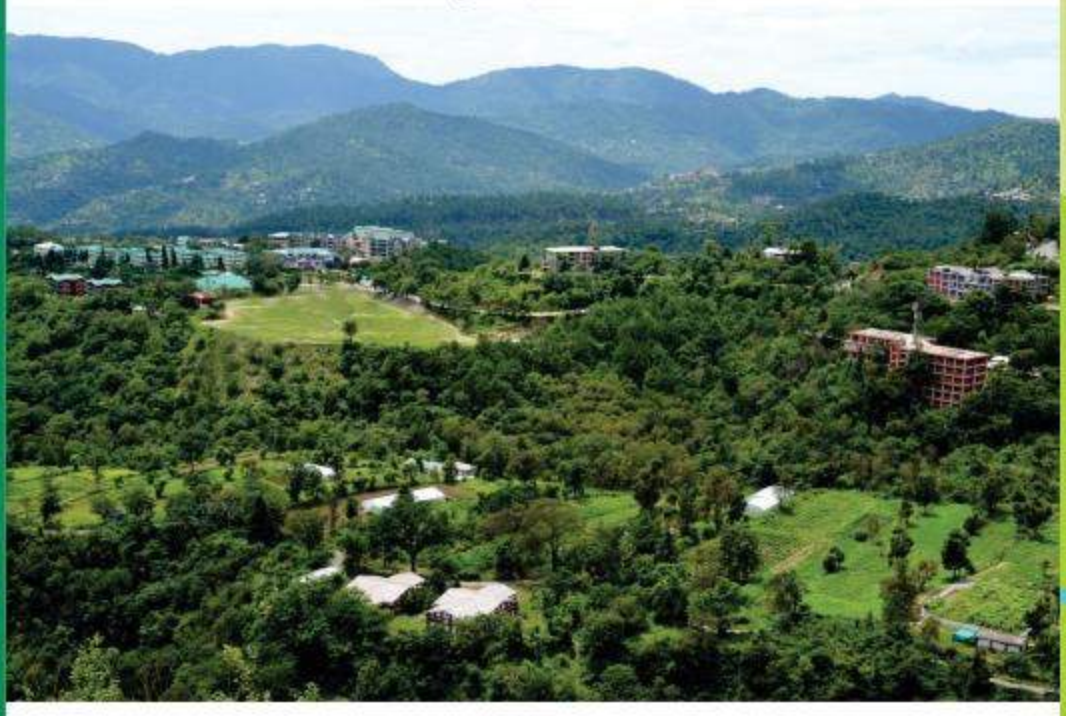
SOUVENIR

Indian Agricultural Universities Association's
9th Brain Storming Session cum
Vice-Chancellors Conference

on

Alternative Farming Systems Involving Horticulture to Increase
Crop Productivity and Doubling Farmers' Income

May 3-4, 2018



Dr YS Parmar University of Horticulture and Forestry
Nauni, Solan Himachal Pradesh-173230

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ब्लॉक संख्या 32, एस.डी.ए. कामर्शियल कॉम्पलेक्स, कसुम्पटी, शिमला – 171009, टेली – +91177 2622258, 2624380, 2623323 फैक्स: +911772622271, ई मेल:shimla@nabard.org

Himachal Pradesh Regional Office

Block No.32, S.D.A. Commercial Complex, Kasumpti, Shimla-171009, Tel.+91177 2622258, 2624380, 2623323, FAx: +911772622271 Email : shimla@nabard.org

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Published by :
Dr YS Parmar University of Horticulture and Forestry,
Nauni, Solan (HP)-173230

सत्यमेव जयते

आचार्य देवव्रत
राज्यपाल
हिमाचल प्रदेश
Acharya Devvrat
Governor
Himachal Pradesh

संदेश

यह प्रसन्नता का विषय है डॉ. यशवन्त सिंह परमार औद्यानिकी एवं वानिकी विश्वविद्यालय, नौणी, सोलन द्वारा भारतीय कृषि विश्वविद्यालय संघ के तत्वावधान में 3 और 4 मई, 2018 को ''फसल उत्पादकता में वृद्धि व किसानों की आय दोगुनी करने के लिए बागवानी से जुड़ी वैकल्पिक कृषि पद्धति'' पर विचार मंथन एवं कुलपति सम्मेलन का आयोजन किया जा रहा है।

देश की करीब 60 प्रतिशत जनसंख्या कृषि पर निर्भर करती है और हिमाचल प्रदेश में लगभग 80 प्रतिशत जनसंख्या कृषि, बागवानी एवं संबद्ध गतिविधियों से जीवकोपार्जन करती है। कृषि क्षेत्र में आज देश के समक्ष सबसे बड़ी चुनौती स्वस्थ्य के लिए उत्तम उत्पाद के साथ-साथ किसानों की आय बढ़ाने की है। भारत सरकार ने वर्ष 2022 तक किसानों की आय को दोगुना करने का लक्ष्य निर्धारित किया है, जिसपर हर स्तर पर ठोस प्रयास किए जा रहे हैं।

इस दिशा में मैने शून्य लागत प्राकृतिक कृषि पद्धति का विकल्प दिया है। इस पद्धति से जहां किसानों की आय दोगुनी होगी वहीं पर्यावरण बचेगा, मिट्टी की उर्वरा शक्ति बढ़ेगी, पानी की कम खपत होगी और उत्पाद स्वास्थ्य की दृष्टि से लाभदायक होगा।

मुझे विश्वास है कि सम्मेलन में देश से आये वैज्ञानिकों के अनुभव व सुझाव किसान हित में होंगे और इस पद्धति को आगे बढ़ाने में सहायक सिद्ध होंगे।

सम्मेलन के सफल आयोजन की हार्दिक शुभकामनाएं।

(देवव्रत)

राज भवन, शिमला-171002
Raj Bhavan, Shimla-171002
0177-2624840, 2624451
0177-2624440, 2624152
governorsecy-hp@nic.in

Jai Ram Thakur
CHIEF MINISTER
HIMACHAL PRADESH
SHIMLA-171 002
Tel. : (O) +91-177-2625400
(R) +91-177-2621384
Fax : +91-177-2625011
E-mail : cm-hp@nic.in

Message

It is a matter of immense pleasure that Dr. Y.S. Parmar University of Horticulture and Forestry Nauni, Solan, in collaboration with the Indian Agricultural Universities Association is organizing 9th Brain Storming Session cum Vice Chancellors Conference on the theme "Alternative Farming Systems involving Horticulture to Increase Crop Productivity and Doubling Farmer Income" on 3rd and 4th May, 2018 and a Souvenir is also being brought out to mark the occasion.

Agriculture sector needs optimum use of latest technology to maximise output as the Indian agriculture suffers from low productivity. Droughts are the major threats for agriculture sector which reduce agricultural income substantially as over 60 percent of farming is rain dependent.

I hope the conference would certainly go along-way in bring desired results for preparing policies and programmes in agriculture sector and suggesting new techniques to be introduced in agro-horti sectors.

I wish the grand success to the Conference.

(Jai Ram Thakur)

Mahender Singh Thakur
Irrigation & Public Health, Horticulture
and Sainik Welfare Minister
Himachal Pradesh.

Tel. 0177-2621938 (O)
2625754 (R)
Mob. 98059-65952
D-No- 8055
Date- 05-04-18

Message

I am immensely pleased to know that Dr. Y.S. Parmar University of Horticulture and Forestry in collaboration with Indian Agricultural University Association is organizing 9th Brain Storming session cum Vice Chancellors Conference on 3 May, 2018. To commemorate the occasion, a souvenir is also being brought out.

I am very much impressed with the theme "Alternative Farming system involving Horticulture to increase crop productivity and doubling farmer's income" which is going to benefit the farmers directly.

I am sure that this session would be help to all, through this we will be able to create awareness regarding benefits of alternative farming among farmers and it will be productive in achieving the goal of doubling their income by 2022.

I extend my best wishes for the successful event and publication of souvenir.

(Mahender Singh)

Dr. Ram Lal Markanda
Agriculture, Tribal Development
and Information Technology Minister
Himachal Pradesh,Shimla-171 002

Message

I am extremely happy to know that Dr. YS Parmar University of Horticulture and Forestry Nauni, Solan in collaboration with the Indian Agricultural Universities Association, is organizing the 9th Brain Storming Session cum Vice Chancellors Conference on the theme "Alternative Farming Systems Involving Horticulture to Increase Crop Productivity and Doubling Farmer's Income" on 3rd and 4th May, 2018 at Nauni and a souvenir is being brought out to mark the occasion.

As we all know that two-third population of Himachal Pradesh works in Agriculture and Horticulture sector. Prime Minister of India has declared that the farmer's income is to be doubled by 2022 and has also called upon the scientists and policy makers for their sincere and extraordinary efforts in this direction. Keeping in view the Prime Minister's declaration and vision, we sincerely intend to transform the farm and horticulture economy in H.P. by taking the various initiatives. I, understand that this brain storming session being a part of exercise would go a long way in developing the strategies for doubling the farmer's income in India.

I am hopeful that deliberations and the exchange of ideas during the conference will come out with new ideas which will help to achieve the goal.

I extend my best wishes for the grand success of the conference and hope that all the delegates will return with a new vision and vigour to carry out meaningful research.

Dr. Ram Lal Markanda

गोविन्द सिंह ठाकुर
वन, परिवहन, युवा सेवाएं एवं खेल, मंत्री
हिमाचल प्रदेश
शिमला – 171002

Message

It is a matter of great pleasure that Dr. YS Parmar University of Horticulture and Forestry Nauni, Solan in collaboration with the Indian Agricultural Universities Association, is organizing the 9th Brain Storming Session cum Vice Chancellors Conference on the theme **"Alternative Farming Systems Involving Horticulture to Increase Crop Productivity and Doubling Farmer's Income"** on 3rd-4th May, 2018 at Nauni and a souvenir is being brought out to commemorate the occasion.

As we all aware, that Prime Minister of India has called upon the scientists and policy makers to double the farmers' income by 2022. Keeping in view the Prime Minister's declaration, we sincerely intend to transform the agriculture and horticulture economy in Himachal Pradesh by taking the various initiatives. The State government under the World Bank funded Horticulture Development Project of Rs.1134 crore, has proposed to utilize Rs. 100 crore on this project during this financial year. I, hope that this brain storming session being a part of exercise would go a long way in developing the strategies for doubling the farmers' income in India.

I am hopeful that deliberations and the exchange of ideas during the conference will come out with new ideas which will help to reach the goal.

I extend my best wishes for the grand success of the conference and hope that all the delegates will return with a new vision and vigour to carry out meaningful research.

(Govind Singh Thakur)

सत्यमेव जयते

भारत सरकार
कृषि अनुसंधान और शिक्षा विभाग एवं
भारतीय कृषि अनुसंधान परिषद्
कृषि एवं किसान कल्याण मंत्रालय, कृषि भवन, नई दिल्ली 110 001

GOVERNMENT OF INDIA
DEPARTMENT OF AGRICULTURAL RESEARCH & EDUCATION
AND
INDIAN COUNCIL OF AGRICULTURAL RESEARCH
MINISTRY OF AGRICULTURE AND FARMERS WELFARE
KRISHI BHAWAN, NEW DELHI 110 001
Tel.: 23382629; 23386711 Fax: 91-11-23384773
E-mail: cg.icar@nic.in

त्रिलोचन महापात्र, पीएच.डी.
एफ एन ए, एफ एन ए एस सी, एफ एन ए ए एस
सचिव एवं महानिदेशक

Trilochan Mohapatra, Ph.D.
FNA, FNASc, FNAAS
Sectretry & Director General

Message

I am immensely pleased to know that the Dr. Y.S. Parmar University of Horticulture and Forestry, in collaboration with the Indian Agricultural Universities Association (IAUA) is organizing the 9th Brain Storming Session cum Vice Chancellors Conference on 3-4th May, 2018 at the University campus in Nauni, Solan, Himachal Pradesh.

I congratulate the Indian Agricultural Universities Association for selecting 'Alternative Farming Systems Involving Horticulture to Increase Crop Productivity and Doubling Farmers' Income', as the theme for this Conference. This topic is appropriate and is of utmost importance as over 55% percent of India's population is dependent on agriculture and allied sectors. The present government's policy to give the highest importance to the agriculture sector in the country and make it remunerative for the farmers with adequate emphasis on production and reducing the input cost is welcome step. In this context Government of India has rightly set the goal of doubling farmers' income by 2022. Alternative farming systems based on horticulture will have a significant role to play in improving the financial status of our farmers.

I am confident that the deliberations during the conference will be fruitful and come up with recommendations and strategies, which will be of immense importance to the farmers' welfare and will go a long way in achieving our goal.

I convey my best wishes for successful conduct of the Conference and publication of Souvenir on this occasion.

(T. MOHAPATRA)

Dated the 19th April, 2018
New Delhi

Dr. Shrikant Baldi
अतिरिक्त मुख्य सचिव
Addl. Chief Secretary (Agriculture)
Ellerslie
Shimla - 171002

Message

I am delighted to know that Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan, in collaboration with the Indian Agricultural Universities Association is organizing 9th Brain Storming Session cum Vice Chancellors Conference on 3rd and 4th May, 2018 on the theme "*Alternative Farming Systems involving Horticulture to Increase Crop Productivity and Doubling Farmer Income*" and a Souvenir is also being brought out to commemorate the occasion.

Nearly 91 percent population of the State is living in rural areas depends upon agriculture. Farm economy of the State assumes a great significance in context of raising overall rate of growth of the economy on the one hand, and raising the income of the vast multitude of farmers on the other. The farm sector also faces serious constraints on productivity front in the State in the sense that nearly four-fifth of the farm holdings belong to the small and marginal category.

The emergence of vegetable cultivation as a high return activity will bring results in enhancing farmer's income, but there is a need to study their magnitude and sustainability in the State.

Agriculture and Horticulture Universities need to prepare specific strategies to raise crop yields and provide advice on the creation of integrated supply chains.

I believe that Agriculture and Horticulture Universities being among the top stakeholders in doubling the income of farmers by 2022 would suggest new techniques to be introduced in agro-horti sectors.

I convey my sincere wishes for the grand success of the Conference.

(Dr. Shrikant Baldi)

Jagdish Chander Sharma
प्रधान सचिव
एलर्जली
शिमला – 171002

Message

I am extremely happy to learn that the Dr YS Parmar University of Horticulture and Forestry in collaboration with the Indian Agricultural Universities Association is organizing the 9th Brain Storming Session cum Vice Chancellors Conference on 3-4th May, 2018 at the University campus in Nauni, Solan.

I must congratulate the Indian Agricultural Universities Association for selecting "Alternative Farming Systems involving Horticulture to Increase Crop Productivity and Doubling Farmers Income", as the theme for the Conference. This theme touches the two core areas the require concerted efforts of all stakeholders in order to achieve desired results.

For a state like Himachal Pradesh, the topic of 'Alternative Farming Systems based on Horticulture' is very significant as it can benefit the farmers by developing strategies for doubling farmers' income.

I am sure that the deliberations of this conference will come up with new ideas and recommendations, which will go a long way in transforming the horticulture and agriculture sectors of Himachal Pradesh and the rest of the country.

I extend my best wishes for the successful conduct of the Conference and publication of Souvenir on this occasion.

(Jagdish Chander Sharma)

Articles

Mechanization in Horticulture: Potentials and Limitations

Dr. N. C. Patel
Vice Chancellor
Anand Agricultural University, Anand, Gujarat-388110

India, with its wide variability of climate and soil, is highly favorable for growing a large range of horticultural crops such as fruits, vegetables, tropical tuber crops, mushroom, ornamental crops, medicinal and aromatic plants, spices and plantation crops like coconut, cashew, cocoa, tea, coffee and rubber etc. Horticulture which is a part of agriculture is concerned with the raising of so called garden crops. Fruits, vegetables and other horticultural produce are rich sources of vitamins and minerals which promotes human health.

India has witnessed voluminous increase in horticulture production over the last few years. Significant progress has been made in area expansion resulting in higher production. Over the last decade, the area under horticulture grew by about 3% per annum and annual production increased by 5.4%. During 2016-17, the production of horticultural crops was about 295.2 million tonnes from an area of 24.9 million hectares. Although area and production of horticultural crops are increasing at a faster rate, all the operations performed in cultivation of these crops are being done manually with conventional tools, which involves quantum of labour force and drudgery. Horticulture sector cannot grow at commercial scale depending on old instincts and traditional knowledge. Hence, mechanization of horticulture is one of the prime needs of many Asian and African countries. Judicious use of inputs and timely accomplishment of critical operations is very important to make the production cost-effective.

Horticulture Sector Overview in Gujarat

Gujarat has a total geographical area of 19.6 M ha of which about 9.7 M ha is utilized for agricultural purposes. About 49% of the total area of the state is under cultivation. Out of the total geographical area, the area covered under command area is about 3.8 million ha. Rain fed area of the state is about 6.6 million ha. Average land holding of Gujarat is 2.03 ha compared to 1.16 ha of total of India. The area under irrigation is about 33% of the net area sown, while rest of area is cultivated under rain fed conditions. Thus, there is large area dependence on rain in the state.

Horticulture is a priority sector in Agriculture by virtue of its vast potential in improving the socio economic conditions of the farmers. The horticulture sector is supplier for large number of agro based industries, which has high avenues for generation of skill full employment and self-employment opportunities both in rural and urban areas. Gujarat has a wide variety of soil, rainfall pattern, temperature regimes and irrigation availability. The major fruit crops grown in Gujarat are Banana, Mango, Citrus, Papaya and Sapota. In the year 2016 -17 the production of fruit crops was estimated at 83.75 lakh tonnes. The major vegetables grown in Gujarat are Onion, Garlic, Potato, Brinjal, Tomato, Okra and Cucurbits. In the year 2016-17, the average production of vegetables was estimated at 14.08 million tonnes.

Different machines have been developed for effective cultivation, intercultural operations, harvesting, grading, packaging and value-addition of horticultural produce. The growers are adopting latest designs of mango harvester, kinnow clipper, potato digger, coconut peeler etc. for effective horticultural practices. Machines developed for different purposes like cool sterilization (irradiation) for sprouting in potato and onion, dehydration of different produce, vapour heat treatment (VHT) in major mango growing belts, packaging of coconut water, banana, fig and chip making machine, etc. need to be popularized. The priority for development of small scale processing plants for areca nut and oil palm should also increase. A working model of raw cashew nut grader consisting of gravity separator and oscillating sieve separator has been fabricated. Machineries for primary processing of high value vegetables were developed for making packaged vegetables shreds/pieces and being sold through chain of city retail outlets.

Potentials for Mechanisation in Horticulture

Mechanization creates the need for new approaches to cultural practices, necessitates the development of new varieties adapted to machine harvesting and demands a product with different handling and processing qualities. As the cost of labour increases and the availability of good labour decreases farmers raising horticultural crops must mechanize or else turn to other crops that have already become mechanized and thus require a minimum of labour for their production. Advances have been made to develop suitable machines for different operations in horticultural crops, which need to be disseminated.

Nursery

The prices of vegetable seeds especially F1 hybrids are very high. These need proper environment for better germination. Greenhouses for different agro-climatic conditions need to be developed for raising the nursery. Healthy and disease free seedlings can be raised in shorter duration under greenhouse conditions. Necessary root media can be pulverized, mixed, pasteurized and filled in the pot or tray. For this necessary equipment need to be developed. The root media can be mixed in batches by modifying the concrete mixer. The pasteurization can be done by applying steam to the rooting media by maintaining the media at 60^{0}C to 82^{0}C for the required duration. Different diseases and weeds can also be controlled in this way. Portable steam generator can be used to generate the steam and the aerated steam can be passed through perforated pipes buried below the media or beds. The potting media can be filled in the seedling tray or pots for transplanting, using screw augurs.

The seeds can be sown using precision planters, which need development for Indian conditions. The fertilizer can be applied to nursery beds or trays can be done through drip irrigation. The irrigation can be done through drippers or micro-sprinklers. In place of selling seeds, the seed industry can raise healthy nursery and sell the seedlings to the farmers. The farmers can also grow the healthy nursery on their own. For ensuring this, the nurseries will need to be equipped with modern facilities for micro irrigation, green houses, equipment for molecular analysis, virus detection and plant health clinics etc. Initial support for establishing such nurseries in the public as well as private sector would be needed

Greenhouse

The rooting media for transplantation of floricultural plants can also be mixed, sterilized and filled in pots or trays as explained above. The rooting media in the greenhouse needs pasteurization at least once in a year which can be done by steam or formalin.

Transplanting

The transplanting of nursery in the field is very labour intensive and seedling transplanters for different crops are required. Crops like onion, which need close spacing need bare root transplanter development. Widely spaced crops like cabbage, cauliflower, brinjal, etc. need tray type or block type seedling transplanter. The raising of seedlings in blocks and transplanting increases the accuracy and efficiency of transplanting along with healthy crop. Necessary systems for transporting the seedlings, filling in the transplanter and transplanting systems needs development.

Pesticides Spraying

Mostly the spraying of fruit, vegetable and floricultural crops are being done by manual sprayers. These operations are labour intensive and can be mechanized by using power-operated sprayers. The efficient orchard sprayers need development. Tall tree sprayers are also required for old plantations of mango and for other plantation crops like coconut.

Harvesting and Transporting

Horticultural crops like fruits and vegetables give very high yield and need very careful harvesting and transporting. The high capacity harvesters for different fruit crops like mango, guava, sapota, orange, pineapple, etc. need to be developed. The harvesters for reduction of labour for vegetable crops like onion, cabbage, cauliflower, tomato etc. are required.

Grading

The better quality and grade of fruits or vegetables get a premium price in the market. For export of fruits there are different grades based on weight of individual fruits. The electronic fruit grader is required to be tested and adopted by the export houses. Size grader for different fruits like sapota, orange, mango, pineapple etc is required for local market.

Packaging

Around 30 % of the produce get spoiled during the marketing chain from farm to the retailer under Indian conditions. Therefore, proper packaging for fruits, flowers and vegetables for internal trade and export needs development..

Farm Implements for Horticultural Crops

S.No.	Name of the implement	Function
1.	Tractor drawn low draft chisel plough	It is suitable for deep tillage up to a depth of 40 cm for opening hard soil pan
2.	Tractor drawn trencher	To form rectangular trench of 30 x 30 cm
3.	Tractor drawn channel former	To form channels and beds at regular intervals for irrigation.
4.	Power tiller operated heavy duty auger digger	To dig holes for planting tree saplings
5.	Power tiller operated axial flow pump	To lift water from open water sources
6.	Power tiller operated boom sprayer	For row crop spraying
7.	Sprayer for tall trees	To spray chemicals in orchard trees
8.	Power tiller operated lawn mower	For mowing lawn grass
9.	Power tiller operated turmeric harvester	For harvesting turmeric rhizomes
10.	Tractor drawn turmeric harvester	For harvesting Turmeric rhizomes
11.	Power rotary weeder such as	For mechanical control of weeds in crops sugarcane, tapioca, cotton and orchards
12.	Power tiller drawn bund former	For forming bunds

Soilless Culture

In order to circumvent the heterozygosity of soil search for alternative substitute resulted in usage of natural substrates like cocopeat, rock wool, gravel, sand, saw dust, groundnut and paddy husk, vermiculite and perlite etc. Media constituent like cocopeat is successfully used for better management in both vegetables and flowers. It is already proven that crop grown on cocopeat and rock wool have better growth and development compared to soil grown plants. It has a special advantage due to high retention of water and coupled with good aeration because of lesser bulk density and higher porosity. Besides this the flowers and vegetables are lighter in weight when grown on these media which is of great significance in exports. Hydroponic techniques using deep flow technique, nutrient film technique is used to limited extent for commercial cultivation of vegetables and flowers.

Remote Sensing In Horticulture

There is vast potential for growing a large variety of horticultural crops for which identification of land and other resources would be necessary. One of the major constraints for developing effective plans in the horticulture sector is the lack of reliable and up to date data. While agricultural crops are being covered under crop estimation surveys, there is no such mechanism for the horticultural crops. Hence, there is an urgent need to create reliable data base through a system of acquisition through satellite imageries which can be updated

periodically. Remote sensing data having capability of providing regular, synoptic, multi-temporal and multi-spectral coverage of the country can generate such information for crops and other natural resources. India has its own remote sensing satellites (IRS), which provide world class multi-spectral and multi-resolution data. Keeping in view the urgent need for developing data base in the horticulture sector, a core group on Horticulture Crop acreage and production estimation was constituted in the Ministry of Agriculture in September, 1996. The core group has identified the potential for estimation of area as well as forecast of production of major horticultural crops using remote sensing and Geographical Informal System (GIS) based techniques. It has also recommended the need for creating a National Horticultural Information Centre (NHIC) in the Ministry of Agriculture.

Integrated Pack Houses

These centres may serve farms in respective regions having an area of around 5,000-10,000 ha. Farms associated with each of the centers would collect farm produce and bring them to common cold storage centres, where this produce would be given treatments, such as washing, sorting, grading, waxing and packaging. The treated products will then be preserved in the appropriate cold storage facility. The services of these centres will not only increase the value of the farm products, but will also remove most of the unwanted bio-degradable bio mass from the horticulture products, which can be utilized as farm manure or even as cattle feed.

Value Addition

Value added products are now attracting more of export market like oleochemicals, oleoresins, and essential oils and hence development of new value added products in spices, coconut, cashew, tea, and coffee will go a long way in export promotion. Newer technologies need to be developed. Similarly newer processed fruits, vegetables, ready to serve food items need to be developed and popularised. Further following aspects also need immediate attention:

1. Processing capacity of existing units needs to be augmented.
2. Existing facilities need to be modernized.
3. Product diversification needs to be encouraged.
4. The prescribed international and domestic SPA standards should be disseminated and adhered to.

Hi-tech Horticulture

Hi-tech horticulture refers to the technology requiring high investment with potential to provide high returns, is inevitable to meet the challenge of increasing the productivity levels of horticultural crops having improved quality standards, to meet both domestic and export demands. Hi-tech interventions includes micro-propagation, micro-irrigation, fertigation, protected cultivation, organic farming, application of GIS and remote sensing, bio-intensive integrated pest management, precision farming, etc. To achieve the success in high-tech horticulture vertical integration, effective linkage, credit support and policy are essential. Hi-tech interventions should be closely linked with marketing arrangements for the

horticultural produce.

Post-Harvest Management Technologies Developed at Anand Agricultural University

- Development of handheld harvesters for mango, guava, lemon etc. and machine for their handling procedures available.
- A tractor operated hydraulic platform has been developed for harvesting mangoes from tall trees. The equipment is also useful for pruning and spraying operations.
- Standardization of pre- and post-harvest chemical treatments to control post-harvest diseases in mango and banana for long distance transport and storage.
- Post-harvest treatments including pre-cooling, passive evaporative cooling for increasing the shelf-life of fresh fruits and processed fruits standardized.
- A weight based mango grader machine developed and is under commercial adoption by the exporters. This machine has been designed and developed on the basis of weight of fruits.
- Packing materials like Corrugated Fiberboard boxes (CFBs), perforated punnettes, cling film wraps, sachets, etc. standardized for packaging different fresh horticultural produce.
- Novel products like extracts from mango fruit kernel, essential oils from citrus, extraction of active compounds like lycopene etc. from tomato pomace, preparation value added products from aonla and carrot pomace have been developed.

Limitations in Mechanisation of Horticulture

Perishability alone contributes to heavy losses in the availability and quality after harvest of these crops and makes investments risk-oriented.

- The major constraints for lower productivity in the small grower sector are: -
- Small land holding (less than 2ha).
- Lack of awareness.
- Inadequate technology adoption.
- Inadequate financial resources.
- High capital investment for mechanization
- Poor linkage between Research and Development sectors, industries and farming communities

Post- harvest handling accounts for 20 to 40 per cent of the losses at different stages of grading, packing, storage, transport and finally marketing of both fresh and processed products. Such an enormous loss has proved a great handicap in exploiting the full production potential of these crops and thereby improve the rural income, employment and nutrition of the masses. The production and marketing of these commodities also suffer from the crippling uncertainty and instability of the domestic as well as export market conditions. Since most of these are grown by small and marginal farmers, and handled at the retail level by poor sections, the effect is all the more devastating. Very often these commodities have to be sold through distress sales.

Fruits and vegetables are mostly marketed through commission agents. A very small portion is handled by cooperative marketing societies. In some case fruits, the owners to the pre-

harvest contractors also auction vegetables and flowers. The pre-harvest contract could be for one or even three years in perennial crops. The returns from such arrangements are very low. Such sales also result in poor upkeep of the plantation / orchards and the contractors hesitate to make further investment in the upkeep of such plantations / orchards.

The constraints in promotion of mechanization include the varied requirement of equipment for each agro climatic zone, the small and fragmented land holding, low investment capacity of the farmers, inadequate irrigation facilities, know how status of the farmers, repairs maintenance facilities etc.

CONCLUSION

There is great potential for mechanization in horticulture. Large number of farm implements and machineries have been developed in different states by several manufacturers. However, the crop specific machineries need to be developed considering the limitation / constraints mentioned in the paper. In order to utilize the inputs efficiently, precision machineries / implements need to be provided to the farmers for undertaking different operations. The horticultural crop-wise gap in mechanization need to be filled through developing appropriate implements / machineries. Further, in view of the acute shortage of manpower for farm operations, custom hiring of horticultural equipment and resources should be encouraged. Moreover, the precision equipment manufacturers should be promoted.

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स्क्रब टाईफस : ध्यान दें

आम तौर पर बरसात के मौसम में तेज बुखार से पीड़ित रोगियों की संख्या बढ़ जाती है। यह बुखार स्क्रब टाईफस भी हो सकता है। यह रोग एक जीवाणु विशेष (रिकेटशिया) से संक्रमित पिस्सु (माईट) के काटने से फैलता है जो खेतों, झाड़ियों व घास में रहने वाले चूहों में पनपता है। यह जीवाणु चमड़ी के माध्यम से शरीर में प्रवेश करता है और स्क्रब टाईफस बुखार पैदा करता है।

लक्षण

तेज बुखार जो 104 से 105 डिग्री तक जा सकता है।

जोड़ो में दर्द व कम्पकंपी के साथ बुखार।

शरीर में ऐंठन, अकड़न या शरीर टूटा हुआ लगना।

अधिक संक्रमण में गर्दन, बाजुओं के नीचे, कूल्हों के ऊपर गिल्टियां होना।

रोकथाम

शरीर की सफाई का ध्यान रखें

घर तथा आसपास के वातावरण को साफ रखें

घर के चारों ओर घास, खरपतवार नहीं उगने दें

घर के अन्दर और आसपास कीटनाशक दवाओं का छिड़काव करें

- इस बुखार को लोग जोड़–तोड़ बुखार भी कहते हैं।
- यह रोग एक आदमी से दूसरे को नहीं फैलता
- स्क्रब टाईफस का इलाज़ बहुत आसान है। तुरन्त डॉक्टर को दिखाएं।
- बुखार कैसा भी हो नज़दीक के स्वास्थ्य केन्द्र में संपर्क करें।
- खेतों व झाड़ियों में काम करते समय पूरा शरीर (खासकर टांगें, पांव और बाजू) ढककर रखें।

स्क्रब टाईफस का इलाज सभी स्वास्थ्य केंद्रों में मुफ्त किया जाता है।

जारीकर्ता:– राष्ट्रीय स्वास्थ्य मिशन, स्वास्थ्य एवं परिवार कल्याण विभाग, हिमाचल प्रदेश

Alternate Farming Systems for Increasing the Production and Productivity of Horticultural Crops for Doubling the Farmer's Income

Hari C Sharma
Vice Chancellor, YSP University of Horticulture and Forestry, Nauni173230, Himachal Pradesh, India. Email: vcuhf@yspuniversity.ac.in

Introduction

Nearly 70% of the population in Himachal Pradesh is engaged in agriculture/ horticulture, which accounts for 15% of the Gross State Domestic Product (GSDP). Himachal Pradesh is well endowed with congenial conditions for taking up large scale cultivation of fruits, vegetables, flowers, mushrooms, beekeeping, sericulture, aromatic and medicinal plants, and agro-forestry on a commercial scale. Cultivation of temperate fruits has made a huge impact in the mid and high-hill regions of Himachal Pradesh, but the fruit cultivation has not been taken up on a commercial scale in the lower Shivalik Hills, which accounts for nearly 60% of the total area and the population. The goal of doubling the income of the farmers by 2022 cannot be achieved by increasing crop production only, but has to be accompanied by improvement in infrastructure, policy support, marketing and value addition (Chand 2016). Efficient and organized supply chain holds the key for providing incentives to farmers to intensify, expand and diversify agricultural production.

Major Constraints and Productivity Gaps

Several abiotic (drought, frost, hail storms, floods, and insufficient chilling) and biotic (insect pests, diseases, nematodes, monkeys, stray/wild animals, and birds) constrain the productivity of horticultural crops. Because of the monkey menace and damage by the wild/ stray animals, many farmers have given up crop cultivation in many parts of Himachal Pradesh. Availability of food grains in the public distribution system, and the tendency among the youth to look for white collar jobs are also the major reasons for lack of interest among the youth in farming. Lack of irrigation facilities (as <20% of the total cultivable area is irrigated) is one of the major reasons for slow growth in adoption of precision farming in horticultural crops (Sarial 2017). Lack of transport, storage, and marketing facilities are the major bottlenecks in adoption of large scale cultivation of fruits and vegetables..

In the mid and high-hill regions of Himachal Pradesh temperate fruits has made a huge impact but, it has not been taken up on a commercial scale in the lower Shivalik hills, where the majority of the state population resides. In order to increase the production and productivity of horticultural crops, it is important to adopt modern technologies such as protected cultivation of vegetables and flowers, hydroponics, aquaponics, precision farming, high density cultivation of fruits, balanced use of organic and synthetic fertilizers, and need based application of micronutrients for increased crop productivity (Sharma 2017). There is a need to integrate crop production with sericulture, bee keeping and mushroom cultivation, and adopt integrated horticultural-livestock-medicinal plants production systems. This requires an in-depth understanding of the nature of interactions of horticultural

crops with the organic inputs, fertilizers, and the climate for sustainable crop production.

Horticultural Crops as an Engine of Growth for Doubling Farmers' Income

To achieve the objective of increasing the farmer's income through intensive cultivation of horticultural crops, it is imperative to overcome the major constraints to increasing crop production such as shortage of irrigation facilities and farm roads, improve input use efficiency, availability of quality planting material, and develop facilities for marketing of the farm produce. To realize a major boost in farmers' income, it is equally important to invest in developing newer technologies and innovations, as well as increase the collaboration between different institutions, and promote public-private partnerships for large-scale production of horticultural crops for the national and international markets (Sharma 2018). Technological interventions to increase the production and productivity of horticultural crops have been discussed below,

Water Harvesting and Storage

In Himachal Pradesh, only 18-20% area is under irrigation. Therefore, there is an urgent need to improve irrigation infrastructure to cover > 50% of the cultivable area under irrigation for increasing the production and productivity of different crops. This can be achieved by tapping the water from rivers and rivulets through water channels and pipes along the hill slopes; construction of small and medium sized dams, barrages, and tanks on all of small rivers and rivulets, and use the stored water by lift irrigation and/or gravity flow. The water use efficiency can be improved by crop residue/polythene mulching, sprinkler/drip irrigation.

Water harvesting (left, and use of drip irrigation (right) to increase water use efficiency for increasing crop productivity of horticultural crops.

Protected Cultivation of Vegetables and Flowers

To overcome the limitation of crop production depending upon season, the concept of protected cultivation has been adopted on a large-scale. Protected cultivation is basically

modification of the natural environment to achieve optimum plant growth. Modifications can be made to both aerial and root environments for increasing crop yields, extending the growing season for permitting plant growth during the off season. This technology offers advantages such as control over the growing environment, production of quality produce, no chemical drift from the poly-houses to neighbors fields, better management of insect pests and diseases, increased water use efficiency, year round supply of high value produce to markets, increasing marketing power and economic returns, and more predictable yield and quality. Protected cultivation failed in many parts of India due to shattering of the poly-houses, and buildup of insect pest and pathogen populations in the greenhouses. However, protected cultivation is now picking up all over India, and there is need to develop robust polyhouse structures, and package of practices to be followed by the farmers.

Protected cultivation of vegetables and flowers in the polyhouse.

High Density Plantations

The productivity of fruit crops in India (e.g., apple7.98 MT/ha) as compared to other countries (31.0 MT/ha in USA and 18.0 MT/ha in China). The major causes of low productivity are old varieties, poor pollination and pollinator management, low density plantings, use of seedling rootstocks, poor canopy architecture and management, poor water and nutrient management, poor orchard floor management and weather vagaries such as occurrence of low temperature and hail storms at flowering as well as fruit developmental stages.

High-density planting to boost fruit production.

To overcome the problems of low productivity in fruits, new varieties of different fruit crops on clonal rootstocks need to be developed and evaluated in different agro-climatic conditions of the state to identify the suitable rootstock and scion combinations for each zone of the state.

Hydroponics

Hydroponics offer an opportunity to provide optimal conditions for plant growth with higher yields as compared to open field agriculture. This technique can also be used in urban areas where space is the constraint to produce fresh vegetables all the year round. Hydroponic culture is an easy, environmentally sound way to grow a wide variety of healthy plants. Plants grow up to 50% faster in hydroponics than in soil because they have easy access to food and water, and the nutrients are directly available to plants. Plants grow in a disease free medium, and hence, little or no chemicals are needed for pest control. Since plants do not need to compete for nutrients, more plants can be grown in smaller areas, and increased control over growing conditions makes it easier to provide the best possible environment for plants, leading to better quality produce and higher yields. For popularization of hydroponics, it is very important to provide scientifically proven technology and to create awareness of its potential among the farmers.

Hydroponic system for vegetable production.

Precision Farming

Precision farming is a management concept based on observing, measuring and responding to inter- and intra-field variability in crops. The goal of precision agricultural research is to define a decision support system for optimizing returns on inputs while preserving resources. It is reorientation of the total system of crop production towards a low-input, high-efficiency, sustainable agriculture. This new approach mainly benefits from the emergence and convergence of several technologies, including the global positioning system (GPS), geographic information system (GIS), miniaturized computer components, automatic control, in-field and remote sensing, mobile computing, advanced information processing, and telecommunications.

Organic/Natural Farming

The organic approach is driven by biological processes to maintain and achieve high soil quality, control pests, and provide favourable growing environment for crop production. There is a need to popularize the holistic farming technique of 'Zero Budget Natural Farming (ZBNF)' based on the use of farm based inputs. This farming system has been adopted successfully by several farmers across the country. This climate resilient, cost effective, ecologically safe and sustainable technique can help in reducing the market dependency of farmers for farm inputs and enhance their self-reliance. This technique involves the use of cow dung and urine to reduce production costs and enhance farmers' self-reliance.

Crop/System Diversification

Diversification of agriculture through high value cash crops such as fruits (apple, plum, peach, pear, apricot, pecan nut, kiwi fruit, pomegranate, mango, litchi, orange, cherry), vegetables (tomato, peas, capsicum, beans, cole crops, and cucurbits), flowers (rose, carnation, chrysanthemum, gerbera, marigold and gladiolus), agroforestry (*Grevia*, mulberry, poplar, willow), timber wood, mushrooms, beekeeping and medicinal plants is important to increase the sources of farmers income.

The following crops/farming systems should be promoted for diversifying the sources of farm income.

Tea/Coffee

Tea in Himachal Pradesh is mainly cultivated in Kangra district and cultivates both black tea and green tea, but black tea constitutes around 90% of the production. Tea cultivation can be expanded in areas with >1,000 mm rainfall, with deep alluvial soils up to 1,000 m amsl in parts of Kangra, Mandi, Hamirpur, Sirmaur, and Bilaspur districts. Coffee is another potential and remunerative crop for the Lower Shivalik Hills of Himachal Pradesh. It can be cultivated in areas with high rainfall and deep alluvial soils up to 1,000 m amsl in Bilaspur, Mandi, Kangra, Hamirpur, and Sirmaur districts. It can be grown along with mango, papaya, and other fruit crops needed as shade for coffee cultivation.

Beekeeping and Pollination Management

Pollinizer and pollinators management in cross pollinated crops is important for good fruit set and reduction in fruit drop, which ultimately increases yield and improves the quality of the fruits. Planting of suitable pollinizing varieties and their optimum proportion in the orchard along with the optimum number of bee hives are important for maximizing fruit production. In addition to pollination, beekeeping is one of important components of diversifying farmers income.

Sericulture

India is importing huge quantities of silk from China, South Korea, and Japan. To meet the domestic requirements, silkworm rearing can be adopted on a large scale in the lower Shivalik hills, where mulberry is growing in plenty under natural conditions. There are already a large number of silkworm rearing units and spinning mills set up in this area. This can be promoted as a self-employment scheme for the young entrepreneurs. To give a technological boost to silk production in Himachal Pradesh, we are strengthening silkworm research at the YSP-UHF Campus, Neri, to collect and multiply the mulberry varieties suitable for silkworm rearing, distribute the material to the farmers, and develop marketing linkages with the silk industry.

Sericulture and mushroom cultivation can be taken up as a enterprise for attracting youth to agriculture.

Aromatic and Medicinal Plants

Medicinal and aromatic plants can be exploited to boost farmers' income in Himachal Pradesh. Integration of medicinal and aromatic plants in orchards/ land-use system with the application of organic manure produces high biomass and high net returns, e.g. returns from a sole crop of *Oscimum* are Rs 22,850/- ha, and agro-forestry system is more remunerative than the sole crop.

Dairying/Goat/Sheep Rearing

Promotion of improved pasture and grassland management, agro-forestry, and cultivation of sweet stalk sorghum, maize and pearl millet to increase milk production through cooperative societies can be taken up as an important component of integrated natural farming systems. Rearing of sheep, goats, backyard poultry, pigs and rabbits should be promoted for diversifying farm incomes.

Hari Mithi Chari UHF-S 1(ICSV 700, Sweet Sorghum) for boosting milk production.

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Doubling Farmers income through alternative farming systems in Himachal Pradesh

Prof. Ashok K. Sarial
Vice Chancellor
CSK HP Krishi Vishvavidyalaya, Palampur -176062 (HP)

Himalayan region holds a large percentage of the hill farming communities. Hill farmers sustain largely on subsistence farming which they practice mainly on available rainfed farmlands. The proliferation of extremely small and marginal land holdings due to ever increasing population pressure- resultant sub-division of land holdings coupled with rainfed farming, lack of recent technical knowhow in agriculture production and poor marketing facilities are some of the constraints in boosting farm productivity and profitability. The problem is more serious in the state like Himachal Pradesh, where only 11 per cent of the total geographical area in available for cultivation. In the state sources of livelihood are limited and over two third of the rural people subsist on agri-horti-livestock husbandry (Table 1). Irrigation is limited and irrigation water conveyance is difficult; as a result the average productivity of crops and commodities is much lower than the potential that exists.

Table 1. Livelihood production systems

Zones	Climate/ Altitude (m amsl)	Livelihood production system	Parts of the state
Zone I		Agri-livestock fish-horticulture	Una, Bilaspur, Hamirpur and parts of Sirmaur, Kangra, Solan and Chamba districts
Zone II	Sub-humid 801-1800	Agri-horti-livestock-fish	Tehsils of Palampur and Kangra of Kangra district, Rampur tehsil of Shimla district, and parts of Mandi, Solan, Kullu, Chamba, Sirmaur and Shimla districts.
Zone III	Temperate 1801-2200	Horti-livestock- pasture-agriculture- fish	Shimla district (except Rampur tehsil) and parts of Kullu, Solan, Chamba, Mandi, Kangra and Sirmaur districts
Zone IV	Temperate dry-alpine, >2200	Livestock- silvipasture-agriculture- horti.	Kinnaur, Lahaul and Spiti, and Pangi, Bharmour tehsils of Chamba district

Major Crops of Himachal Pradesh

Since ancient times the farmers have developed multitude of indigenous onfarm techniques and technologies for optimal production. A huge range of traditional crops are grown in the region and over 40 species (Table 2) are grown in traditional agro-ecosystems which have been managed by local farming communities since time immemorial.

Table 2. Crops Mainly Grown in the State Prior to Diversification

Crop's category	Mid hills	High hills
Fields crops	Maize, wheat, paddy, barley, mash, mustard, rice bean, horse gram, linseed	Barley, wheat, buckwheat, black pea, rajmash, amaranthus, chenopods, millets, Ladakhi lucerne
Vegetable crops	*Bhindi*, cucurbits, brinjal, onion, radish, turnip, potato	Peas, potato
Fruit crops	Mango, litchi, citrus, pear, ber, wild sour pomegranate (*Daaru*), apple	Almond, apricot, walnut, *chilgoza* (Pine nut), pecan nut
Medicinal/ aromatic/ spices crops	Turmeric, ginger	Saffron, black zeera, kuth, hops

Area and Production of Food Grain Crops

Wheat, maize, paddy and barley are the main crops of the state. The total area under food grains decreased from 853.8 thousand hectares in 1997-98 to 764.85 thousand hectares in 2015-16 (Anonymous, 2017a). Although, the area of wheat and maize crops has increasing trend, but being labour intensive crop the area under paddy crop decreased significantly over the years. Barley a crop of high hills also has a significant reduction in the area over the time. Area under pulses decreased from 72 thousand ha in 1970-71 to 31 thousand ha in 2014-15(Anonymous, 2015a). The significant reduction in area of some crops could also be due to shift in area toward cash crops. With the adoption of improved production, technological interventions (improved varieties, nutrients, weed and pest management etc.) a significant increase in food grain production from 1,226.79 thousand tonnes in 2008-09 to 1,634.05 thousand tonnes in 2015-16 has been observed (Anonymous, 2017a). Food grains are grown by the farmers to meet the family's daily requirement but in economic term these crops are not capable to provide a sound economic support to the family.

Income of the Farmers

The NSSO (70th round) data revealed that the average monthly income per agricultural household in India during the agricultural year 2012-13 was around Rs. 6,426 in which net receipt from farm business (cultivation and farming of animals) accounted for 60% of the average monthly income and the income from wages and salary accounted for a sizeable proportion of nearly 32%. At constant prices of 2011-12 the estimated monthly income for the year 2015-16 was around Rs. 6,176. As per 2013 estimates total monthly income of farmers in Himachal Pradesh from all sources was Rs. 8,777. Of the total Rs.8,777 wages contributed Rs. 4,030, cultivation Rs. 2,876, rearing of animals Rs. 1,047 and non-farm business Rs. 824. Thus, the goal of doubling the income of the farmers by 2022 cannot be achieved by raising production alone unless the integrated approach is followed and necessary backward and forward support services are strengthened in the rural areas (Chandrasekhar & Mehrotra, 2016).

Cultivation of crops is a major source of family income of 63.5 % of households in India with respective number of 38.7 % in Himachal Pradesh. In hill state Himachal Pradesh 40.7 % households depends on cultivation of crops, livestock rearing and other non-agriculture activities to earn income for their families (Anonymous, 2014).Our past experience clearly evinced that the income from cropping alone is hardly enough to sustain the farmers' livelihood. With enhanced consumerism in rural areas, farmers' requirement for cash also increased to improve their standard of living. Therefore, farmers' income and needs would have to be augmented from other productive farming components. Under the situation 'Integrated Farming Systems' (IFS) provide a potent tool to support income, employment, livelihood and nutritional security in a sustainable manner. Integrated farming systems embodies multiple crops (cereals, legumes, tree crops, vegetables etc.) and multiple enterprises (animal farming, bee keeping, fish farming etc.) on a single farm. FAO stated that "there is no waste", and "waste is only a misplaced resource" which can become a valuable material for another product" in IFS. Productivity of food grains in Himachal Pradesh have increased but the most important change has been the shift of existing crops/their varieties or inclusion of new crops or enterprises with a view to increase productivity *vis-à-vis* income of the farm. In this situation, Integrated Farming System (IFS) approach plays an imperial role for maximizing profit and production to meet the nutritional requirement and food security with less investment using available resources optimally.

By considering these important aspects, this paper presents the alternative farming systems approaches to improve the income of hilly farmers.

Horticulture Crops Cultivation

The topographical variations and altitudinal differences coupled with fertile, deep and well drained soils favour the cultivation of temperate to sub-tropical fruits in Himachal Pradesh. The area under fruits, which was 792 ha in 1950-51 with total production of 1,200tonnes increased to 2,29,202 ha during 2016-17 with total fruit production of 6.12 lakh tonnes. The area under temperate fruits other than apple has increased from 900 hectares in 1960-61 to 28,163 hectares in 2016-17. Nuts and dry fruits have an increased area from 231 hectares in 1960-61 to 10,364 hectares in 2016-17; citrus and other sub-tropical fruits have increased from 1,225 hectares and 623 hectares in 1960-61 to 24,475 hectares and 54,304 hectares in 2016-17, respectively (Anonymous, 2017a). The total value output of fruits and vegetables in Himachal Pradesh from 2011-12 to 2014-15 has been increased by 40 per cent (Anonymous, 2017b).

Apple is so far the most important fruit crop of Himachal Pradesh. Area under apple has increased from 400 hectares in 1950-51 to 1,11,896 hectares in 2016-17(Anonymous, 2017a).Unable to reap required results from apple trees, orchardists in lower belts of Himachal Pradesh are now shifting towards pomegranate having an area of 2670 ha with production of 2,742 tonnes in the year 2016-17(Anonymous, 2016a). Apple belts of Bhuntar, Garhsa and Bajaura valleys in Kullu district have been severely affected by global warming. As a result, the fruit cultivation is being shifted to higher reaches. Now farmers are also growing apples on large scale at elevation ranging between 9,000 and 13,000 feet. The

pomegranate cultivation has ushered the farmers to a new socio-economic life style. In the midhill zone, the agro-climatic conditions are also suitable for the cultivation of new fruits like kiwi, olive, pecan and strawberry (Table 3). In warmer areas of the state, mango has emerged as an important fruit crop. Litchi is also gaining importance in certain regions.

Table 3.Trend in the area under new fruit crops

Fruit	Area(ha)			
	2013-14	2014-15	2015-16	2016-17
Kiwi	113	121	123	123
Pomegranate	2196	2332	2482	2670
Olive	37	36	34	34
Strawberry	54	55	55	54
Pecan nut	855	874	903	918
Mango	40298	41105	41523	41765
Litchi	4972	5231	5409	5673

Vegetable Crops Cultivation

The important role of vegetables in improving the socio-economic conditions of small and marginal landholders in the region is well recognized. The high income from vegetable crops in high and mid hill regions has been mentioned to the tune of Rs 78,000 in Sirmaur to Rs 1,50,000 in Lahaul and Spiti. In a recent such study under '*Rashtriya Krishi VikasYojna* (RKVY)', it was found that the farmers earned fairly high net returns through cultivation of vegetable crops from Rs. 2,73,140 in capsicum to Rs 43,861 in tomato from one hectare (Anonymous, 2015b).

Presently the area under vegetable crops has increased to around 93,000 hectare with a production of about 17.8 lakh metric ton, which was only 5.80 lakh tons in 2000-01. The vegetable growers are able to fetch net return of Rs. 60,000 to Rs. 100,000 per hectare from off-season vegetables, whereas, the traditional crops only provide net return of Rs. 8,000 to 10,000 per ha(Anonymous, 2017c).The cultivation of vegetable crops in kitchen gardening under backyard cultivation system under open condition or in small scale polyhouse will help to maintain a round the year supply of vegetable *vis-à-vis* income to farming families. In Himachal Pradesh the total value output of kitchen gardening has been increased by 43.69 per cent from 2011-12 to 2014-15 (Anonymous, 2017b).

Garlic and Ginger Cultivation

On account of higher productivity and better market prices the garlic crop is becoming a major choice of farmers in some pockets of the state. During the year 2011-12 this crop was grown in area of 3,339 ha with production of 44,733 tonnes. The districts with marketable surplus were Kullu, Mandi, Sirmour and Kangra. Similarly, ginger occupied an area of 2,270 ha with production of 25,500 tonnes with more concentration in Sirmaur, Solan, Bilaspur and Shimla districts (Anonymous, 2017d).

Remunerative Cropping Systems

Long term studies in the state have established the economic viability of diversified cropping systems over traditional maize-wheat or rice-wheat cropping systems. In Himachal Pradesh, maize + asparagus, bean-radish-onion appeared a most profitable system and followed by maize (cob) + french bean - pea- summer squash system (Anonymous,2011).

Quality Seed and its Replacement

Providing quality seed and its replacement, which is currently less than 20 per cent in pulses, and below 30 per cent in wheat and paddy is required. Quality seed replacement needs to be increased to at least 33 per cent in high yielding varieties and 100 % in hybrids of all crops. Increase in the breeder's seed production which recently has declined by about 40 per cent compared to 2010-11. It is also extremely important to ensure the supply of quality seeds, create community seeds banks and check spurious seed through regulatory measures.

Livestock Rearing

The farmers' income in India is growing at the rate of 3.5% per annum, the income from livestock sector is growing at the rate of 14.5% per annum. Livestock contributes 25-30% of the total farm income per household in Himachal Pradesh. It imparts resilience to household income and does not fluctuate from year to year unlike agricultural production. Increase in milk productivity would increase the family income. The experts have assessed that by maintaining a dairy unit comprising two adult cattle, five goats, one buck and fifty poultry birds under rural integrated farming system with total fixed and variable costs of about 2.11 lakh, a farmer can earn about Rs. 98,000 per annum with monthly income of Rs. 8167 (Sarial, 2016).

Protected Cultivation

The protected cultivation technology holds special significance for hilly areas where arable land is scanty and there is a great variation in agro-climatic conditions. It ensures high productivity and provides self-employment avenues to the youth and the rural population. The Department of Agriculture in the state has provided 85% subsidy on the construction of poly houses to the individual farmers of the state and 50% subsidy for creating small and medium lift irrigation schemes. So, far 2,763 polyhouses have been set up in the state covering an area of about 46ha (Anonymous, 2017d). Capsicum is the most prominent crop grown under protected cultivation accounting for almost 57 % and followed by tomato cultivation, whereas, next crop is cucurbits with minor coverage by beans and few other crops. On an average the cropping intensity of about 108 per cent has been observed in most of the cases.

Floriculture

The commercial activity of production and marketing of floriculture products is foundation of profitable and excellent employment opportunities to the people of hilly states like Himachal Pradesh. The agro-climatic conditions prevailing in the state offer excellent opportunities for the development of floriculture both to serve the internal off-season market

and also exports. Area under floriculture crops in the state has arisen from only 25 ha in 1993-94 to 708.61 ha during 2016-17. Farmers are earning 9,191.97 lakh annually from the cultivation of flower crops. Ornamental crops grown according to area are *Chrysanthemum*, marigold, gladiolus, carnation, rose, potted plants, annuals, gerbera, daffodils and *Alstroemeria* (Anonymous, 2017e).

Mushroom Cultivation

The climate in most parts of the state is suitable to take minimum two crops of button mushroom (*Agaricus bisporus*) under natural conditions for additional income generation especially for rural women. Button mushroom cultivation technology provides 100-120% net profit in three months cropping cycle. Therefore, two cropping cycle of 1000 Kg/annum compost under suitable conditions of temperature 18-22 °C can yield net profit of Rs. 15,000-18,000 in three months time. Six workers regularly earn their employment for 4-5 months at the compost unit and around 18-20 women earn average 7 days wages/month (Anonymous, 2016b). During 2017-18 about 429.76 MT of pasteurized compost for mushroom was supplied to the growers and 5,077.00 tone of mushroom was produced in the state. (Anonymous,2017a).

Apiculture

Honey bees in addition to honey and wax also add value by increased fruit harvests as a result of pollination, which is 14 to 20 times more than the value of honey obtained directly from the bee colonies. In view of the importance of honey bees the Department of Horticulture (HP) has 32 beekeeping demonstration apiaries at various suitable places in the state. Unemployed educated youths are taking *Apis mellifera* beekeeping as full time profession and nearly 80,000 bee colonies are being maintained by 500 commercial bee keepers. These bee colonies are capable of producing about 1600 tonnes of honey annually as against 3 tonnes during 1981-82. Ten colonies of *Apis mellifera* honey bee maintained with initial cost of Rs. 40,000/- after three years can multiply to 25 colonies with harvest of about 250 kg of honey fetching worth Rs. 50,000/- per year. Himachal Pradesh has potential to accommodate 2 lakh bee colonies in the state. Considering the scope of beekeeping units at farmers' level for their additional income in the integrated farming system different sized apiaries can be maintained (Anonymous, 2016c).

Sericulture

Sericulture is one of the important agro-based rural cottage industries of the state and providing gainful employment to about 10,228 rural families for supplementing their income by producing silk cocoons. Fourteen silk yarn reeling units have been set up in private sector in Kangra, Bilaspur, Hamirpur, Mandi, Una and Sirmaur districts. Recently from March 2017 to December 2017, 240.82 tones silk cocoons yielding 32.11 tons of raw silk providing an income of about 722.46 lakh (Anonymous, 2017a).

Food Processing and Value Addition

Agro-processing industries for value addition and value chain need attention and promotion to minimize post-harvest losses and ensure remunerative prices to farmers. By

establishing food processing and value addition units' farmers can earn a handsome profit. Promotion of contract farming to enable small and marginal farmers overcoming three major constraints like access to technology/technical knowhow, assured market and remunerative price through establishing regulatory framework is another innovative approach so that farmer's interests are protected and contracts are faithfully implemented.

Integrated Farming System (IFS) Model Studies

In the fifth year of establishment the synthesized IFS (1.0 ha) model for mid hills of Himachal at experimental farm of Himachal Pradesh Krishi VishvaVidyalaya, Palampur comprising cropping systems (0.65 ha), horticulture with vegetable crops (0.175ha), dairy (two cows+1 buffalo) along with supplementary enterprises like vermi-composting, apiary and mushroom with total cost of Rs. 1,54,797/- provided estimated net profit of Rs. 75,007/- per annum. (Anonymous, 2016d).

Choudhary et. al. (2012) made an effort to develop IFS model for small and marginal farmers of Mandi district of Himachal Pradesh with desired technological modification to boost the farmers' productivity and profitability. Integration of grain crops, vegetable crops and practically feasible enterprises were able to earn net profitability of Rs. 4,97,721/- per ha with annual cost of cultivation of Rs. 1,00,847/- per ha and overall holistic B:C of 4.92.

Farmers' income and food requirement would have to be augmented and supplemented by adoption of efficient secondary/tertiary alternative enterprises and systems. However, these alternative systems will be required to be made and designed in such a manner that they lead to substantial improvement in energy efficiencies at the farm and helps in maximum use of synergies through adoption of close cycles. These systems should be socially acceptable, environmental friendly and economically viable.

The contents of the article are from the publication "Doubling farmers' income – a model for hilly and mountainous region" by Sarial (2016).

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Himachal Pradesh Council for Science, Technology & Environment (HIMCOSTE), B-34, SDA Complex, Kasumpti, Shimla – 171009

Ph.: 0177-2622489, Fax: 0177-2620998 Email: stc-hp@nic.in

Activities of HIMCOSTE:

Aryabhata Geo-Informatics Space Application Centre (AGiSAC)

- Web based Geo-Spatial Information system
- Spatial Mapping of Departmental Infrastructure/Works/Schemes
- Online Updation of Departmental Databases
- Departmental Reporting System

State Centre on Climate Change (SCCC)

- Glacier inventory of entire Satluj river basin.
- Effect of climatic variations on Baspa river basin
- Monitoring of glaciers of Spiti river basin.
- Glacier inventory of Chenab basin.

HP Remote Sensing Centre (RSC)

Digital Mapping of Projects form DoS, GoI

- Natural Resources Information System
- Crop Acreage & Production Estimation
- National Survey of Potential and Actual Area under Sericulture through Remote Sensing
- Integrated Mission for Sustainable Development
- Waste Land Mapping Project

Identification of Ground Water Potential

HP State Biodiversity Board (HPSBB)

- Regulate access to biological resources in the State with the purpose of securing equitable share in benefits arising out of the use of biological resources; and associated knowledge relating to biological resources.
- To conserve and sustainable use of biological diversity.

Himachal Pradesh Patent Information Centre (HPPIC)

Patents, Geographical Indications (GIs), Trade Marks, Copyrights

Himachal Pradesh Environmental Information System Centre (HPENVIS)

Collect ,Compile and Disseminate the Environmental information through ENVIS website and newsletters

Technology Dissemination, Appropriate Technology Centre, Sundernagar, Distt. Mandi (ATC)

- Training of Artisans for income generation
- Building Centres
- Low Cost Green House Technology Propagation
- Rooftop Rain Water Harvesting Technology

Environment Education & Outreach

- National Environment Awareness Campaign (NEAC)
- National Green Corps (NGC)
- Eco Clubs activity in the State

State Wetlands Management Authority (SWMA)

- Pong Dam Wetland, Rewalsar Wetland and Chandertal Wetland

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- Impact of Hydro-Power Projects on Environment in H.P.
- Disaster Management especially w.r.t Earthquake resistant structures, landslides and flash floods in H.P.
- Urban solid waste management in H.P.
- Health science especially public health and medicine specific to health issues in H.P.
- Renewable energy especially w.r.t Solar, Wind, Bio-energy and Passive Solar Heating in H.P.
- Problems of environmental pollution in industrial area of H.P.
- Geospatial technology and its applications in H.P.

Science Popularization

- Children Science Congress (CSC)
- EduSat Network Established by Vigyan Prasar, New Delhi for students and teachers
- National Science Day and Mathematics Day Celebrations
- Popular Lecture Series
- Hands on Science Activities for teachers
- Planetarium Education and Night Sky watching

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- Our students qualify GATE and GRE for admissions in reputed Higher institutions of learning both in India & Abroad; also placed in PSUs.

B.Tech. Programs (after 10+2) Admission in first year of the following programs:

- Bioinformatics (BI)
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- Civil Engineering (CE)
- Computer Science and Engineering (CSE)
- Electronics & Communication Engineering (ECE)
- Information Technology (IT)

Admission Criteria:

- 80% seats shall be allotted through JEE (Main) 2018 overall all India rank. Remaining 20% seats shall be allotted through merit drawn on marks merit of 10+2 examinations. The candidate should have minimum of 60% aggregate marks in the 10+2 or its equivalent with Physics and Mathematics as compulsory subjects and one out of :- Chemistry, Computer Sciences, Informatic Practices, Multimedia & Web technology, Engineering Drawing, Engineering Graphics & English.
- (10+2) Merit Based admission procedure (Non JEE Students) for Biotechnology/ Bioinformatics

  50% seats in above programs shall be based on merit of marks in 10+2 examination with Biology/ Biotechnology & Physics as core subjects and any two out of Chemistry, Computer Science, English and Maths as other subjects.

B.Tech. Programs (Lateral Entry to the second year of the following programs):

• Bioinformatics (BI) • Biotechnology (BT) • Civil Engineering (CE) • Electronics & Communication Engineering (ECE)

Admission Criteria (lateral entry for vacant seats):

- Three years diploma after 10th Class or B.Tech. first year passed in the respective subject both with minimum 60% or with 6.0 CGPA.
- Students with backlog subjects in their first year degree course are not eligible for lateral entry.
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	JEE overall All India rank	20th June 2018	1st 2nd & 3rd July 2018	JIIT, Sector, 62, Noida, U.P.
	10+2 marks	30th June 2018	5th 6th & 7th July 2018	JUIT, Waknaghat, H.P.
	JEE (Vacant seats)	20th June 2018	6th July 2018	JUIT, Waknaghat, H.P.

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- Facilitation of access to financial services.
- Promotion of Agri-entrepreneurship.
- Establishment of common service centers and promotion of farmer producer companies.
- Creation and strengthening of post-harvest infrastructure.
- Promoting women participation in project activities.
- Modernization of agricultural markets and promotion of e-marketing.
- ICT based platform for electronic delivery of horticulture department services.

For Detailed Information:

Contact your nearest Horticulture Development Officer, or

Project Direct, HPHDP,
Dyerton Bizhub, Talland By-pass,
Shimla-1
Email: hdp-pd-hp@gov.in
Contact no: 0177-2674465

Director Horticulture, HPHDP,
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An Initiative of Himachal Pradesh State Pollution Control Board

OUTDOOR – POLLUTION ABATING PLANTS

S. No.	Common Names	Botanical/ Scientific Name
1	Peepal (पीपल)	*Ficus religiosa*
2	Bargad (बरगद)	*Ficus Benghalensis*
3	Arjun (अर्जुन)	*Terminalia arjuna*
4	Bahera (बहेड़ा)	*Terminalia bellerica*
5	Jamun (जामुन)	*Syzygium cumuni*
6	Siris (सिरिस)	*Albizia lebbeck*
7	Neem (नीम)	*Azadirachta indica*
8	Muski Kapoor (मुस्की कपूर)	*Cinnamomum camphora*
9	Mahaneem (महानीम)	*Melia azedarach*
10	Karanj (करंज)	*Pongamia pinnata*
11	Bael (बेल)	*Aegle marmelos*
12	Kachnar (कचनार)	*Bauhinia variegata*
13	Amaltas (अमलतास)	*Cassia fistula*
14	Amla (आमला)	*Emblica officinalis*
15	Suhanjan (सुहानजन)	*Moringa oleifera*
16	Harsingar (हरसिंगार)	*Nyctanthes arbor tristris*
17	China Rose (चाईना रोज)	*Hibiscus rosa sinensis*
18	Jatropha (जटरोफा)	*Jatropha curcas*
19	Pit Kaner (पीत कनेर)	*Thevetia nerifolia*
20	Safed Chameli (सफेद चमेली)	*Jasminum grandiflorum*
21	Raat ki Rani (रात की रानी)	*Cistrum nocturnum*
22	Kapoor Tulsi (कपूर तुलसी)	*Ocimum kilimandschoricum*

OUTDOOR – POLLUTION ABATING PLANTS

S. No.	Common Names	Botanical/ Scientific Name
23	Ghritkumari (घृतकुमारी)	*Aloe vera*
24	Spider Plant (स्पाइडर प्लांट)	*Chlorophytum comosum*
25	Rosemary (रोज़मेरी)	*Rosmarinus officinalis*
26	Curry Leaf (कढ़ी पत्ता)	*Murraya koenigii*
27	Basuti (बसूटी)	*Adhatoda Vasica*

INDOOR – POLLUTION ABATING PLANTS

S. No.	Common Names	Botanical/ Scientific Name
1	Spider Plant (स्पाइडर प्लांट)	*Chlorohytum comosum*
2	Golden Pothos (गोल्डन पोथोस)	*Epipremnum pinnatum*
3	Peace Lilly (पीस लिली)	*Spathyphylum*
4	Chinese Evergreen (चाईनीज सदाबहार)	*Dieffenbachia segulne*
5	Aloe Vera (घृतकुमारी)	*Aloe barbadensis mill*
6	Gerbera Daisy (गेरबेरा डेज़ी)	*Gerbera jamesonii*
7	Chrysanthemum (गुलदावदी)	*Chrysanthemum indicum*
9	English Ivy (इंग्लिश आइवी)	*Hedera helix*
10	Snake plant (स्नेक प्लांट)	*Sansevieria isurentii*
11	Rhapis Palm (रैफिस पाम)	*Rhapis excelsa*
12	Areca Palm (एरेका पाम)	*Dypsis lutescens*

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