 % of women folk are engaged in the drying of products in the traditional way;
- 2 hours at an average daily are spent in the drying process, including handling of products;
- By a conservative calculation arrived at by taking the minimum wage of unskilled worker as fixed by the Govt. (presently Rs.150/day), the average cost of labour input by women comes to Rs. 45 per day.
- Most of self help groups (SHGs), consisting of female members only, are engaged in commercial activities. They market the dried local products of all types for income generation.
- 10–25% of crops are damaged after harvesting due to a variety of reasons;
- The time taken in the drying of products by traditional methods is 5 to 15 days depending upon the type of crop and climatic conditions.
- In addition to commercial crops, the farmers also dry all types of vegetables, grains, cereals for their own use. Sometimes there are also local specific typical products.

Inferences:

From the analysis of the survey results, the following inferences were drawn:

- Although presently due to non availability of proper technology, the solar drier is not in use in rural areas yet it can be gainfully employed for the whole year as and when it is properly introduced and technical knowhow for its operation and maintenance is made available to the farmers. Not only for commercial purposes, it can be used for drying the products even for domestic use which the farmers are otherwise importing from the open market;
- Once the utility of the drier is known to the farmers, it will itself create demand for the same among the farmers;
- The SHGs can become a formidable target group as they are drying their products in traditional ways for commercial marketing proposes;
- When popularized, there will be greater demand for maintenance and upkeep of drier which, in turn, will generate income to the local carpenters.



Indirect Solar Dryer with Backup System

Methodology:

Based upon base line survey a 25 kg capacity solar drier was designed and constructed. It has two parts, one solar collector and second drying chamber. The solar collector is consisting of wooden box fitted with 4 mm thick glass at the top with dimension of 2.1m*1.1m*0.3m has black painted plywood wall of the changed to absorbed solar radiation and is insulated with saw dust at the bottom of the box. Solar collector has been fixed at an angle 29^0 with the horizontal for receiving maximum solar radiation. The

holes are provided at the front (south orientation) for air inlet in solar collector and at the back for air outlet to drying chamber.

The drying cabinet with dimension of 1.1m*0.7m*1.0m is divided into four divisions separated by three removable trays. Each tray of size 1.02m*0.7m*0.05m is made of iron square mesh with wooden border. Front side of drying chamber is covered by glass slut (6mm). The holes are provided at the front (south orientation) for air inlet from solar collector and top of the drying chamber (north orientation) for moist air outlet. An exhaust fan run by AC or by solar panel battery has been provided at top of the drying chamber (north orientation) for faster drying. The bulbs are provided in the solar air heater for heating during late evening or during bad weather. This will reduce the dying time as drying will continue throughout 24 hours.

Indirect Solar Drier

Results:

Drying results of pomegranate which are presented in table 2 reveal that reducing sugar was found maximum (22.10%) in the arils dried in indirect solar drier while minimum (20.25%) was in open sun. The total sugar was found maximum (25.16%) in arils dried in indirect solar drier and minimum (23.20%) in open sun. The maximum titratable acidity (13.71%) in the arils dried in oven, whereas minimum titratable acidity of 12.40% was observed in the arils dried in open sun. Data on the effect of drying modes on the ascorbic acid content show that indirect solar dried arils had maximum (12.09mg/100g) ascorbic acid, whereas open sun dried arils had minimum (7.85mg/100g) ascorbic acid.

Table 2 Test results of wild pomegranate seeds dried

Characteristics (on dry bars)	Anardana		
	Open sun	Oven	Solar drier
TSS	37.01	37. 84	39.59
Reducing sugar (%)	20.25	21.20	21.70
Total Sugar (%)	22.60	23.49	24.18
Titratable acidity (%)	12.40	13.71	13.09
Ascorbic acid (mg/100gm)	7.85	10.39	12.09
Moisture content (%) often drying	11.32	7.58	9.02
Colour	Light brownish	Brownish pink	Pink
	Ginger		
Colour	Greenish yellow	Dull	Original yellow
Oleoresin (%) on dry wet basis	3.91	4.05	4.31
Moisture content (%)	9.54	5.88	9.3

Characteristics (on dry bars)	Anardana		
	Open sun	Oven	Solar drier
	Tomato		
Titrable Acidity (%)	4.10	4.14	4.48
Total soluble acid (mg/100gm)	61.2	62.5	72.1
Ascorbic acid mg/100gm	84.8	93.1	92.1
	Red Chilly		
Colour	Light red	Blackish dark red	Radish pink
Moisture content (%)	11.94	6.38	7.34
	Turmeric		
Colour	Light radish yellow	Blackish yellow	Dark radish yellow
Moisture content (%)	11.37	7.59	9.23

Testing of solar drier in field conditions:

The solar drier was also tested in the field conditions. It is both appropriate and interesting to present the data about the vast geographical variations in the locations of installation of 15 driers, which ranged from an altitude of 552 meters to 2878 meters above sea level (Table 3).

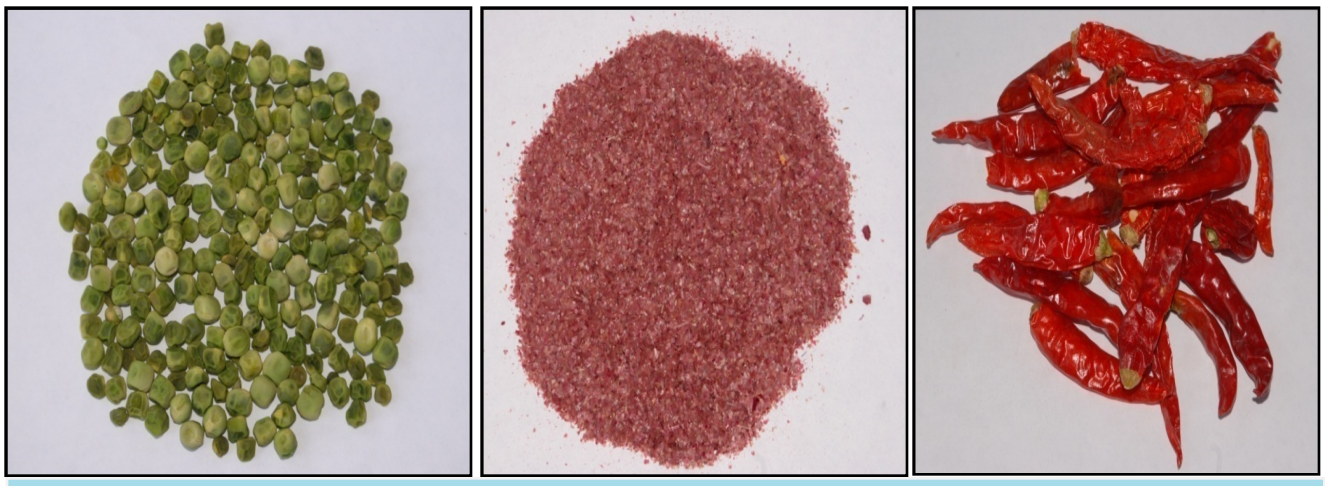
Table 3 Geographical description of sites at which solar driers were installed

S. No.	Location	Altitude (meter)	Latitude	Longitude
1	Thola	1629	30^{0}44’450 N	77^{0}33’146E
2	Thirdhar	2213	30^{0}42’894 N	77^{0}30’144E
3	Sataun	552	30^{0}33’546 N	77^{0}38’545E
4	Bhajond	1486	30^{0}44’175 N	77^{0}22’658E
5	Bhangari	1809	30^{0}46’898 N	77^{0}24’410E
6	Ritab	1596	30^{0}56’410 N	77^{0}19’567E
7	Sanhot	1840	30^{0}53’251 N	77^{0}21’349E
8	Jalana	1216	30^{0}09’748 N	76^{0}59’3338E
9	Nagwain	1192	31^{0}48’468 N	77^{0}10’475E
10	Sharan	1743	31^{0}40’070 N	77^{0}19’650E
11	Kalashan	1650	31^{0}23’116 N	77^{0}08’275E
12	Faigal	1262	31^{0}21’355 N	77^{0}04’972E
13	Sangla	2622	31^{0}25’458 N	78^{0}15’823E
14	Leo	2878	31^{0}53’180 N	78^{0}35’806E
15	Khawangi	2300	31^{0}33’132 N	78^{0}16’367E

During monitoring of solar driers in the field, the farmer's opinion was that the solar driers not only saved the drying time but also saved labour to carry products from outside (open sun) to inside (house) during mornings and evenings and even during bad weather. The time thus saved was utilized in other farming or off farming activities. The crop is protected from wild animals particularly from monkeys. The success of the technology can be viewed as a fact that the farmers have provided the wood for the fabrication of solar drier as their contribution. The solar drier can be fabricated by the local artisans and the capacity of the drier can be changed as per the requirement of the farmers. The quality of the solar dried products had shown considerable improvement. It was observed that during this season the farmers sold their products at higher price. The increase in the prices in the local markets ranged from 29% to 200%. The comparative rates of dried products sold by the farmers in the market are presented in Table 4.

Table 4 Rates (Rs.) of one kg dried products in the market

Product	Open sun dried(gm)	Solar drier dried	Increase (%)
Garlic powder	200	300	50.0
Apricot	80	135	68.8
Almond	-	300	0.0
Turmeric	100	200	100.0
Ginger (Sounth)	300	500	66.7
Peas	100	300	200.0
Turmeric	200	300	50.0
Red Chili	140	180	28.6
Apple Chips	100	300	200.0
Turmeric	80	200	150.0
Red Chili	100	150	50.0



Dry Pea Dry onion Dry Chilly

The awareness/orientation training camps were organized in the field before the installation of solar driers to have the idea of its operation, use and benefits so that they can make up their mind for its adoption. During the training camps the importance of solar drier for income generation, time saving, better quality of dried products and protection from insects & wild animals were highlighted. The SHGs' women showed keen interest and demanded more solar driers for their groups.

Orientation Program with Panchayat and Pradhans

After the installation of solar driers in the villages, users' camps were organized for the farmers to apprise them about the functioning of solar drier. Do's and don'ts about the technology were highlighted. A popular document was distributed among the farmers for their awareness containing material about the solar drier technology. The local carpenters were trained for repair and maintenance of solar driers. They will be paid by the farmers and service will be provided by the carpenters to the farmers on payment basis. A technical manual was prepared for the carpenters, which will help them in maintaining the quality of the technology during its fabrication in the field. This will make the technology a success.

Carpenter Training on Solar Drier

A study was carried out by one of the beneficiaries (Society for Farmer's Development, Talahar, Nagwain, Mandi) for the drying of apples in solar drier. The results showed that the drying cost was negligible as compared with biomass based drier and quality of dried product was better than the drying in biomass based drier. In addition the rate of dried apple in solar drier sold during International Fair at Kullu was Rs. 600/- per kg whereas the rate of dried apple in open sun was Rs. 450/- per Kg. The test report has been summarized in Table 5.

Table 5 Test results in the field conditions

Date	Loading		Temperature	Unloading		Yield	Drying time
	Weight (kg)	Time	°C	Weight (gm)	Time	(%)	(Hrs.)
5-9-11	2.200	11 am	36-45	200	11am 8/9/11	9.09	72
13-9-11	2.200	11 am	36-45	197	12 noon 15/9/11	8.95	73
22-9-11	2.200	10 am	36-45	198	10 am 24/9/11	9.0	73

When the indirect solar drier was developed and the project formulated, its use was conceived, in a limited sense, for drying of routine traditional local products, which are being dried in open sun involving avoidable time, labour and various hazards adversely affecting their quality, for ensuring better quality and marketability. At that time, the real potential of the drier, as demonstrated by its use in field conditions during the course of implementation of the project, could not be assessed. During the monitoring it was observed that some of the farmers have able to dry such type of products which was not drying earlier in addition to their commercial dried products. The bark of onion was one of the typical products dried in solar drier for making colour for the dying of woolen which was not available easily in the market. The colour was natural and costly which has increased their income.

Economics:

The cost of the technology is around Rs. 25,000/- plus the cost on wood which will be provided by the beneficiaries. Since it is fabricated by the local carpenters, therefore its fabrication expenditure is low as compared to its cost if fabricated in industry. Its capacity can be changed as power the requirement of the beneficiaries.

Outcomes:

The dryer can be used for drying of produce as well as their products of irrespective of the season, climate and location. It is very much effective and efficient in drying the products than drying the crops in open sun. Indirect solar dried products meet the International Standards for quality. Importance of solar drier is very much pertinent in hilly areas because under natural conditions the sun exposure time availability is very less due to cloudy weather. Indirect solar dryer preserves foods by removing access moisture from food to prevent decay and spoilage. Different types of grains and their products are well dried in the indirect solar dryer under clean conditions and in a reasonably short time. Depending upon availability of space, local material and amount of material to be dried the capacity of indirect solar drier can be increased or decreased. Solar drying of fruits and vegetables can reduce the losses and improve the quality of products and farmers get better price in the market. The drying cost in indirect solar dryer is negligible and quality of dried product becomes better. Indirect solar dryer also provide additional income to the local carpenters by adopting as entrepreneurship as they can fabricate it themselves and sell in the local market for the end users. The farmers can dry all types of fruits, vegetables, grains, cereals for their own use as well as for commercial purpose.

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SINGLE CROSS HYBRID SEED PRODUCTION OF QUALITY PROTEIN MAIZE IN HILLY REGION

Maize *(Zea mays* L.) is the third most important cereal crop of India after wheat and rice. Currently it occupies over 9.00 million hectare with contribution of 24.00 million tonnes in production, which contributes nearly 8% in the national food production. The contribution of maize in terms of Rupees is Rs. 100 billion to the agricultural GDP at current prices apart from the providing employment to nearly 100 million man-days at the farm and industrial sectors. In addition to staple food for human being and quality feed for animals, maize serves as a basic raw material for many industries such as production of starch, oil, protein, alcoholic beverages, food sweeteners and bio-fuel. Being a potential crop in India, maize occupies an important place as a source of human food (25%), animal feed (12 %), poultry feed (49%), industrial products mainly as starch (12%), and 1 % each in brewery and seed.

Maize is a good source of carbohydrates, fats, proteins and some of the important vitamins and minerals. Several million people, especially in the developing countries, derive their protein and calorie requirements from maize.

In terms of acreage, maize is the first ranking crop in Jammu and Kashmir of all the three regions namely Jammu, Kashmir and Ladakh having distinct geographical outlook and agro climatic zones. Nearly one-third of the total cropped area and was devoted to its cultivation. Maize is widely cultivated in Jammu and Kashmir, being grown in the Kandi, Karewa, and plain areas. It is the staple food of Gujjars, Bakarwals and Pahari people living in the Kandi and hilly areas. Maize is grown in almost all the districts of the state except Leh and Kargil. Its cultivation is largely confined to the Kandi areas and hilly tracts. Jammu division of J & K State occupies highest area under cultivation of maize. It is a major *kharif* season crop of this region. The main concentration of maize is found in the Doda, Ramban, Reasi, Rajouri, Poonch, Bhadarwah and Udhampur district.

Maize can be grown on a variety of soils but it performs well in the sandy loam to loamy soils. Varieties of maize have also been developed which perform well in the colder hilly and mountainous areas. It can be grown in all such regions where the summer is long enough to permit its cultivation, and frost does not set in too early. It needs about 30°C temperature at the time of germination, growth and development, and over 20°C at the time of ripening. In fact, maize is a soil exhaustive crop. Rainfall varying from 500 mm to 750 mm during vegetative growth period is conducive to the proper development of maize plant. Maize is very sensitive to water particularly during the early growth and at flowering stages. Maize requires a well-tilled and highly manures soil. The preparation of soil is carried out in time to suit the sowing season which

is April to May in the Jammu Plain and May to June in the Valley of Kashmir and the Kandi and hilly areas of the state. The field is ploughed from two to three times or dug deeps with spade. Clods are broken by the female members of the cultivators' family. Before sowing, weeds and stubbles are removed and burnt. The field is ploughed two to three times to obtain a fine title. Cattle manure is also substantially applied to enhance the soil fertility. The maize plant is subject to many of the insects and pests. The crop also suffers from insects attacks on the cobs. Now many plant protection techniques like IPM / IDM have been developed to reduce the danger to the crop arising out of pests and diseases.

Cropping Pattern and Production:

Among the food-grains, the main crops are Maize (25.60 %), Wheat (20.47 %) and Rice (22.77 %) accounting for 68.84 per cent of total cropped area of the State. Besides, other crops like Barley, Bajra, Sorghum, Pulses, Oilseeds, Minor millets, Vegetables, Fodder, Flower, Aromatic and Medicinal plants are also grown in the state.

Table 1 Details of Area, Production and Yield (Year 2012 – 13)

S. N.	Crop	Area(ha)	Production (qt)	Yield (q/ha)
Jammu Division				
1.	Rice (Kharif)	114.56	3201.19	19.64
2.	Maize (Kharif)	206.40	7116.55	34.48
3.	Wheat (Rabi)	236,56	4500.00	19.02
4.	Pulses (Kh + Rb)	30.02	367.30	12.24
Total food grain		**587.54**	**15185.04**	**85.38**
5.	Oilseed (Kh + Rb)	36.91	345.30	9.35
6.	Vegetables (Kh + Rb)	32.50	6900.00	212.31
7.	Fodder green (Kh + Rb)	20.00	8000.00	400.00
Total Food grain & Other Crops		**676.95**	**30430.34**	**707.04**
Kashmir Division				
1.	Rice	158.00	5410.00	34.10
2.	Maize	100.00	2000.00	20.00
3.	Wheat	8.25	148.00	18.00
4.	Pulses (Kh + Rb)	24.50	223.00	9.10
Total food grain		**290.75**	**7781.00**	**81.20**
5.	Oilseed (Kh + Rb)	85.50	855.00	10.00
6.	Vegetables (Kh + Rb)	30.03	8360.00	278.38
7.	Fodder green (Kh + Rb)	34.00	13600.00	400.00
Total Food grain & Other Crops		**440.28**	**30596.00**	**769.58**
Total Food grain (J&K)		***878.29***	***22966.04***	***166.58***
Total Food grain & Other Crops (J&K)		***1117.23***	***61026.34***	***1476.62***

*Source: Agriculture Production Deptt***.**

Other Importance of Maize Crop

However, in spite of several important uses, maize has an in-built drawback of being deficient in two essential amino acids, viz., lysine and tryptophan. This leads to poor net protein utilization and low biological value of traditional maize genotypes. To overcome this problem, the cultivation of quality protein maize (QPM) for enhancing lysine and tryptophan content of maize endosperm protein is essential. Quality protein maize looks and taste like normal maize with same or higher yield potential, but it contains nearly twice the quantity of essential amino acids, lysine and tryptophan, which makes it rich in quality proteins.

In view of the significance of QPM for human nutritional security and ever-growing poultry sector in India, a special emphasis is being given on QPM single cross hybrid breeding. The cultivation of QPM hybrids will ensure nutritionally superior food to the rural mass as well as higher income to farmers. Therefore, the QPM may be a strong support to the mission of food and nutritional security programme of the country particularly in under privileged and tribal regions, where maize is consumed as a staple food. QPM will also ensure quality feed for poultry and animal sector which are the largest consumers of maize.

Nutritive Value of Quality Protein Maize (QPM):

Maize consists of three main parts - the hull or bran coat with high fiber content, germ rich in oil and starchy endosperm. The normal maize grain under Indian conditions on an average, contains 14.9% moisture, 11.1% protein, 3.6% fat, 2.7% fiber, 66.2% other carbohydrates and 1.5% minerals. Maize kernel protein is made up of five different fractions. The percentage of different fractions to total nitrogen in maize kernel is albumin 7%, globulin 5%, non-protein nitrogen 6%, prolamine 52% and glutelin 25% and the left over 5% is residual nitrogen. Protein being the primary structural and functional component of every living cell is one of the most important ingredients that determine the quality of food and feed.

In normal maize grain the quality of protein is poor due to the presence of largest concentration of an alcohol soluble protein fraction 'prolamine' also known as 'Zein' in the endosperm. The amount of this alcohol soluble protein fraction zein is low in immature maize. The majority of the population depends on cereals for their livelihood in most of the countries and maize is the staple cereal food throughout the world. Therefore, it was realized to improve the biological value of protein in maize genotypes. For this purpose, a new corn type known as 'Quality Protein Maize' (QPM) was developed by lowering the concentration of zein by 30%. As a result, the concentration of two essential amino acids viz., lysine and tryptophan in grain was increased in QPM genotypes as compared to normal grain maize genotypes. The lower content of leucine in QPM further balances the ratio of leucine to isoleucine content. The balanced proportion of all these essential amino acid in Quality Protein Maize (QPM) enhanced the biological value of protein. The True Protein Digestibility of normal maize and Quality Protein Maize is almost same, but the biological value of normal maize is just half as compared to that of QPM varieties rather, the biological value of QPM is highest among all the food grains because all the cereals except QPM are deficient in an essential amino acid i.e., lysine, and all pulses are deficient in other essential amino acid i.e.,

methionine. The quality parameters viz., protein content, lysine & tryptophan content of QPM hybrids released for their cultivation in India are given in Table.

Table 2 Comparisons on Essential Amino Acid Content in Normal Maize and QPM Grain

Amino Acid	Amino Acid Content (mg per g N)	
	Normal grain	QPM grain
Lysine	177	256
Isoleucine	206	193
Leucine	827	507
Sulfur amino acids	188	188
Aromatic amino acids	505	502
Threonine	213	199
Tryptophan	35	78
Valine	292	298

Table 3 Protein Quality of Maize Grain

Quality measures	Normal	QPM
True protein digestibility (%)	82-91	92
Biological value (%)	40-47	80
Amount needed for equilibrium	547	230

Table 4 Quality Characters of QPM Hybrids Released in India

Hybrid Name	Hybrid Type	Protein content in grain (%)	Tryptophan content in protein (%)
HQPM-7	Single cross	9.42	0.72
Vivek QPM-9	Single cross	8.46	0.83
HQPM-5	Single cross	9.80	0.76
HQPM-1	Single cross	9.36	0.94
Shaktiman-4	Single cross	9.98	0.93
Shaktiman-3	Single cross	9.63	0.73
Shaktiman-2	Single cross	9.30	1.04
Shaktiman-1	Three way cross	9.60	1.01

Uses of Quality Protein Maize:

The different parts of the plant and the grain are put to a number of industrial uses. Moreover, the grains form an important cattle food, being fed to farm cattle and horses. The silk threads of maize are used as a filter; husks for making of mattresses; cobs for the making of corn pipes. The stalks and cobs are used for the preparation of furfural. Oil is also extracted from maize which is used for cooking, glucose, and dextrin. Maize provides huge quantities of fodder to the cattle. In India, the maize is mainly consumed as feed (61%) and food (25%) and hence, QPM being superior in quality has better option in these sectors. The main uses of QPM are described as under

- **Food and Nutritional Security**: The Quality Protein Maize (QPM) has got special attention among the cereals due to presence of high amount of two essential amino acids viz., lysine and tryptophan and low content of non desirable amino acid (leucine). The QPM may be utilized for diversified purposes in food and nutritional security programme as infant food, health food / mixes, convenience foods, and emergency ration. It is also useful in fulfilling the protein requirements of different rural sections of society like infants, lactating mothers' and old persons etc. to prevent malnutrition problem. It's green cob is very nutritious, tasty and liked by people. The Quality Protein Maize (QPM) has been found superior food for human being.

- **Providing Nutritious Feed:** Due to increase in population demands of poultry and pork is increasing in global market for which maize is the major source of feed that indicates growing demand for maize globally. India being the 5th largest poultry producer in the world with a very high growth that consumes 49 % of the total maize production as poultry feed. This increase in demand of the total maize production would raise the further demand of QPM. Quality Protein Maize (QPM) with its high carbohydrates, fats, better quality proteins, some of vitamins and minerals, it is also nutritious feed for poultry, livestock, swine, fish, etc. Use of QPM as poultry feed leads to early development of broilers, save energy and feed, and also the extra cost incurred on lysine and tryptophan fortification.

- **Promoting Maize Based Entrepreneurship:** The nutritious products developed from QPM will add value to highly priced industrial foods like cornflakes etc. The high value products can also be prepared at village level and can be a great source of rural entrepreneurship development, employment generation and rural prosperity.

Maize Production Technology:

In general, the management practices for quality protein maize (QPM) are almost same as normal grain maize. However, there are few specific considerations for higher productivity with good quality and better resource use efficiency which are described as follows.

Areas Suitable for Cultivation:

QPM maize can be grown in most parts of the country from plains to high altitudes of up to 2700 mtrs. Due to the highly cross pollinated nature of the crop there is chances of contamination from traditional maize cultivars. For maintaining the purity and superior quality of the QPM,

maintenance of isolation distance or sowing time difference is required to ensure the purity of the crop.

Soils:

QPM can be grown successfully in wide range of soils ranging from loamy sand to clay. However, soils rich in organic matter content having high water holding capacity with neutral pH are considered good for higher production. Low lying fields having poor drainage capacity should be avoided due to sensitive nature of crop to moisture stresses particularly excess soil moisture. Therefore, the fields having provision of proper drainage should be selected for cultivation of maize.

Cultivars:

In India, among nine popularly grown cultivars in which seven are single cross hybrid, one is three way cross hybrid and one is composite of QPM having different maturity period and grain colour have been developed by the public sector Institutes. These cultivars have been developed and find suitable for their cultivation under different agro-climatic conditions of India having compatibility under different cropping systems and preference of the local people. However, farmers are advised to grow single cross hybrids for higher productivity but for the areas like tribal and high risk prone regions where hybrids cannot reach in time due to seed constraints, the farmers can go for cultivation of composites.

Time of Sowing:

The QPM can be grown in all seasons viz; kharif, post monsoon, rabi and spring. Kharif season is best suited for higher productivity particularly under hilly conditions of Jammu and Kashmir. If, there is facility of irrigation available the sowing should be done 12-15 prior to onset of monsoon. However, in rainfed areas, the sowing time should be coincided with onset of monsoon. The optimum time of sowing in different agro-climatic zones is given in Table 5.

Table 5 Optimum sowing time in different seasons

Area	Optimum Time for Sowing	
	Irrigated	Unirrigated
Subtropical	First fortnight of June to 15th July	With the onset of monsoon
Intermediate	Last week of May to first week of June	With the onset of monsoon
Temperate	Sowing can be done from 15th April to 15th May	Sowing can be done from 15th April to 15th May

Seed Rate and Plant Population:

The seed rate depends on seed size, season, sowing methods and the planter but, in general, 20 kg seed/hectare is optimum for higher productivity and input use efficiency. A plant population of about 70000 to 80000/hectare with plant geometry of 60x70x20cm (row to row x plant to plant)

is optimum depending upon the season.

Seed treatment:

To protect the seed from major soil borne diseases and insect-pests, it is always advisable to treat the seed with fungicides and insecticides before sowing.

Method of sowing:

Mainly the maize is sown directly through seed but during winters where fields are not vacant in time (till November), transplanting can be done successfully by raising the nursery. However, the method of sowing depends on season, cropping system, soil conditions and time of planting. The sowing methods for situation specificity are described as follows-

(i) Raised Bed Planting: In general the raised bed planting is best planting method for maize during monsoon and winter seasons both under excess moisture as well as limited irrigation availability conditions. Sowing should be done on the southern side of the east-west ridges/beds, which helps in good germination. Planting should be done at proper spacing. Preferably, the raised bed planter having inclined plate, cupping or roller type seed metering systems should be used for planting that facilitates in placement of seed and fertilizers at proper place in one operation that helps in getting good crop stand, higher productivity and resource use efficiency. Using raised bed planting technology, 20-30% irrigation water can be saved with higher productivity. Moreover, under temporary excess soil moisture/water logging due to heavy rains, the furrows will act as drainage channels and crop can be saved from excess soil moisture stress.

(ii) Zero-tillage Planting: Maize can be successfully grown without any preparatory tillage under no-till situation with less cost of cultivation, higher profitability and better resource use efficiency. Under such condition one should ensure good soil moisture at sowing and seed and fertilizers should be placed in band using zero-till seed-cum-fertilizer planter with furrow opener as per the soil texture and field condition. Large number of farmers particularly under rice-maize systems in peninsular and eastern India are practicing successful zero tillage planting and getting higher farm profitability.

(iii) Transplanting: Maize can also be established and grown successfully with transplanting during winter season. Under intensive cropping systems where field are not vacant in time and where chances of delayed planting exists. Therefore, for the situation where

fields are vacated during December- January, it is advisable to grow nursery and transplant the seedlings in furrows and apply irrigation water for proper establishment. Using this technique, temporal isolation can also be maintained in corn growing regions for purity and good quality of QPM. For one hectare, 700 m^2 area is required for nursery and the nursery should be raised during second fortnight of November. The 30-40 days old seedlings (depending on the growth) should be transplanted during December-January in furrows as the yield in furrows is always higher than flat.

(iv) **Flat Planting:** For rainfed areas and on conserved moisture, flat planting can be done using seed-cum-fertilizer planters.

(iv) **Furrow Planting:** During spring season, it is always advisable to grow maize in furrows for proper growth, seed setting and higher productivity.

Nutrient Management:

Maize in general and hybrids in particular are very responsive to nutrients. Besides, chemical fertilizers, it is very responsive to organic manures. The application of nutrients depends mainly on soil nutrient status and cropping system. For getting desirable yields, the nutrient applications should be done in such a way that matched the soil supplying capacity and plant demand (SSNM approach) keeping in view of the preceding crop (cropping system). Results of multi location trails revealed that SSNM approach led to remarkably higher productivity over existing recommended practice across the ecologies. The maize in general responds well to organic manures. The results of integrated nutrient management (INM) trials on QPM Maize demonstrated the response of QPM to FYM. Therefore, in general application of 10 tonne FYM per hectare, 10-15 days prior to sowing supplemented with 150-180 kg N, 70-80 kg P_2O_5, 70-80 kg K_20 and 25 kg $ZnS0_4$ per hectare gives higher economic yields. Under rainfed or un-irrigated conditions the reduced doses of fertilizer is used. Full doses of P., K., and Zn should be applied as basal. Results of multi-location trials carried out under AICRP on maize revealed that application of nitrogen in 5-splits (as mentioned below) leads to higher productivity and nitrogen use efficiency compared to recommended 3-splits doses. N application at grain filling results in better grain filling. Therefore, nitrogen application should be done in five splits as mentioned below for higher nitrogen use efficiency.

Use of Nitrogen

1. 10 % N should be applied as basal
2. 20 % N at 4 leaf stage
3. 30 % N at 8 leaf stage
4. 30 % N at flowering stage
5. 10 % N at grain filling

Water Management:

The water management depends on season as about 80% of maize is cultivated during monsoon season particularly under rainfed conditions. However, in areas with assured irrigation facilities depending upon the rains and moisture holding capacity of the soil, irrigation should be applied as and when required by the crop and first irrigation should be applied very carefully wherein water

should not overflow on the ridges/beds.

In general, the irrigation should be applied in furrows up to 2/3rd height of the ridges/beds. Young seedlings, knee high stage, flowering and grain filling are the most sensitive stages for water stress and irrigation should be ensured at these stages.

In raised bed planting system, the crop can also be irrigated in alternate furrow to save more irrigation water.

In rainfed areas, tied-ridges are helpful in conserving the rainwater for its availability in the root zone for longer period.

Weed Management :

Weeds are the serious problem in maize, particularly in monsoon season that competes with maize for nutrient and causes yield loss up to 35 per cent. Therefore, timely weed management is needed for achieving higher yield. Atrazine being a selective and broad-spectrum herbicide in maize checks the emergence of wide spectrum of weeds. Pre-emergence application of Atrazine @ of 1.0-1.5 kg a.i ha in 600 litre water is effective way for control of weeds. While spraying, the person who is doing spray should move backward so that the Atrazine film on the soil surface may not be disturbed. Preferably three boom flat fan nozzle may be used for proper ground coverage and saving time. One to two hoeing are recommended for aeration and uprooting of the remaining weeds, if any. While doing hoeing, the person should move backward to avoid compaction and better aeration. For areas where zero tillage is practiced, pre-plant application (10-15 days prior to seeding) of non-selective herbicides viz., Glyphosate @ 1.0 kg a.i. ha in 400-600 litre water or Parquet @ 0.5 kg a.i. / ha in 600 litre water is recommended to control the weeds.

Crop protection:

Insect-pest management:

Maize stalk borer *(Chilo partellus)* is a major pest during monsoon season throughout the country that lays eggs on lower side of the leaves 10-25 days after germination. The larva of the Stalk borer enters in the whorl and cause damage of leaves. Whereas Pink stem borer (*Sesemia inference*) occurs during winter season particularly in peninsular India where winter maize is important crop and the moth of the Pink stem borer is nocturnal and lays eggs on lower leaf sheath. The larvae of the Pink stem borer enter the plant near the base and cause damage to stem. For control of Stalk borer, foliar spray of Dichlorvas (30 EC) @ 2 ml per liter of water is recommended after 10 days of germination is effective. It can also be controlled by release of 8 Trichocards *(Trichogramma chilonis)* per ha at 10 days after germination. Intercropping of cowpea with maize is an eco- friendly option for reducing the incidence of Stalk borer on maize. Results of the trials conducted on maize revealed that compared to other crops, the Stalk borer egg load on maize was drastically reduced when it was intercropped with cowpea. Termite is also

an important pest in many areas and for control of this Carbofuran (3 G) granules should be applied @ 20 kg ha-1 followed by light irrigation. If the termite incidence is in patches, Carbofuran (3G) should be applied as spot application @ 2-3 granules/plant.

Disease management:

Several diseases occur during different seasons in various parts of the country that leads to loss to yield if not managed properly in time. Estimated losses due to major diseases of maize in India is 13.2% of which foliar diseases (5%), stalk rots, root rots, ear rots (5%) cause major yield losses. The major diseases and their management practices are described as below-

- **Turcicum Leaf Blight (TLB):** Spray Zineb/Meneb @ 2.5-4.0 g/Liter of water (2- 4 applications) at 8-10 days interval
- **Maydis Leaf Blight (MLB):** Spray of Dithane Z - 78 or Zineb @ 2.5 - 4.0 g /liter of water (2-4 applications) at 8-10 days interval after first appearance of symptoms of disease
- **Polysora Rust:** Three sprays of Dithane M-45 @ 2-2.5 gm/liter beginning from first appearance of symptoms at 15 days interval.
- **Banded leaf and sheath blight (BLSB):** Seed treatment of peat based formulation (*Pseudomonas fluorescence*) @ 16 g/kg of seed or as soil application @ 7g / liter of water (soil drenching) or foliar spray of Sheethmar (Validamycin) @ 2.5 ml/liter water.
- **Post Flowering Stalk Rot of Maize (PFSR):** Avoid water stress at flowering. Use balance dose of nutrients wherein potassium application helps in minimizing the disease. Use of bio-control agents (*Trichoderma* Formulation) in furrows after mixing with FYM (@ 10^9 spores/kg FYM) at 10 days prior to its use in the field.
- Downy mildews (DM): Seed treatment with fungicides like Apron 35 WS@ 2.5 g/kg seed,

Harvesting and Post Harvest Management:

Harvesting should be done at optimum moisture content (20%) in grain to avoid post harvest losses due to store grain pests and diseases. The harvested cobs should be sun dried before shelling and should be shelled at 13-14 % grain moisture. Shelling can be done manually or by power operated maize sheller. For proper storage of the grain, drying should be done till the moisture content is reduced to 8-10 % and should be kept in aerated jute bags.

Seed Production Technology of Quality Protein Maize Single Cross Hybrid

Isolation Distance :

If possible, the hybrid seed production should be taken either in the area where no other maize variety is planted nearby the seed production plot or at least 400-500 meters distance is required between two maize genotypes to maintain the genetic purity.

Parents			Female	Male
Vivek QPM 9			VQL 1	VQL 2
HQPM 4			HKL 163	HKL 161
Sowing time			First week of July in Kharif and Last week of August for post monsoon	
Seed rate			Female	Male
			15 kg/ ha	10 kg/ ha
Female: Male ratio			3:1	
Spacing			Row spacing (East- West direction) : 60 cm Plant spacing : 20 cm	
Nutrient Management			FYM@ 15 tonnes / ha	
N	**P_2O_5**	**K_2O**	**$ZnSO_4$**	**Remarks**
200 kg	80 kg	80 kg	25 kg	Recommendation of Directorate of Maize Research (Under Irrigated Condition)
90 kg	60 kg	30 kg	25 kg	Recommendation of SKUAST - Jammu (Under Irrigated Condition)

Total FYM, full doses of phosphorus, potash and zinc and 10 % N should be applied as basal. The remaining dose of nitrogen should be applied in four splits as per details given below to avoid losses and meet the requirement throughout the crop cycle.

Use of Nitrogen

i. 20% N at 4 leaf stage
ii. 30% N at 8 leaf stage
iii. 30% N at flowering stage
iv. 10% N at grain filling

Water Management:

Irrigation should be given as and when required by the crop depending upon the rains and moisture holding capacity of the soil. Light and frequent irrigations are desirable Young seedlings, knee high stage, flowering and grain filling and 10 days after grain filling are the most sensitive stages for water stress for inbred and irrigation should ensured at these stages. Water should not overflow on the ridges. The irrigation should be applied in furrows upto 2/3rd height of the ridges

Weed management:

Weeds are the serious problem in maize, particularly in wet (monsoon) season that competes with maize for nutrient and causes yield loss up to 35 %. Atrazine being a selective and broad-spectrum herbicide in maize checks the emergence of both broad leaves and most of the grasses. Pre-emergence application of atrazine @ of 1.0-1.5 kg per ha in 600 litre water is effective for controlling weeds. While spraying, the person who is doing spray should move backward so that the Atrazine film on the soil surface may not be disturbed. Preferably, three nozzle booms may be used for proper ground coverage and saving time. One to two hoeing are recommended for aeration and uprooting of the remaining weeds.

Insect Pest Management:

Stem borer is a serious problem in maize. It can be controlled by 1-2 spray of Dichlorovas (30EC @ 2ml / litre water) after 10 days and 20 days of germination. Application should be done in the central whorl of plant.

1st spray 1000ml Dichlorovas (30 EC) or 750ml Methyldemeton (25 EC) in 500 liters water after 10 days of germination.

2nd spray 1000ml Dichlorovas (30 EC) or 750ml Methyldemeton (25 EC) in 500 liters water after 25 days of germination.

Removal of Off-type Plants and Thinning:

i) At early stage i.e. after 12-15 days of sowing, off-type plants and excess plants should be removed and proper plant to plant distance of 20-25 cm should be maintained to provide an equal opportunity to each plant to grow,
ii) At knee height stage and
iii) At flowering i.e. before anthesis

Dissimilar plants should be removed from the male and female lines to maintain the genetic purity of seed. Dissimilar tassel bearing male plant should also be removed.

Earthing Up:

One day prior to earthing up, third split of nitrogen should be applied followed by hoeing. On the next day earthing up operation should be completed with movement of the person in the backward direction. This operation should be done before teaseling stage to save the crop from lodging.

De-teaseling:

De-teaseling in female should be done before anthesis. It should be practiced row-wise. One person should follow to monitor the each row to check that no part of the tassel is left inside. The process of de-teaseling should continue for 8-10 days. While de-teaseling, leaf should not be removed which will otherwise reduce the photosynthesis. It has been observed that the removal of 1 to 3 leaves along with tassel reduces 5-15 per cent yield. The removed tassel should not be thrown in the field but fed to the cattle as it is nutritive fodder.

Harvesting:

Male parent should be harvested first than the female and should be kept separately. Optimum moisture content in grain at harvesting should be around 20 per cent. The harvested cobs should spread evenly instead of making heap.

Stages of crop inspection:

(i) At the time of sowing: to monitor the land, isolation distance, planting ratio of male: female, proper sowing time, seed treatment

(ii) During pre-flowering / vegetative stage: to verify the rouging and removal of off type plants

(iii) During flowering stage: to check disease and pest infestation

(iv) During post-flowering and pre-harvest stage: to remove the late and diseased plants Harvesting time: to see the proper time of harvesting

POST HARVEST MANAGEMENT:

Drying and sorting of seed parent cobs:

The drying of the cobs should not be done either on the kuccha or pucca flour, rather it should be dried on polythene sheets to avoid seed injury and during night the cobs should be kept covered. To maintain the purity, dissimilar, diseased and pest infested cobs should be removed before shelling. The female cobs should be dried upto 13-14 per cent moisture content before shelling.

Shelling:

Shelling of female parent should be done earlier than male to avoid mechanical mixture. Shelling can be done manually or by power operated maize sheller.

Seed Processing:

All under size, broken, damaged etc seeds should be removed for maintaining the quality of seed.

Storage and Marketing:

Seed drying should be done till the moisture content of the seed is reduced to 8 per cent and it should be kept in aerated jute bags. Seed should be stored at cool and dry place preferably in cold storage. Poor storage conditions will lead to loss of vigor and poor germination. Marketing should be done with specifications and standards.

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7

PROMOTING ORGANIC FARMING ON MOUNTAIN STATES : SOME TECHNOLOGY INTERVENTIONS

Introduction: Organic farming is an ancient agriculture system in India and very much associated with our culture. This concept has been re-established by modern science. Basically the organic farming was conceptualized first by Sir Albert Habard in 1930 which was including, crop rotation, green manuring, use of organic fertilization, bio-pesticides, bio-fungicides and natural minerals, to maintain crop productivity and soil health for long time. The main principal of organic farming is the use of Natural Resources and environmental friendly technologies for maintaining crop productivity, soil fertility and crop protection.

Importance of organic farming: Organic farming is not only good for soil health but also good for human health who consume food products produced through organic agriculture.

Long lasting soil productivity and stability: Use of organic fertilization maintain the soil fertility for long time. It produces adequate minerals to the soil, maintain soil, structure, composition, porosity, water holding capacity etc. which ensure higher productivity for a long time.

Low cost production: The organic farming is low cost system of agriculture in which farmers produce organic manure, bio-pesticides etc. by their own resources. Therefore, the production cost is low, as compared to use of commercial chemical fertilizers and insecticides.

Maintain Environmental Purity: The production and use of synthetic inorganic fertilizers and pesticides not only damage our soil but also pollute our environment. They also kill the useful microbes and fungi and other useful organization associated with our agriculture system.

Organic agriculture is good for human health: The excessive use of synthetic chemicals and fertilizers is acting as a slow poison for human being. Use of organic farming can help to get rid of these slow poisons, which are hazardous to human health.

Low water requirement: The soils rich in organic matter have more water holding capacity, that is why good crops can be produced even with low irrigation or rainfall.

Importance of cattle in organic farming: The domestic cattle play a major role in our ancient agriculture system and livelihood. This has been replaced by chemical fertilizers and modern agriculture, tools and machines. That leads to loss of our precious cattle biodiversity which is not a good sign. Organic farming has special place for our domestic cattles, animals and have direct impact on our prosperity.

Ensuring quality of food through organic farming:

- Restoration of all important minerals nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, carbon, hydrogen, oxygen, sulphur, zinc, copper, iron, boron, chlorine, molybdenum etc. in our food products.
- Farmers get high price in the market for organic agriculture produce.
- Export possibilities of organic food are more.

Green manure as Organic fertilizer: Dhaincha, Sanai, Gwar, Lobia, Yellow shengi, Moong etc. are generally grown as green manure. The agriculture field is ploughed deeps when crop is young and irrigated. The green biomass is converted into organic manure by fast decomposition and the field is ready for crop cultivation.

Biogas slurry as compost : The cow dung slurry used in biogas has double the available NPK for plants (1.5 to 2% Nitrogen, 0.86 to 1.04% Phosphorus and 1.0 to 1.5 % Potash). By using biogas discharged cow dung slurry, we can increase 25 to 30% crop production. Hence, farmer is benefited in two ways (i) the biogas generated is used for cooking and (ii) the residue discharge as organic fertilizer for crops.

Cow urine as organic fertilizer and bio insecticide: The cow urine had been used in Ayurveda for various medicines since long time however; its use as fertilizer and bio insecticide has also been recognized since long time. On mountains fresh cow urine is given to mother during early days of delivery as medicine. The seeds of major crops are treated with cow urine mixed with ash, dried and then stored. This treatment protects them from all insect/pest infestation for long time during storage. The spray of cow urine on leaves of crop plants also check insect/ pest /pathogen attack.

Cow urine has about 95% water and 4 % solid waste. The solid waste of cow urine generally consist of 92% organic products, 5 % mineral, 1.3% potash, 0.01% phosphorus and generally mixed with cow dung to produce compost as organic fertilizer.

Compost and Vermi compost: The compost is prepared from all organic waste including cow dung, cow urine, litter, weeds, agriculture waste, kitchen waste etc. The organic waste is filled in the pits of different sizes depending up on the quantity of litter / organic waste available. The bacteria, fungi and earthworms digest it and convert it into organic manure in 6 to 8 months. This properly digested manure considered to be the healthiest fertilizer for improving the soil fertility and increase crop production.

The vermi compost is another way of producing compost using earth worms. It is a faster method of converting cow dung and other litter in to well digested compost. The use of vermi compost has following benefits.

- Use of vermi compost help in controlling termites and other harmful insects / pest and pathogens, thus the cost of crop protection get reduced.
- It also control weeds to some extent hence, reduce the labour cost.
- By using vermi compost the soil fertility and availability of mineral contents can be maintained for 2 to 3 crops.
- The quality of the agriculture produce is high by use of vermi compost and the farmer gets batter prize for his produce.
- The vermi compost contains the growth hormones like auxins, gibberellins, and cytokines etc which are not available in other organic manures.
- Vermi compost helps the growth and establishment of VAM fungi and nitrogen fixing bacteria. It also improve the acidity and alkalinity of the soil and make it batter for crop growth.
- Vermi compost is complete environment friendly fertilizer.

Technologies intervention:

Cow dung manure: In traditional method, the cow dung is collected and kept in open in form of a hive which generally spread over a bigger area, gives falls smell and takes long time in decay and

converting into manure. However, if kept in a perforated pits of any size depending upon availability of cow dung and mulched on the top for maintaining moisture helps faster bacterial & fungal activity in combination with earthworms and a well digested cow dung manure is ready for use in less than six months which otherwise takes 8 to 10 months in normal course.

Compost: This type of organic manure is prepared from all type of organic litter, dry leaves, agriculture waste etc in combination with cow dung and cow urine mixed in pits. In this process one feet thick layer of litter spread over the bottom of the pit covered by 6 inch thick layer of cow dung again litter layer followed by cow dung till the pit is filled one feet above the surface of the pit. A fine layer of wet mud converging is provided at the tops to minimize moisture loss. The pits watered as and when required. Perforated pits for proper aeration leads to faster bacterial and fungal activity. In this way batter quality organic manure is prepared in four to six month.

Vermi compost: The cow dung manure is filled in 3 x 10 x 1 feet (width, length and height) of pits. One kilogram earthworms are spread over each bed. The worms' penetrate inside themselves and starts digesting the cow dung. The area needs to be thatched by grass to protect the beds from direct sun. The moisture of the beds needs to be maintained. The well digested manure is sieved and filled in sacks however, the worms are reused for next set of vermi composting.

Organic Bio pesticides:

Cow urine: Cow urine is most effective organic pesticide have around 33 elements present in it, which helps in controlling, pests pathogens and bacterial growth and keeps the crop healthy.

Preparation method:

1- Collect 10 litres local cow urine in a copper container. Add 1 kg Neem leaves and keep it for 15 days to melt the leaves completely in cow urine. After that boil it till the concentrate becomes 5 litters filter and cool the filtrate then dilute it 100 times with normal water and spray on crops. If 50 gram garlic is added in this solution, it becomes more effective for controlling different insects and their larvae.

2- 200 ml of cow urine is mixed with 15 litres of water and sprayed directly on crops after 15 days of sowing at an interval of 10 days regularly. It keeps the crops protected from all pest, pathogens and bacterial attack

3- 40 litres Cow urine + 500 gm Tobacco + 500 gm Garlic + 4 kg Neem leaves + one piece of copper mixed in a cement tank or earthenware pot and kept for 21 days. The mouth of the tank / container

should be covered. After 3 weeks (21 days) the mixture should be boiled and filtered. The filtrate (1 litre mixed with 30 litres of water) is sprayed on crops. Repeat it in 15 days interval for complete protection.

4- Neem fruit pulp : 50 gram Neem fruit pulp is kept in a malmal cloth and dip in one liter of water for overnight. In the morning remove the cloth with pulp. The solution is boiled and cooled. A small pouch of shampoo is added in the solution so that it should stick on the leaves of the crop plants and sprayed on crops.

The Neem leaf concentrate: The 1 kg Neem leaves are shocked in 5 litres of water overnight later grind it with water and filter the solution. Add one pouch of shampoo in the filtrate and spray on crops. The solution is found effective in controlling leave defoliators.

Neem oil: 30 ml of Neem seed oil is mixed with 1 litre of water. Add 1 pouch of shampoo as sticky material and spray it immediately on the crops.

Butter milk: 5 litres butter milk (chhanch) is kept in copper container or earthen were pot and buried under soil for 10 days. Then this butter milk is mixed with 100 litres of water and sprayed on crops for controlling different pest.

Bakain/drak/*Melia composita* or *M. azadirach*: The leave of bakain are also found effective bio-pesticides. The 1 kg leaves are shocked in 5 litres of water for overnight. Then filtered, add one pouch shampoo in the solution and sprayed on crops.

Precautions on and after spray of bio-insecticides:

- The solution should not be inhaled rather nose and mouth need to be covered with thin cotton cloth.
- The solution used immediately after it is prepared.
- The solution is kept away from the reach of children's and animals.
- Clean your hands and face with soap after spray.
- The spray should reach to the lower surface of the leaves as well.
- The spray has preferably to be done in the evening hours.
- The utensils used for making spray should be kept separate from the other cooking utensils.
- Cover your skin and face while spraying on crops and avoid touch of the solution on skin.

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