SOUVENIR

National Conference
on
ALTERNATE FARMING SYSTEMS TO ENHANCE FARMERS' INCOME

Solan, Himachal Pradesh
September 19-21, 2017

EDITORS

Rajeshwar Singh Chandel ❖ Sudhir Verma ❖ Pramod Kumar
Ashu Chandel ❖ NS Thakur ❖ Amit Vikram

Indian Ecological Society - HP Chapter
and
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Nauni 173 230, Solan, HP

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राधा मोहन सिंह
कृषि एवं किसान कल्याण मंत्री
भारत सरकार
Minister of Agriculture
& Farmer Welfare
Government of India

संदेश

यह अत्यन्त हर्ष का विषय है कि इंडियन इकोलॉजिकल सोसाइटी का हिमाचल अध्याय एवं डा. यशवन्त सिंह परमार औद्यानिकी एवं वानिकी विश्वविद्यालय, नौणी, सोलन (हि.प्र.) मिलकर 'वैकल्पिक कृषि पद्धतियों द्वारा किसान आय वृद्धि' पर 19 – 21 सितम्बर 2017 को नौणी, सोलन (हि.प्र.) में राष्ट्रीय सम्मेलन का आयोजन कर रहे हैं। वर्तमान कृषि व्यवस्था में बाजार संचालित आधुनिक कृषि पद्धतियों एवं बढ़ती उत्पादन लागत ने किसानों के प्राकृतिक खेती तन्त्र और आत्म निर्भरता पर प्रतिकुल प्रभाव डाला है। फलस्वरूप खेती की लागत में कई गुना वृद्धि हुई है। विभिन्न रसायनों एवं उर्वरकों के नियमित प्रयोग के बावजूद भी उत्पादन लगभग स्थिरप्राय: हो गया है। ऐसी परिस्थितियां किसान को ऋण लेने के लिए मजबूर कर रही है और फसल की विफलता की स्थिति में वह ऋण जाल में फंस रहें हैं।

मै आशा करता हूँ कि सम्मेलन के व्याख्यान, विचार – विमर्श और परिणाम जलवायु अनुरूप, किफायती, पारिस्थितिकी के लिए सुरक्षित एवं दीर्घकालिक टिकाऊ व्यवस्था हेतु एक आशाजनक विकल्प प्रस्तुत करेंगें। साथ में किसानों हेतू 'शुन्य लागत प्राकृतिक खेती' विषय पर दो दिन का अलग सत्र किसानों की आय दोगुना करने की दिशा में एक सार्थक कदम होगा।

मै राष्ट्रीय सम्मेलन की सफलता की कामना करता हूँ।

राधा मोहन सिंह

सत्यमेव जयते

JP Nadda
Minister of Health & Family Welfare
Government of India
स्वास्थ्य एवं परिवार कल्याण मंत्री
भारत सरकार

MESSAGE

I am extremely happy to learn that Indian Ecological Society in collaboration with Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh is organizing National Conference on "Alternate Farming Systems to Enhance Farmers' Income" w.e.f. 19th to 21st September, 2017.

Food security is an important issue in the developing countries. With the changing climate and ever increasing population pressure, sustainable food production is a big challenge ahead. In addition increasing use of synthetic chemicals particularly pesticides have been reported to result in the presence of toxic residues in various food commodities including water. Human exposure to excessive pesticide residues may cause a number of fatal diseases.

I am glad to know that all these important issues have been included as themes for discussions during the conference. Different deliberation and a special session for farmers on 'Zero Budget Natural Farming' will definitely be a milestone in the direction to achieve the target of Hon'ble Prime Minister to double the farmers' income by 2022 and ensure a healthy society.

I extend my best wishes for the conference.

(JP Nadda)

सत्यमेव जयते

आचार्य देवव्रत
राज्यपाल
हिमाचल प्रदेश

संदेश

मुझे यह जानकर अत्यन्त प्रसन्नता हुई कि "इंडियन इंकोलॉजिकल सोसाइटी का हिमाचल अध्याय" (The Indian Ecological Society -himachal Chapter) एवं डॉ. यशवन्त सिंह परमार, औद्योगिकी एवं वानिकी विश्वविद्यालय, नौणी सोलन हिमाचल प्रदेश मिलकर "वैकल्पिक कृषि पद्धतियों" द्वारा किसान आय वृद्धि पर 19 – 21 सितम्बर, 2017 को नौणी, सोलन हिमाचल प्रदेश में एक राष्ट्रीय सम्मेलन का आयोजन कर रहे हैं । आज के बाजार संचालित कृषि परिवेश में यह विषय अत्यन्त महत्वूर्ण है। रसायनों के अन्धाधुन्ध प्रयोग से जहाँ मृदा की उर्वरता घटी है , पर्यावरण को नुकसान पहुँचा है, प्राकृतिक संसाधन प्रदुषित हुए हैं, वहीं मानव स्वास्थ्य पर भी प्रतिकूल प्रभाव पड़ा है। खेती में बढ़ती आदानों की मांग एवं लागत को ध्यान में रखते हुए कम लागत आधारित वैकल्पिक कृषि पद्धतियों की आवश्यकता है ।

यह अति प्रसन्नता की बात है कि इस राष्ट्रीय सम्मेलन के दौरान प्रगतिशील किसानों के लिए भी जैविक कृषि एवं शून्य लागत प्राकृतिक कृषि विषय पर अलग से सत्र रखे गए हैं । ऐसे वैज्ञानिक सम्मेलनों में किसानों की भागीदारी एवं उनके लिए कम लागत खेती आधारित विषयों का लाना निश्चित रूप से इस राष्ट्रीय सम्मेलन की प्रासंगिकता को वर्तमान किसान आवश्यकता के परिपेक्ष्य में और बढ़ाता है।

मै आशा करता हूँ कि इस सम्मेलन के दौरान हुए विचार– विमर्श व सिफारिश खेती के स्थायित्व एवं किसान आय की विश्वसनीयता कि दिशा में एक महत्वपूर्ण कदम होगा ।

इस सम्मेलन की सफलता के लिए मेरी हार्दिक शुभकामनाएं ।

(देवव्रत)

Vidya Stokes
Irrigation & Public Health
Horticulture and
Information & Technology Minister,
Himachal Pradesh

MESSAGE

Horticulture is one of the important components of Indian agriculture and India is the second largest producer of fruits and vegetables. Horticulture has not only brought prosperity to the small and marginal farmers, but has contributed significantly towards the nutritional security of the nation. Commercial horticulture also paved ways for crop diversification for better economic gains and risk mitigation. Himachal Pradesh has made significant strides in production of fruits, vegetables and flowers. However, farmers are being economically burdened through costlier inputs, increased attack of insect-pests and disease. Under such changing scenario, there is a need to develop alternative cost-effective technologies and farming systems to reduce the cost of cultivation and enhance the crop productivity and ultimately the farmers' income.

I am happy to know that Indian Ecological Society in collaboration with Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh is organising National Conference on "Alternate Farming Systems to Enhance Farmers' Income" on 19-21, September 2017. The theme chosen for the conference seems appropriate and is the need of the hour. I hope the scientists and experts from different parts of the country participating in the conference will deliberate upon the farmers' issues and come out with effective roadmap to enhance the farmers' income.

I wish a grand success for the conference.

(Vidya Stokes)

Prem Kumar Dhumal
Former Chief Minister
Leader of Opposition
Himachal Pradesh

MESSAGE

I am happy to know that Indian Ecological Society in collaboration with Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh is organising three days' National Conference on "Alternate Farming Systems to Enhance Farmers' Income" on 19-21, September 2017. The conference has selected themes like Hi-tech farming systems to enhance farm income, alternate farming systems for sustainable production, natural resource management, and value addition, economics and marketing systems which are very relevant in the present changing agricultural scenario.

There is no doubt that Indian horticulture has contributed not only towards the food security, but also to the nutritional security of the country. The climate is changing day-by-day and with the changing climate, agriculture scenario is also changing resulting in more challenges to the farmers.

I am sure, the galaxy of scientists and experts will deliberate upon different issues of the farming community during the conference and will come out with the strategies effective in doubling the farmers' income by 2022.

I congratulate the organisers and wish every success for the conference.

(Prem Kumar Dhumal)

Trilochan Mohapatra
Secretary & Director General
Department of Agricultural Research & Education
and Indian Council of Agricultural Research
Goverment of India
Ministry of Agriculture and Farmers Welfare
Krishi Bhawan, New Delhi-110 001

सत्यमेव जयते

MESSAGE

I am pleased to know that Indian Ecological Society in collaboration with Dr YS Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh is organizing National Conference on "Alternate Farming Systems to Enhance Farmers' Income" w.e.f. 19th to 21st September, 2017 which will certainly deliberate on and address the issues related to enhance the farmers' income.

Green revolution is the most significant achievement of India after independence. The main highlights of the green revolution were the introduction and development of high yielding varieties and the application of chemical fertilizers and pesticides. As time progressed, extensive dependence on chemical farming has shown its darker side. The land is losing its fertility and is demanding larger quantities of fertilizers to be used every season. Pests are becoming resistant to pesticides, requiring the farmers to use stronger and costlier pesticides that can do more damage to the environment. Both consumers and farmers are now gradually shifting back to organic farming in India which has been practiced in India for thousands of years. However, in the present scenario of commercial agriculture, it is important to blend the science with the traditional organic agriculture and develop alternative cost effective sustainable farming systems.

I congratulate the organizers for selecting this important topic for the conference and wish all success for the event.

(Trilochan Mohapatra)

Hari C Sharma
Vice Chancellor
Dr Y S Parmar University of
Horticulture and Forestry, India

MESSAGE

I am pleased to learn that the Indian Ecological Society in collaboration with YSP University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh is organising the National Conference on "Alternate Farming Systems to Enhance Farmers' Income" from 19th to 21st September 2017.

Because of reduced farm size, climate change and change in the food habits of the people, there is a need to have a critical look at the Alternative Farming Systems to sustain the production and productivity of agricultural crops to meet the food requirements of the people, and to enhance the income of the farmers. Hence, the topic chosen for the conference is of utmost importance and highly timely for sustainable crop production and food security.

I am sure the participants will deliberate upon the various issues that need to be addressed to make Alternative Systems as a viable option to ensure food and nutritional security.

I wish all success for the fruitful deliberations at the conference.

(Hari C Sharma)

A K Dhawan
President
The Indian Ecological Society
Ludhiana-141 004, India

MESSAGE

I am pleased that Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh in collaboration with Indian Ecological Society, Ludhiana is organising three day on National Conference on "**Alternate Farming Systems to Enhance Farmers Income'** from 19-21 September 2017 .

The over exploitation of natural resources in conventional farming resulted in aggravating the decline in ground water reserves, macronutrient deficiency, insect pest and disease appearance, new weed flora and elimination of farmers' friendly insects, microbial flora, birds, reptiles on account of rampant blanket use of toxic pesticides and warranting the need for alternative farming systems ensuring the judicious use of resources with precision modes. Conventional farming threatens future food production by reducing biodiversity, and contributing to environmental degradation and climate change which lower yields. Alternatives to conventional farming should be embraced to improve subsistence farmers' yields and to ensure adequate food production for the growing global population. Alternate Framing Systems is another sustainable option as it mimics natural ecosystems that can produce more food using fewer resources and will improve soil fertility, adaptation to climate change and reduce farming input cost. In comparison to conventional farming, the alternative cropping system will ensures food security, livelihoods, safety to natural resources and environment. It is well documented that alternate cropping system has less soil erosion, more stable soil aggregates, higher organic matter content, less use of agrochemical with same or higher productivity with higher net productivity and reducing risk of climate variability. This seems to be the viable options small-scale farmers produce food for 70% of the global population but are world's poorest and most food insecure people.

The deliberations and outcome of the conference will be a step forward towards setting the agenda for increasing the farmers' income through adoption of climate resilient, cost-effective, ecologically safe alternate farm technologies. I hope deliberations will be useful to generate concrete recommendations for increasing the farmers' income by adopting alternate farming system. It is my privilege to welcome delegates at for three day nation conference at Dr YS Parmar University of Horticulture & Forestry, Nauni, Solan, Himachal Pradesh.

Dhawan

(A K Dhawan)

SOUVENIR

cum

Invited Papers

National Conference

on

ALTERNATE FARMING SYSTEMS TO ENHANCE FARMERS' INCOME

Solan, Himachal Pradesh
September 19-21, 2017

Editors

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Foreword

High input and market driven modern agricultural practices have adversely affected the natural farming systems and self-reliance of the farmers. Presently, the cost of inputs has increased manifold and despite their regular use, the production levels have reached a plateau. Thus, farmers are compelled to take loans and in the event of crop failure they are forced into debt trap. **The National Conference on 'Alternate Farming Systems to Enhance Farmers' Income'** is aimed at focussing our attention on holistic farming systems and the technologies that are safer to the environment, reduce production costs and enhance farmers' self-reliance. The production costs seem to be a major challenge to the scientists and planners to achieve the target of the Union Government to double the farmers' income by 2022. Further, the changing climatic scenario is affecting crop productivity through its effects on crop water availability, soil fertility, pest incidence and crop- pollinator interactions. The indiscriminate use of chemical inputs has further polluted the environment and adversely affected the soil and human health.

The research and developments efforts are, therefore, being redirected to examine the hi-tech and alternate farming systems for a sustainable increase in farm incomes. The deliberations and outcome of the conference will be a step forward towards setting the agenda for increasing the farmers' income through adoption of climate resilient, cost-effective, ecologically safe and promising alternate farm technologies.

The Indian Ecological Society (Himachal Chapter) has tried to take account of the exchange between different cultures and disciplines to provide important knowledge resource on this current issue to different stakeholders. We consider it our privilege to extend a warm welcome to all the farm science luminaries for their visionary presentations to the participants and text contributions to this Souvenir. We sinecerely acknowledge the National Advisory Committee of the Conference for their advice, Conference Organising Committee, Conference Partners and all sponsorors from the government, public and private organisations to support this national event in a whole hearted manner.

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Editors

Dated: 19.09.2017
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सुभाष पालेकर

जीरो बजट आध्यात्मिक कृषि तंत्र शोध, विकास एवं प्रसार आंदोलनए 19, जया कॉलोनी, टेलीकॉम कॉलनी के पास, नवाथे चौक, बड़नेरा रोडद्व अमरावती 444 607 (महाराष्ट्र राज्य)

वेदा में और प्राचीन ग्रंथो में गोबर के उपयोग के बारे में जो लिखा है; वह विस्तार से मैने पहले बताया है। प्राचीन ग्रंथो ने एक बहोत ही बढ़िया अर्थ पूर्ण संदेश दिया, जो हजारों सालों के अुनभव से प्रगट हुआ है,वह है '**गोमये वसते लक्ष्मी**' और '**करागे्र वसते लक्ष्मी**' । गोमये वसते लक्ष्मी का जो वर्णन वेदों मे किया गया है, उस का वैज्ञानिक आधार खोजना बहोत आवश्यक है और वह मैने किया । हम देख रहे है कि हजारो सालो से गांव का एक धनी किसान या सावकार अड़ोस-पड़ोस के पुरे क्षेत्र से गोबर की खाद ख़रीदता है और खेती में फसल लेने के लिए डालता है। आज भी वह परिपाठी निरंतर चली आ रही है। इतना सारा गोबर खाद क्यों डालना है। यह सवाल जब मै कृषि विश्वद्यिालय को पुछता हूं तो वह कहने है गोबर खाद फसलों का खाद्य है। मुझे बहोत बड़ा एक सवाल पड़ा कि किसानों के व्दारां खेतो में डाले हुए ट्रक ट्रॅक्अर से भरे गोबर खाद का जो समथंन और पुष्टी कृषी वैज्ञानिक करते है, क्यां इस के पिदे कुछ वैज्ञानिक आधार है? यह खोजने के कार्य में मै जुट गया । उस पर मैने 1988 से लेकर 1996 तक खोज कार्य किया और बाद में मुझे मालूम पड़ा कि कृषि विश्वविद्यालय जो कहते है कि गोबर खाद जड़ो का खाद्य है, वास्तव में उन का यह दावा झूठ है । यह लोग किसानों को गुमराह कर रहें है । क्योंकि मैंने किए हुए शोध कार्य के जो निष्कर्ष मुझे मिले, इस से यह सिद्ध हुआ है कि न तो गोबर खाद और न रासायनिक खाद और न तो जैविक खाद किसी भी पेड पौधे का खाद्य है। सत्य यह है कि किसी भी पेड़ पौधे का 98.5 प्रतिशत शरीर केवल हवा पानी और सौर उर्जा से बनता है। और यह हवा पानी और सौर उर्जा हमें कुदरत मुफ्त में देती है, उपर से देना नही पड़ता। इस की पुरी पुष्टि विज्ञान की शाखा वनस्पति शास्त्र ने की है।

प्रकाश संश्लेष्ण क्रिया (Photosynthesis) के माध्यम से कोई भी पेड़ पौधे का हरा पत्ता दिन में एक ही काम करता है, आहार निर्मिती करता है । उस आहार को कर्बोदक (Carbohydrates) अथवा कच्ची शर्करा कहते है । वह हरा पत्ता यह आहार निर्माण करने के लिए हवा में से कर्बाम्लवायू लेता है, सुरज की रोशनी से सौर ऊर्जा लेता है। (प्रति स्वेअर फीट हरे पत्ते के सतह पर प्रति दिन 12.5 किला कॅलरी सौर ऊर्जा) और भूमि से पानी लेता है। यह कर्बाम्लवायू पौधों को हवा देसी है, बिल नही भेजता । और पानी मान्सून के मेघ देते है, मुफ्त में देते है, बील नही भजते । और आकाश (27 नक्षत्र) जो वैश्विक ऊर्जा (Cosmic Rays) देता है, वह मुफ्त में देता है बिल नहीं भेजता । और यह अपने आप होता है। इस में मानव का कुछ भी अंश दान नही हैं । घने जंगलो में कहां मानव है। वहाँ तो बिना मानवीय सहयता और आस्तित्व वृक्षों को हर साल अनगिनत फल लगते है। इस का मतलब है पेड़ पौधों को फसल को कुदरत बढाती है हम बढाते नहीं फल दाने का उत्पादनप कुदरत देता है हम देते नही । अगर यह वास्तव सत्य हमारे सामने प्रस्तुत होता है कि 98.5 प्रतिशत शरीर केवल कुदरत बनाती है तो सवाल कहाँ पदा होता है कि गोबर खाद यां रासायनिक खाद यां जैविक खाद जड़ो का खाद्य है? इस का मतलब है कषि

वैज्ञानिक झुठ बोलते है किसानों को गुमराह करते है। अगर गोबर खाद किसी पेड़ पौधे का खाद्य नहीं है तो क्यां है? यह सवाल आपके मन में जरूर आया होगा ।

साथियो, गोबर अथवा गोबर का खाद वास्तव में खाद ही नहीं है । बल्कि, अनंत कोटी उपयोगी सूक्ष्म जीवजंतुओं का महासागर है, जामन है । मैने इस पर छह साल प्रायोग किए है हमारे देश में स्थित सभी मुख्य देशी गायों के गोबर और गोमूत्र पर मैनें लगभग छह साल प्रयोग किए है। वे नस्ले है **महाराष्ट्र** की गौलाऊ, लाल कंधारी, देवनी, खिलार, निमाडी, डागीं : **गुजरात** की गीर और कान्क्रेज, **राजस्थान** की थारपारकर आरै राठी : **पंजाब** की सहिवाल और रेड़ सिंधी : **हरियाणा** की हरियाणा : **उत्तर प्रदेश** की गंगाकिनारी : **बंगाल और आसाम** की छाटे कद की बंगाली : आन्ध की ओंगोल: **तमिलनाडू** की कांगयम, ऊम्बलचेरी और बरगूर: केरला की वेचूर, कासरगोड: कर्नाटका की कृष्णा, मलनाड गिड्डा, हल्लीकर, अमृत महल । इस के लिए गोबर की प्रति एकड़ (प्रति पांच कच्चा बिघा या प्रति डेढ़ पक्का बिघा) 1000 किलो से लेकर 1 किलो तक अलग मात्रा लेकर अलग-अलग फसलों को हर साल मात्रा बदल कर जीवामृत्र और घनजीवामृत के माध्यम से उपयोग किया । यह शोध कार्य सन् 1990 से 1996 तक चला । छल साल के अभ्यास के बाद मुझे मालूम पड़ा कि देशी गाय का गोबर अनंत कोटी सूक्ष्म जीवाणुओं का महासागर है और देशी गाय की आंत उन सभी सूक्ष्म जीवाणूओं के निर्मिती का कारखाना है । कोई भी सूक्ष्म जीवाणू किसी भी मानवि कारखाने में निर्माण नहीं होता । प्रयोगशाला में उनका कोशिका विभाजन से गुणन होता है, निर्मिती नहीं । और दुनिया में जिनती भी पशुओं की नस्ले हैं उन सब में भारतीय देशी गाय का गोबर एक अभ्दुत, अव्दितीय, अनंत अनंत कोटी सूक्ष्म जीवजंतुओं का महासागर रूपी जामन है ।

हडा भर दूध मं हम एक चमचा दही जब जामन के रूप में डालते है, तो उस में केवल 400 से 500 करोड़ लॅक्टाबॅसीलस जीवाणू होते है। लेकिन , दूसरे दिन सुबह उस 100 लिटर दूध का पूरा दही बन जाता है। तो परार्ध अनंत कोटी जीवाणुओं का गुणन हो जाता है । अगर 100 लिटर दूध में जामन के रूप में केवल किलो गोबर चाहिए, यह खोजने के लिए मैने प्रयोग चालू कर दिया । प्रति एकड़ 1 किलो से लेकर 1000 किलो तक की विविध मात्राएं हर प्लॉट में निरतर बदली: सेकडों परिक्षण किए। और अंत में मुझे मालुम पड़ा कि अगर आप के पास एक देशी गाय है, तो आप 30 एकड़ (180 कच्चा बिघा या 45 पक्का बिघा) की फसल ले सकते है। न तो कोई गोबर का खाद डालना पडता है। और न जैविक अथवाा रासायनिक खाद डालना पडता है और उपज रासायनिक अथवा जैविक से कम नही । यह चमत्कार देशी गाय का गोबर करता है।

एक ग्राम देशी गाय के गोबर में मुझे मालुम पड़ा कि कम से कम 300 करोड़ और ज्यादा से ज्यादा 500 करोड़ उपयुक्त सूक्ष्म जीवाणू होते है और 1 एकड़ के लिए महिने में एक बार केवल देशी गाय का 10 किलो गोबर जामन के रूप में चाहिए । 10 किलो गोबर में 30 लाख करोड़ जीवाणू होते है । एक गाय 1 दिन में औसतना 1 किलो गोबर देती है । एक बैल 1 दिन में औसतन 13 किलो गोबर देता है और 1 भैस 1 दिन में औसतन 15 किलो गोबर देती है । हमारे जीरो बजट कुदरती खेती में 1 एकड़ के लिए और महिने में एक बार देना है। एक दिन का 10 किला गोबरा एकड़ के लिए और महिने में केवल एक बार देना है । इस का तमलब हजै एक देशी का 30 दिन का गोबर 30 एकड़ के लिए पर्याप्त है तो एक बात तो हमे ख्याल में आ गयी कि देशी गाय का गोबर और गोमूत्र से हमारी जीरो बजट कुदरती खेती तंत्र मे जीवामृत और

घनजीवामृत हम बनाते है । और केवल उस का ही उपयोग खेती में करते है और चमत्कार होता है । यह चमत्कार देशी गाय का गोबर कैसे करतो है, यह सवाल आप के मन में जरूर आया होगा । चलिए इस का भी समाधान मै करता हूं।

जब कृषि विश्वविद्यालय कहते है कि फसल लेने के लिए भूमि में उपर से ट्रक ट्रॅक्टर से खाद डालना ही पडता है ता वे झूठ बोलते है किसानों को गुमराह करते हैं क्योंकि व कहते हैं कि भूमि में पेड पौधों को बढ़ने के लिए और उपज देने के लिए जो तत्व चाहिए वह भूमि में नही है उपर से डालना ही पडता है। यह झूठ है क्योंकि वास्तव में भूमि अन्नापूर्णा है । उपर से कछ भी खाद्य तत्व डालना नही पडता । अगर वे कृषि वैज्ञानिक सच कहते है तो मै उन को एक सवाल पूछता हूं कि जंगलो में इनल खाद्य तत्वों की आवश्यकता क्यों नहीं है? शायद इस का जवाब उनके पास नहीं हैं। जंगल के विशालकाय पेड़ यां वृक्ष बिना मानवि सहायता और आस्तित्व हर साल अनगिनत फल देते है। उन पेड़ पौधों को बढ़ने के लिए और अनगिनत फल देने के लिए जो खाद्य तत्व चाहिए, उन की आपुर्ति तो मानव ने नहीं की और न करता है । तो फिर कहां से मिलते हैं? अब कृषि वैज्ञानिक अपना यह अज्ञान तो प्रकट नहीं करेगें कि खाद्य तत्व केवल खेती के फसलो को ही चाहिए, जंगल के पेड पौधों को उन की कोई आवश्यकता नहीं । वास्तविक पेड़ पौधों का शरीर पृथ्वी (खनीज क्षार) आप (मेघों ने दिया हुआ जल), तेज (सौर ऊर्जा), वायु (हवा ने दिया हुआ कार्बन डायऑक्साईड), आकाश (नक्षत्रां ने दी हुइ वैश्विक ऊर्जा) इन पंचमहाभूतों से बना हुआ होता है। यह सभी पंचमहाभूत जहां से लिए जाते है, अगर वहां वे स्थित नहीं हाते तो पौधों को नहीं मिलते। अगर कृषि विश्वविद्यालय के मता अनुसार भूमि मे कुछ भी नहीं उपर से डालना ही पड़ता है, तो जंगल के पेड़ पौधों को कैसे मिलता है? वहां तो हमारा अस्तित्व भी नहीं है जंगल के किसी भी पेड़ का कोई भी पत्ता तोड़े, दुनिया के किसी भो प्रयोगशाला में परिक्षण करे। आपको किसी भी खाद्यतत्व की कमी नहीं मिलती है । इसका मतलब है भूमि से पौधों न जो लिया वह सभी भूमि में स्थित है इसलिए मिल गया। अगर भूमि में खाद्यतत्व नहीं होते तो नही मिलते । इसका मतलब है भूमि में सभी खाद्यतत्व अक्षय रूप में है भूमि अन्नपूर्णा है।

पेड़ पौधों को बढ़ने के लिए कार्बन और नायट्रोजन चाहिए, वह पत्ते और नत्र स्थिरक सूक्ष्म जीवाणूं हवा से फोकट में लेते है। हवा में 78.6 प्रतिशत नायट्रोजन है । याने हवा नायट्रोजन का महासागर है। और हवा में से नायट्रोजन लेकर पेड़ पौधों की जड़ो को उपलब्ध कराने का काम एक सूक्ष्म जीव करता है। जिस का नाम है नत्र स्थिरक जीव (Nitrogen Fixing Bacteria) । यह सूक्ष्म जीव किसी कारखाने में निमार्ण नहीं होता। केवल देशी गाय के आंत में निमार्ण होता है। देशी गाय का गोबर बाहर निकलता है तो गोबर में आता है। और जब हम देशी गोवशं के गोबर से जीवामृत, घनजीवामृत बनाते है आर फसलों के लिए भूमि पर डालते है तो वे जीवाणू भूमि मे जाते है । हव ामें से जिनता नायट्रोजन चाहिए उतना लेते है और जड़ो को उपलब्ध कराते है। हरे पत्तों को प्रकाश संश्लेषन क्रिया के माध्यम से आहार निर्माण करने के लिए कार्बन हायड्रोजन (Carbon Hydrogen) और ऑक्सीन (Oxygen) चाहिए । इन में से कार्बन जैसे मैने कहा हवा में से फोकट में मिलता है। उदजन और प्राणवायु उस जल से मिलता है जो जल वर्षा ऋतु में मानसून के मेघ मुफ्त में देते है। इस का मतलब है, अगर हम बारिश के जल की हर बुद भूमि में संग्रहित करते है तो जल की आपुर्ति हो जाती है। साथ साथ वातावरण मे जो नही होती है उसको भी

जड़ो को उपलब्ध करा सकते है। बारिश काल में वातावरण में 90 प्रतिशत नमी होती है जाडे में 65 प्रतिशत और धुप काल में 35 प्रतिशत नही होती है। याने हवा पानी का महासागर है । और यह हवा में से पानी खिचकर जड़ो को उपलब्ध कराने का कार्य जीरो बजट कृषि में ह्युमस और काष्ट पदार्थ करते है। मेघ जल मुफ्त में देते हैं उस की निर्मिती कारखाने में नहीं होती । सूरज की सौर ऊर्जा पंचमहाभूतों में से छोट छोटे तत्व जा खनिज क्षार है हमारी भूमि उन मा महासागर ह।

पौधों को जो फॉस्फेट चाहिए, वह भूमि से उस स्थिति में होता है, जिस स्थिति में जड़े नहीं ले सकती । फॉस्फेट को जड़ों को चाहिए उस उपलब्ध स्थिति में रूपांतर करने का काम एक सूक्ष्म जीव करता है जिस का नाम है **फॉस्फेट उपलब्ध करने वाला जीव** (Phosphate Solubilizing Bacteria)। यह सूक्ष्म जीव कारखाने में निर्माण नहीं होता । केवल देशी गाय के आंत में निर्माण होता है । अर्थात, उस के गोबर में होता है। अगर यह गोबर हम जीवामृत और घनजीवामृत के माध्यम से खेती में उपयोग में लाते है तो यह सूक्ष्म जीव भूमि में जाते है और फॉस्फेट जड़ों को उपलब्ध कराते है। उसी तरह पोटॅश भी भूमि में होता है, लेकिन जड़ों को जिस स्थिति में चाहिए, उस स्थिति के नहीं होता। उस स्थिति में रूपांतरण करने को काम एक सूक्ष्म जीवाणू करता है जिस का नाम है **बॅसीलस सिलीकस** । इसकी भी निर्मिती केवल देशी गाय के आंत में होती है। जो उस के गोबर से बने जीवामृत, घनजीवामृत के माध्यम से भूमि में जाता है और जड़ो को उपलब्ध कराता है। देशी गाय के आंत में ऐसे जीवाणूओं की सभी उपयुक्त प्रजातियां होती है : जो सभी आवश्यक खनिज तत्व जड़ो को जिस स्थिति में चाहिए, उस स्थिति में उपलब्ध कराते है । इस का मतलब है अगर युरीया, फॉस्फेट, पोटाश नहीं डालना है और उस की बिलकूल आवश्यकता नही है ता केवल हमे देशी गाय के गोबर, गोमूत्र का जीवमृत और घनजीवामृत के रूप में उपयोग करना है।

देशी गाय के गोबर और गोमूत्र में मेन्थॉलल, अमोनिया, फिनॉल, एण्डोल, फॉरमेलिन जैसे अदभुत तत्व होते है जो जडों को और पौधो को वृद्धि के लिए बहुत ही लाभदायक होते है। और साथ साथ उस में ऐसे उपयुक्त सूक्ष्म जीवाणू होते है जो बिमारी पैदा करने वाले हानीकारक जीवणूओं का नाश करते है। आयुर्वेद में देशी गाय के गोबर के औषधी गुणधर्म के बारे में विस्तार से जानकारी दी है। आयुर्वेद कहता है कि गाय का गोबर (गोमय) कीटाणुनाशक, पोषक, दुर्गन्धी, नाशक, कांती वृद्धि कारक, वीर्य वर्धक, शोषक और रस एवं परम पवित्रता से ओतपोत है। आयुर्वेद और एक सूचना करता है कि देशी गाय के कडे सुखा कर और जला कर उस की रक्षा बनाईए और मंजन के रूप में दातों के लिए उपयोग में लाईए। इस मंजन से सभी दांत रोग नष्ट होते है । यह मेरा भी अनुभव है । 10 से 15 साल पहले हजारों सालो से इस मंजन का उपयोग देहातों में होतो आ रहा है। मेरे देहात में मै इस का ही उपयोग करता था । मेरा परिवार भी इस का उपयोग करता था। लेकिन, हमें कोई दातों की समस्या नहीं थी। मंजन के लिए कंउे का उपयोग ठीक है। लेकिन खाना बनाने के लिए जो कंउे का उपयोग जलन के रूप में करते है वह बहोत खतरनाक है । उस की कोई आवश्यकता नहीं। अब वैज्ञानिक यह मान्य कर रहे है कि देशा गाय के गोबर में प्लेग, कॉलरा जैसे बिमारियों के जंतुओं को नष्ट करने की अदभुत क्षमता है और आयुर्वेद कहता है भूमि की ऊर्वरा शाक्ति बढ़ाने के लिए केवल गोबर ही एकमात्र साधन है।

अग्रमग्रं चरन्ती नामोषधीनां रसं वने ।
तासमृषपभत्रींना पवित्रं कायशोधनम् ।
यन्मे रोगाश्च, शोकांश्च पापं में हर गोमय ।।

अर्थात्, वनों में वनस्पतियों के माध्यम से अनेक औषधियों से परिपूर्ण वनस्पतियों का आस्वाद लेने वाली गाय अपना खुद का स्वास्थय तो रखती है साथ में अपने दिए हुए मानवि स्वास्थ्य को पवित्र और शुद्ध करने वाला गोमय भी देती है। हे गोमाता इस गोमय के माध्यम से तुम सारे मानविरोग, शोक और पापों का नाश कर ।

देशी गाय का गोबर अनेक उपयोग में काम आ रहा है । पुरातन काल में सिर से लेकर पैर तक पुरे शरीर को देशी गाय का गोबर लगा कर स्नान करने की विधि थी । इस को कहते थे **श्रावणी कर्म विधि** । इस से पुरे के पुरे शरीर की जो चमड़े की बिमारियां है वह दुरूस्त होती थी । हमारे किसान जब जीवामृत का हाथों से उपयोग करते है, तो उन्हे अनुभव हुआ कि उन के हाथों के शरीर के चर्म रोग जीवामृत के स्पर्श से दुरूस्त हुए है। देशी गाय के गोबर में जड़ो को और सूक्ष्म जीवाणुओं को जिन का आपस में बहुत ही बडा मेल है इन दोनों की वृद्धि करने की अदभुत क्षमता है । इस के लिए मैं एक उदाहरण दुंगा। मान्सून की बारीश शुरू होते ही हमारे घरों के सामने खाली जगह में गुलाब या अंगुर के तने की कर्टींग (डाली) लगाते थे, तो उस के उपर देशो गाय का गोबर लगा देते थे। यह विधि हजारों सालो से चली आ रही है। लेकिन लगाने वाले हमारे बजूर्गो को यह नही मालुम था कि इस का वैज्ञानिक आधार क्या है। क्यों कि वे अंगुठे छाप थे । उनके पास कोई पी एच डी की डीगरी नही थी। लेकिन उन्हें यह जरूर मालुम था कि जैसे ही भूमि में डाले हुए गुलाब के डाली के उपर देशी गाय का गोबर लगाते है वैसे की जड़ें तेजी से बढ़ती है जड़ें सडती नहीं, लगाए हुए कलम को तेजी से नये पत्ते लगते है और वृद्धि भी अच्छी होती है । साथियों, इस गोबर में ऐसे ग्रोथ हार्मोन्स (वृद्धि संजीवक) होते है जो यह काम करते है ।

माघे गोमयकूंट तु संपूज्य श्रध्दयान्वितः।
खादं शुभ दिनं प्राप्य कुद्दालैस्तोलयेन्तः ।।
रौद्रे संशोष्य तत्सर्व कृत्वा गुण्डकरूपिणम् ।
फाल्गुने प्रतिकेदारे गर्त कृत्वा विधापयेत् ।।
त्तो वपनकाले तु कुर्यात ससाविमोचनम् ।
विना सारेण यव्दान्य वर्ध्वते न फलत्यपि ।।-कृषि संग्रह

अर्थात, गोबर को खादद के काम में लाना चाहिए। इस के लिए माघ मास में गोबर को ढेर लगा कर श्रद्धा पूर्वक उस का पुजन करना चाहिए। और फिर किसी शुभ दिन पर उस को कुदाल से तोड़ना चाहिए । फिर उस से सुखा कर छोटे-छोटे गुंडक (गोले) बना कर फाल्गून मास में गड्डे मे गाड देना चाहिए । और बोने के समय उनका निकाल कर भूमि में बो देना चाहिए । वेद काल में या वेदोत्तर काल में गोबर खाद बनाने की जो विधि चली आ रही है वह निरंतर अभी भी देहातो में अमल में लाते है। **महामुनी पाराशर** ने जो यह विधि बतायी है उस की वैज्ञानिकता जाचं लेनी चाहिए । यह वैज्ञानिकता में आप के सामने रखना चाहुंगा। माघ महीने (फरवरी) में

गोबर के खाद को क्यों छेडना चाहिए? माघ महिना आति ठंड का महिना होता है । और वह जाड़ा याने ठंड काल और धुपकाल के संधीकाल का समय होता है। उस समय तापमान 25^0 सी से कम होता है । उस से गोबर खाद में विघटन करने वाले जीवाणू ज्यादा सक्रीय नहीं हाते । और उन में से बहुतांश कोशावस्था धारण करते है। इसलिए इस महीने में खडडे में डाले हुएं गोबर खाद को उलट फेर ठीक होता है।

आधुनिक कृषि वैज्ञानिकों के आक्षेप

हमारे कृषि विश्वविद्यालय के कृषि वैज्ञानिक हमारे पारपारिक गोबर खाद निर्मिती प्रक्रिया पर आक्षेप लेते है। उनका पहला आक्षेप होता है कि गोबर खाद के ढेर धुप में तपते है और इस से विघटन क्रिया बंद होती है । उनन के आक्षेप पर मेरा उत्तर यह है कि वे कृषि वैज्ञानिक किसी भी काष्ट पदार्थ अथवा गोबर खाद को तेजी से विघटित करना चाहते है । उस को नाम देते है कम्पोष्ट खाद। लेकिन उन का यह आक्षेप अवैज्ञानिक है झुठा है । क्योंकि कुदरत के कुछ कानुन होते हैं । उनन में से उस का एक कानुन है **अस्तेय अपरिग्रह** । जरूरत से ज्यादा विघटन नहीं और जरूरत से ज्यादा संग्रह नहीं । कुदरत में केवल जड़ों को खाद्य तत्वों की आवश्यकता होती है, उतनी ही मात्र में भूमि में जड़ों के पास विघटन क्रिया होती है। कुदरत में आवश्यकता से अधिक संग्रह नहीं होता । जड़ों के पास जब विघटन क्रिया होती है तो उस समय बहुत सारे सन्द्रीय अम्ल (ह्युमिक ॲसीड़)और विविध संजीवक (Growth Hormones) निर्माण हाते है, जीन का जड़ों को आवश्यकता होती है। लेकिन, जब कोई कंपोष्ट खाद जडों के बाहर या खडडे में या कारखाने में पैदा होता है, जो जडों के लिए उन की कोई उपयोगिता नहीं होती । और यह कपोष्ट जब आप भूमि पर डालते है तब जैसे ही सूरज की रोशनी उस कंपोष्ट पर पड़ती है, धूप तपने से उस में से कार्बन हवा मे उड़ कर चला जाता है : हवा के प्राणवायु से उस का संयोग होतो है और कबांम्ल वायु के रूप में वातावरण में उड कर चला जाता है। साथ में मिथेन और नायट्रस ऑक्साईड वायु भी हवा में जाते है और वैश्विक तापमान वृद्धि करते है। भूमि को ऊर्वरा बनाने वाले ह्युमस की निर्मिती में इस की कोई बड़ी भूमिका नहीं होती । तो कुदरती खेती में हमें केवल दो ही बाते करनी है, जो कुछ काष्ट पदार्थ (फसल के त्याज्य पदार्थ) उपलब्ध है, उनन का भूमि के सतह पर आच्छादन के रूप में उपयोग करना और जीवामृत अथवा घनजीवामृत देना । इससे जड़ों के पास विघटन की क्रिया होती है और उसका लाभ सिधे जडो को होता ह । और जड़ों को जितना चाहिए, अगर उतना ही विघटन करना है, उस से ज्यादा तेज गती से विघटन करना हानी कारक है, अनावश्यक है। कृषि वैज्ञानिकों का एक दुसरा आक्षेप होता है कि गोबर खाद खुले में रखने से उस में नायट्रोजन हवा में उड़ कर चला जाता है।

कृषि वैज्ञानिकों का यह दावा भी गलत है । इस के लिए मै कुछ वैज्ञानिक प्रमाण देता हूं । नई दिल्ली के **विश्व विख्यात भारतीय कृषि अनुसंधान संस्था** (Indian Agricultural Research Institute) में भूविज्ञान और कृषि रसायनन शास्त्र विभाग के निवृत विभाग प्रमुख डॉ. एस. व्ही. राय चौधरी इन्होनें ठोस शब्दों में इस बात का वैज्ञानिक आधार दिया है । वे कहते है गोबर खाद में जो क्रियाशील अमोनयिा होतो है, वह जहरीला होने से भूमि में बोये हुएं बीजों को और पौधों के छोटी जड़ों को नुकसानदेह हाता है । लेकिन, गोबर खाद के छोटे छोटे देर अगर हम भूमि पर फैलाते है अथवा खडडे में से निकाल कर दस का बाहर ढेर लगाते है तो उसमें से

जहरीला अमोनिया वातावरण में निकल जाता है। माघ महीने में गोबर खाद के ढेर लगाने की जो पूर्वापार परंपरा चली आ रही है, उस का कारण यही था कि गोबर खाद धुंप में सुख जाए, उस में नमी बची न रहे । उसमें से नमी निकल जाने से अमोनिया को रूपांतरित करने वाले जीवाणू अपना कार्य बंद करके समाधी लेते है जिस से उस का जो गोमूत्र का हिस्सा किण्वन क्रिया (Fermentation) से अमोनिया में रूपांतरित होकर हवा में उड़ कर नही जाता और उसे गोबर खाद में ही युरिया के रूप में बचा कर रखे । किण्यन क्रिया से तापमान नही बढ़ता और उस ताप से होने वाले बाष्पीभवन के व्दारां अमोनिया का नाश नही होता। उल्टा गोमूत्र से अमोनिया की निर्मिती होन के बजाए, कर्बोदक और आम्ल तैयार होते है, जिस से नत्र का उत्पादन बढ़ता है।

जब माघ महीने (फरवरी) में गोबर खाद के ढेर को हम उपर निचे करते है तो उस उलट फेर से ढेर में हवा का प्रवेश होता है । उस हवा से बहोत तपमान बढ़ता है, उष्णता बढ़ती है । यह तपमान अमोनिया को पकडने में और सेंद्रिय आम्लों का संचय करने के लिए अनुकूल नहीं होता । क्योंकि वह जहरिला होता है। जब हवा की रफ्तार प्रति घंटा चौदा किलो मीटर होती है, और उस का तापमान 32 अंश शतांश होता है, तब इस स्थिती में गोबर खाद म से आधा से ज्यादा अमोनिया आधा दिन से एक हप्ता तक हवा में निकल जाता है। यह तो नकुसान करने वाली बात है । इसलिए बारिश काल में गोबर खादद को निचे उपर फेर नहीं करना है। गोमूत्र में जो नत्र होता है वह युरिया के रूप में होता है । किण्वण प्रक्रिया म सूक्ष्म जंतू के माध्यम से उस यूरिया का रूपांतर अमोनिया का तेजी से नाश होता है। यह प्रक्रिया केवल गोबर खाद मे जब नही होती है तभी होती है। जब हम गोबर खाद खडडे से बाहर निकाल कर धुप में सुखाते है तो यह नमी उस में से हवा में उडकर चली जाती है । और उस में नमी न होने के किण्वन क्रिया बंद होती है और अमोनिया का नाश हम टाल सकते है। इस लिए माघ महीने में गोबर खाद का ढेर फावडे कुदाल से निकालकर खडडे से बाहर खुले में डालना है । फाल्गुन महीने में (होली का महीना) यह गोबर खाद चालनी से छान लेना चाहिए और यह छानना हुआ गोबर खाद का संग्रह करना चाहिए । और किसी भी मान्सूनी फसल के (खरीफ अथवा रबी) बीज के साथ प्रति एकड़ 200 किलो यह छाना हुआ गोबर खाद और उस के साथ में प्रति एकड़ 100 किलो घनजीवामृत मिला कर बोआई के समय बा देना चाहिए । कोई भी रासायनिक खाद यां जैविक खाद डालने की आवश्यकता नही । जीवामृत, घन जीवमृत बनाने की पूरी विधि और उस के साथ फसले कैसे ले इसके बारे में विस्तार से जानकारी आगे आप पढ़ने वाले है ।

कोई भी खाद जड़ों का खाद्य नहीं

अभी आपने पढा कि एक देशी गाय से तीस एकड़ की खेती जीरो बजट आध्यात्मिक कृषि में हम कर सकते है। यह सुनकर आप इस पर बिलकुल भी विश्वास नही कर रहे होंगे। आपा कहेगें कि आप प्रति एकड़ ट्रक ट्रॅक्टर से गोबर का खाद डालते है, ट्रक ट्रॅक्टर से रासायनिक खाद डालते है साथ में कपोष्ट व्हर्मीकपोष्ट डालते है और इतने से आपका मन नही भरता तो इसके साथ साथ आप नीम की खल्ली और तालाब का गाद भी डालते है । इतना सारा डालने के बाद भी आपको अच्छी उपज नही मिलती है । और में आपसे कह रहा हूं कि कुछ भी डालने की आवश्यकता नहीं । एक देशी गाय से तीस एकड की खेती होगी और उपज भी बढेंगी । यह कैसे संभव है? यह आपका सवाल सही है । क्योंकि, आपके दिमाग में कृषि वैज्ञानिकों ने एक झुठी बात भर दी

है कि गोबर का खाद एवं रासायनिक खाद जड़ों का खाद्य है। यह आपको बताकर कृषि वैज्ञानिकों ने आपको अब तक गुमराह किया और मुर्ख बनाया है। अगर उनका दावा सही है तो मेरा उनको एक सवाल है कि जंगल के अनगिनत फल देने वाले पेड़ के नीचे किसी भी खाद का उपयोग करने की आवश्यकता क्यों नही पडती? इसका मतलब है कि कृषि वैज्ञानिक सरासर झुठ बोलते है । वास्तविक सत्य यह कि कोई भी खाद चाहे गोबर का खाद हो या रासायनिक, कंपोष्ट हो या व्हर्मीकंपोष्ट किसी भी पेड़ पौधे के जड़ का खाद्य नहीं है। क्योंकि, किसी भी पेड़ पौधे के वृद्धि के लिए आवश्यक खाद्यतत्वों में से 98.5 प्रतिशत तत्व हवा और पानी से ही मिलते है । अगर यह वैज्ञानिक सत्य है तो उपर से डालने की बात ही कहां आती है? जब मै दावा करता हूं कि, किसी भी पेड़ पौधे की जड़ का कोई भी खाद नही होता और पौधों का 98.5 शरीर केवल हवा पानी से बनता है, तब मेरा दायित्व बनता है कि मै यह दावा सिद्ध करू ।

अभी आपकी फसल खड़ी है चाहे गेहूं हो या धान, बाली बहार पडी है और दाने दूध अवस्था में है । यह हरी भरी फसल आप काटीए और उसका भार करिये । समझ लिजीऐ की भार 100 किलो है । अब इस 100 किलो हरे जैव भार को फैलाकर धुप में सुखाईये । जब आखरी दो भार सुखने के बाद एक समान आयेगें, जो समझ लिजिए कि पुरे सुख गये है। पुरा सुखने बाद उसका भार करिये, सुखा भार आपको 22 किलो मिलेंगा । इसका मतलब है 78 किलो भार घट गया । ये 78 किलो पानी है, जो सुखने के बाद उड़कर चला गया। बाद में इसक 22 किलो सुखे हुए जैव भार को सिमेंट के फर्श पर रख कर जलाईएं । जलते समय दो घटनाएं घटती है, एक काला धुआं निकलता है और ज्वालाएं निकलती है। जलने के समय जो काला धुआं हवा में जाता है, वह है कार्बन जो पौधों के हरे पत्तों ने प्रकाश संश्लेषण क्रिया के माध्यम से कर्बाम्लवायू के रूप में खाद्य निर्माण करने के लिए हवा से लिया था । जो धुऐ के रूप में दोबारा हवा में वापस चला गया । ये ज्वालाऐ वास्तव में सूरज की ऊर्जा और ब्रम्हांड़ ऊर्जा है, जो प्रति वर्ग फीट हरे पत्तों ने 12.5 किलो कॅलरी प्रकाश संश्लेषण क्रिया के माध्यम से सूरज की रोशनी में से वैश्विक किरणों में से ली थी । जो ज्वाला के माध्यम से दोबारा सूरज और ब्रम्हांड की ओर चली गयी । ज्वलन क्रिया पूर्ण होने के बाद केवल 1.5 किलो सफेद राख बची रही। इसका मतलब है 98.5 प्रतिशत हिस्सा हवा और ब्रम्हांड में चला गया । इसमें पानी और ऊर्जा दोनों उडकर चली गई । जो 1.5 किलो राख बची रही, वह है खनीज तत्व, जो जडों ने भूमि से लीये थे । जो 78 किलो पानी उड़कर गया, जडों ने भूमि से लिया था ।

भूमि में ये पानी वर्षा जल के माध्यम से संग्रहित हुआ । आपने सिंचन का पानी भी दिया, तो वह सिंचन का पानी वास्तव में बारीश का पानी ही कुंवे, तालाब, नदी, नालो में संग्रहित हुआ । जो भूमि अंतर्गत जलस्त्रोतों से झरनों के माध्यम से उपलब्ध हुआ । यह सारा सिंचन का पानी वर्षा जल ही है, जो मान्सून ने दिया है । सारा पानी उपलब्ध करने वाला मान्सून पानी का बील नही भेजता, मुफ्त में देता है । पौधो के वृद्धि के लिए आवश्यक कर्बाम्लवायू की आपुर्ती हवा करती है जो बील नही भेजती, मुफ्त में मिलता है। सूरज की ऊर्जा और ब्रम्हांड ऊर्जा पौधों को सरज और सत्ताईस नक्षत्र देते है जो बील नहीं भेजते, मुफ्त में देते है । इसका मतलब है पौधों के वृद्धि लिए आवश्यक कुल खाद्य तत्वों में से 98.5 प्रतिशत खाद्य तत्व पौधों को हवा पानी और सूरज की रोशनी से अपने आप मिल जाते है। हमे देनाही नही पडता। तो कोई खाद किसी भी जड़ का खाद्य कैसे हो सकता है? जो 1.5 किलो राख भूमि से लिए हुए खनीज तत्व है वह भी पौधों

के जडों को नीचे गिरे हुऐ काष्ट पदार्थ के विघटन से भरे हुऐ जीव जंतुओं के मृत शरीर के विघटन से केशाकर्षण शक्ति के माध्यम से और देशी केचुओं की गतिविधियों से प्राकृतिक ढंग से अपने आप मिल जाते है। इसके बदले में देशी केचुऐ, जीव जंतू, कभी किसानों को बील नहीं भेजते मुफ्त में काम करते है । साथियों दिमाग में से खाद की बात निकाल दिजीए और जीरो बजट आध्यात्मिक खेती में एक देशी गाय से तीस एकड़ खेती करीए ।

Alternate Farming Systems for Increasing Farmers' Income in North-West Himalayas

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Traditional farming systemshave become economically unviable because of static and low productivity levels, increased cost of inputs, and increased demand for more diversified and processed food products. Cultivation of the same crop year after year has also resulted in decline in soil fertility, emergence of insect pests, diseases, and nematodes as serious constraints in crop production. Decrease in crop productivity has led to increased use of fertilizers and pesticides, which have resulted in a decrease in biodiversity, soil and water pollution, and soil erosion. Therefore, there is a need for adoption of integrated farming systems involving cultivation of improved pest-resistant cultivars suitable for protected/ high density cultivation, balanced use of organic and synthetic fertilizers, need based application of micronutrients, pesticides and to minimize economic burden of the farmers economic and minimize the environmental imprint. This requires an in-depth understanding of the nature of interactions the crops with the fertilizers, pesticides, and the climatic conditions for sustainable crop production and economic well-being of the farmers.

The systems approach recognizes the importance of interactions between different components of the farming system (e.g, soils, water, plants, insect pests, pathogenic bacteria and fungi, and pollinators and animals). It also stresses the significance of the linkages between different components of the farming systems, economy and the environment. Gaining an understanding of how different components function individually and in different combinations is important for identifying complementary and synergistic relationships to design and implement an appropriate farming system in an agro-ecosystem. In Himachal Pradesh,nearly 70% of the population is engaged in agriculture/horticulture, which accounts for 15% of the Gross State Domestic Product (GSDP). The system productivity in Himachal Pradesh is quite low because of:

- Only 10% of the total land is amenable for cultivation due to the hilly terrain, and >86% of the farmers are marginal and small landholders with a land holding o less than 2.0 ha.
- Less than 20% of the total cultivable area is irrigated, while the rest is rain fed with steep slopes of the mountains, and majority of the farmers are engaged in traditional cultivation of food grains (largely maize and wheat, and to a limited extent rice).
- Lack of transport and marketing facilities, storage facilities, processing and value addition are the major bottlenecks in turning farming into as economically viable enterprise.

Options for adoption of a farming systems for increasing crop productivity, profitability and diversificationare limited due to lack the irrigation, and thereby, restricting the options for large-scale adoption of different farming systems to increase system productivity. It is this context that the farmers in the Himalayan region can go for intensiveprotected and/ or precision farming of high value cash crops such asvegetables, fruits, mushrooms, medicinal herbs and flowers. How different components interact with each other in a system, and the potential outcome of these interactions will provide a valuable information for developing systems for sustainable increase in crop production. Interventions to reduce energy-based inputs include adoption ofcereal - legume intercropping and/ or crop rotations, use of crop residue as fodder for animals, recycling the waste organic matter as manure; integrated pest

and nutrient management - including the large-scale adoption of pest-resistant varieties; pest and disease forecasting; biological and cultural pest control; plant residue, sprinkler/ drip irrigation; polythene or living mulches; mechanical weed control; conservation tillage; inter/ strip cropping, undersowing, use of trap crops, and double-row cropping.

Himachal Pradesh is well endowed with congenial conditions for taking up large scale cultivation of fruits, vegetables, flowers, mushrooms, mushrooms, beekeeping, aromatic and medicinal plants, agro-forestry on a commercial scale. Farmers of Himachal Pradesh have been diversifying agriculture, and sources of income to farmers are either through agriculture (farm income 20% in rain fed and 40% in irrigated systems) or non-farm income, which ranges from 60 to 80%. 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.In one of the studiesconducted in Himachal Pradesh, it has been estimated that the farmers earned fairly high net returns through cultivation of vegetable crops - ranging from Rs.2.73 lakhs in capsicum to Rs 43,861 per hectare in tomato. The net returns from green pea cultivation in dry temperate zone of Kinnaur and Lahaul Spiti districts are aroundRs 2.49 lakhs and Rs1.05 lakhs per hectare, respectively.

To achievethe objective of increasing or doubling farmer's income,it is imperative to overcome the major constraintsto increasing crop production such as shortage of irrigation facilities and farm roads, improve input use efficiency, and developfacilities 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 increasethe collaboration between different departments of the central and state governments, and promote public - private partnerships in agri-food system. The establishment of more productive farming system will require well defined land capability classification, knowledge of sensitivity to water runoff and soil erosion, biodiversity needs including plants, wildlife, and soil organisms, water availability, population density, support for the business community, employment needs, and social viability of the local communities, extreme climatic events,and projections for future needs.

Increasing the Farmers' Income

The farmers have been practicing mixed farming system, and hence,information on contribution of each component of farming including cereals, grain legumes, vegetables, fruit crops, agro-forestry, medicinalplants, fisheries, bee keeping, dairy, poultry, mushroom cultivation and collection and sale of forest produce, along with non-farm sources of income, form part of total farm income.

The goal of doubling the income of the farmers by 2022 cannot be achieved by increasing production only, but has to be accompanied by improvement in infrastructure, policy support, marketing and value addition. Efficient and organized supply chain holds the key for providing incentives to farmers to intensify, expand and diversify agricultural production. The farmers' cooperatives can play a catalytic role in boosting the agricultural growth in Himachal Pradesh. The 'Mahakali Flowers and Vegetable Growers' Cooperative Marketing Society Limited (MFVGS) was established at Jubbarhatti in district Shimla, in March, 2009.The society has a modern nursery growing polyhouse (5 lakh seedlings), cold storage for vegetables, and a godown for supply of critical inputs to the member farmers (fertilizers, chemicals, seeds, staking material, packing material, and other usable items for the polyhouse growers). This system reduced the cost of marketing to one tenth due to large-scale handling and marketing, and the farmers' incomes in the area have increased by 40 to 50%. There are several such success stories that need to be documented and replicated in other areas to double farmers' income in Himachal Pradesh.

Farming Systems for Hilly Terrain

To increase crop productivity and increase farmer's incomes, it is important to increase the productivity of the existing cultivated area, increase cropping intensity, and adopt precision farming, mushroom culture, beekeeping, high/medium or high/ ultra-high density planting systems, multi-story cropping systems,agro/horti-forestry farming systems, polyhouse culture, hydroponics, aquaponincs, natural zero budget farming, organic farming, integrated crop – livestockfarming and diversification of cropping systems. There is a need for a mission mode approach to double the farm income by focussing on critical inputs. Some of the farming systems which can be practiced independently or integrated with each other are presented hereunder.

Organic Farming System

The organic approach is driven by a bio, logical processes to maintain and achieve high soil quality, control pests, and provide favourable growing environment for highly productive crops, and prohibit the use of synthetic fertilizers and pesticides. For farm products to meet organic standards, farmers either substitute "organic" inputs or use "biological structuring" to achieve a high level of internal ecosystem services to achieve high levels of efficiency and productivity. Most productive organic farms are highly integrated and usea holistic approach to manage agricultural operations and their processes and impacts. The most notable inputs for organic agriculture are high yielding varieties with resistance to insect pests, diseases, tolerance to drought; use of organic manures such as farm yard manure, green manure, and earthworm manure; microorganisms to increase soil fertility such as use of *Rhizobium* inoculation for nitrogen fixation in legume crops, *Azospirillium* and *Azotobacter* in cereals, phosphorus solubilizing bacteria and Mycorrhiza; biocontrol agents such as parasities and predators, entomopathogenic fungi such as *Metarhiziumanisopliae*, *Beauveriabassiana*, *Lecanium*, *Bacillus thuringiensis*, entomopathogenic protozoa, nematodes; disease controlling fungi such as*Trichoderma*spp. and *Pseudomonas fluorescens*; use of natural plant products for pest control; and application of microbial cultures multiplied on a mixture of cow dung and urine, legume flour, jiggery, and forest soil.

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. Hydroponics is a relatively new concept and between 20,000 and 25,000 hectares of land are currently under hydroponic development globally, supplying 6 to 8 billion dollars' worth of produce. The global hydroponics market is projected to reach USD 395.2 million by 2020, growing at a Compound Annual Growth Rate of 16.8% from 2015 to 2020.In India, due to higher costs and lack of technical knowledge, hydroponic system has not picked up though it has many advantages over open field agriculture. For popularization of hydroponics, it is very important to provide scientifically proven technology and to create awareness of itspotential at the national level.

It offers numerous benefits including:

- Plants grow up to 50% faster than in soil because they have easy access to food and water, and the nutrients are directly available to plants.
- Plants start out in a disease free medium, and therefore, little or no chemicals are needed for pest control.

- Cultivation of crops can be undertakenin areas where it would normally not be because of poor soil, rocky areas, unfavorable climatic conditions, and it is less labor intensive.
- Since plants do not need to compete for nutrients, more plants can be grown in smaller areas.
- Increased control over growing conditions makes it easier to provide the best possible environment for plants, leading to better quality produce and higher yields.
- Fast growing healthy plants grown by hydroponic method are more resistant to pests and diseases.
- It is best suited for urban agriculture where land is the most precious commodity.

Protected Farming System

To overcome the limitation of crop production depending upon season and weather conditions, 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 ascontrol over the growing environment, production of quality produce, no chemical drift from thepoly-houses to neighbors fields, better management of insect pests and diseases, increased water economy, year round supply of high value produce to markets, increasing marketing power and economic returns, and more predictable yield and quality**.**

Over a period of time, this technology has gained importance mainly on account of increased pressure on agriculture land as a result of urbanization/industrialization/land division, better land-use efficiency, enhancing productivity, income, etc. Though, the green cultivation under glasshouses has been a popular concept in developed countries especially experiencing very low temperatures, but the real momentum picked up only after introduction of plastics. A poly-house is generally covered by transparent or translucent material such as glass or plastic which reflects back about 43% of net solar radiation incident upon it, and allowing the transmittance of photo-synthetically active solar radiation in the range of 400-700 nm wavelength. This technology works on the principle of greenhouse effect of the earth, creating a microclimate manually for best possible growth of plants. However, this requires precise technical knowledge of poly-house designs, climate controlling systems, and crop production techniques.

Protected cultivation is being used worldwide to produce more and better quality crops. The structures also vary from fully automated to plastic tunnel types. Throughout the world, the area under protected cultivation is increasing at quite a fast rate. Holland and Israel are the two leading countries taking best out of the protected cultivation for glowing vegetables and flowers. In the Asian continent, China, Japan and South Korea are the leading users of protected cultivation taking the maximum advantage of extended growing season. In the Indian subcontinent, protected cultivation started in eighty's with larger companies establishing hi-tech poly-houses for production of cutflowers mainly for exports, but the technology failed in many parts of the country due to use of unsuitable technology from other countries without understanding the climatic conditions of the area. However, protected cultivation is now picking up with efforts of the Central/State Governments providing financial assistance for adoption of the same.

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 agriculture research is to define a decision support system for whole farm management for optimizing returns on inputs while preserving resources. Itis 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.

High Density Orcharding

Agro-climatic conditions of Himachal Pradesh are highly suitable for cultivation of apple, pear, walnut, cherry, plum, apricot, peach/nectarine and kiwifruit. It is one of the leading temperate fruit producers in India,andmore than 2.0 lac families are involved in apple cultivations only. The area under temperate fruits in the state is 144.9 thousand ha with an annual production of 808.3 thousand MT, and productivity of 5.58 MT/ha.Althoughthe area and production of temperate fruits in the country and state has increased tremendously in last decades, but the productivity is quitelow. The productivity of fruit crops depend upon climate, variety, rootstock, planting density and orchard management practices. The productivity of apple in the country is very low (7.98 MT/ha) compared to other countries such asItaly (36.4 MT/ha), France (33.7 MT/ha), USA (31.0 MT/ha) and China (18.0 MT/ha). 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 andnutrient management, poor orchard floor management and weather vagaries such asoccurrence of low temperature and hail storms at flowering as well as fruit developmental stages. Among the total apple plantations in the state, 83.0 per cent are standard Delicious varieties viz., Royal delicious, Red Delicious and Rich-a-Red. These varieties require cross pollination, become alternate bearer after some years of regular fruiting, and are sensitive to low temperature conditions during flowering. To overcome the problems of low productivity in temperate fruits, new varieties of different fruit crops on clonal rootstocks need to be tested and evaluated in different agro-climatic conditions of the state to identify the suitable rootstock and scion combinations for each zone of the state.

Proper canopy management has paramount importance in high density plantings for harvesting of quality fruits. Photosynthetic activity of the tree and supply of carbohydrates to the developing fruits is directly related to the fruit quality and influenced by the canopy management practices. Orchard floor management practices affect the nutrient supply, soil moisture status and weed control in the orchard and thereby influence the nutrient and water use efficiency which is directly related to the productivity and quality of the fruits. Micro-irrigation and fertigation are the modern techniques of water and nutrient supply to the trees as per their requirements. These methods improve the efficiency of applied water and fertilizers and thereby increase the yield and improve the quality of produce.

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. On the other hand in self-pollinated crops, extra crop load is seen in the orchards which deteriorate the quality of the fruits. Therefore, identification of suitable pollinizing varieties and their optimum proportion in the orchard along with the optimum number of bee hives unit area should be standardized for cross pollinated crops like apple and cherry. However, in self-pollinated crops, suitable chemicals along with their

concentration and time of applications should be identified for fruit thinning and deciding the optimum crop load for production of quality fruits.

Technological and Policy Interventions

- Of the total 5.40 lakh hectares of farmland in the state, only 18-20% is irrigated, which is far below the national average of 49% in India. Since there is plenty of water in Himachal Pradesh, 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 under different farming systems. 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.
- Supplement irrigation water supply through storage of spring water in large tanks, rainwater harvesting and recharge of the groundwater through check dams and percolation tanks.
- Improve water use efficiency through drip and sprinkler irrigation,and moisture conservation through crop residue/polythene mulching and intercroppingforsustainable crop production.
- Improved and timely availability of quality seedofcereals, legumes, vegetables, flowers, and saplings of fruit plants (for example, hybrid seeds of okra, tomato, radish, carrot, cauliflower, bell pepper chilies, cabbage and beetroot), and appropriate varieties suited for protective cultivation to the farmers.
- Integration mushroom cultivation with farming systems (crop – livestock system) under low and mid-hill regions.
- Promotion of integrated farming comprising of crossbred, exotic or Indigenous milch breeds of dairy cattle/Yak, fisheries, sheep, goats, backyard poultry, pig, emu and rabbits.
- Integration of Cluster approach/Contract farming for efficient crop management, and linking production centers with markets and value addition through processing with in the opted farming system.
- Reduction of post-harvest and in-transit losses by developing a chain of cold stores, reefer trucks in strategic alliance with agribusiness cooperatives as per need of the designed farming system.Strengthening of main and link roads, timely availability of transport vehicles, market intelligence, cold storages, warehouses, processing units, and promotion of grower societies (Co-operative marketing), and auction yardsto increase net profits.
- Post-harvesttechnology for value addition, value added products of ginger, mango, citrus, ginger, garlic and vegetables, extraction of pectins, kernel oil of apricot, and value added/dried products of apple, plum, pear, apricot, fig and vegetables.
- Selection of fresh cultivation piece of arable lands for establishing new farming systems through public - private partnership. Mode. Allotment of “Nautaur land” out of the ceiling-surplus, and wastelands, especially in the tribal areas, to increase the size of land holding to small farmers.
- Supporting farming systems adopted by the farmers under Crop Insurance Schemes to mitigate risks of crop failures. Only 4.4% farmers have been brought under Weather Based Crop Insurance Scheme (WBCIS) in apple crop only so far.

Biodiversity Conservation: Sustainability, Threats and Policy Issues

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The term biological diversity – biodiversity as is commonly understood --refers to the variety of life forms and habitats. The Convention on Biological Diversity (CBD) 1992 defines it as " the variability among living organisms from all sources including, inter alia, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". The three hierarchical levels or components of biodiversity are: 1) Ecosystem diversity: The diversity of ecological complexes or biotic communities found in a given area; 2) Species diversity: The diversity of populations of organisms, which interbreed or are reproductively isolated from such other populations & 3) Genetic diversity: The diversity of basic units of hereditary information, which are passed down the generations, found within a species. The Government of India, however, for the conservation of biodiversity at ecosystem level has recognized the following major systems: i) Forest ecosystem ii) Grassland ecosystem iii) wetland ecosystem, iv) Coastal and Marine ecosystem and v) Desert ecosystem.

Forest Ecosystem

This has been divided into 16 major groups and 221 types. (As per Champion & Seth's classification). The major forest types, distribution and percentage area covered in given below:

Forest Type	Distribution	% Forest area
Tropical Forests		
Tropical wet evergreen	North East, And.& Nicobar	5.8
Tropical semi evergreen	South & East	2.5
Tropical moist deciduous	Central & East	30.3
Tropical littoral & swamp	Along the coast	0.9
Tropical dry deciduous	West & Central	38.2
Tropical thorn	West & Central	6.7
Tropical dry evergreen	Central & South	0.1
Sub-tropical Forests		
Subtropical hill forests	South	0.4
Subtropical pine	Sub-Himalayan tract	5.0
Subtropical dry evergreen	North-East & South	0.2
Temperate Forests		
Montane wet temperate	Himalaya & Nilgiris	2.0
Himalayan moist temperate	Temperate areas	3.4
Himalayan dry temperate	Dry temperate areas	0.2
Sub-alpine	Himalaya	4.3
Moist alpine shrub		
Dry alpine shrub		

Grassland Ecosystem

In India the extent of grasslands is about 3.9% or about 12 million ha. The five major grassland systems recognized are:

1. Peninsular India – The Sehima – Dicanthium type.
2. Semi-arid north & north-west India – The Dicanthium – Cenchrus – *Lasiurus* type.

3. Alluvial plain of Ganga & delta plain of West Bengal – The *Phragmites – Saccharum – Imperata* type.
4. Northern plains to eastern parts
   a. Himachal Pradesh – UP Terai belt –Assam &Manipur – The Themeda –
   b. Arundinella type.
5. Temperate and alpine – High attitudes of J&K, HP, UP, WB, Assam, Arunachal Pradesh.

Wetlands

These are lands influenced by water and cover habitats ranging from lakes, rivers, swamps, estuaries and salt marshes.India has about 4.1 million ha. wetland of which 1.5 m ha. is natural and about 2.6 m ha. is man made.The major wetland types are:

1. Tanks & reservoirs of Deccan peninsula.
2. Back waters & estuaries of West Coast of peninsula.
3. Saline wetlands of Rajasthan & Gujarat.
4. Fresh water lakes of Rajasthan, Gujarat, M.P.
5. Deltas, lagoons & swamps of east.
6. Terai swamps, marshes of Gangetic plains.
7. Flood plains of Brahmaputra & marshes & swamps of NE India.
8. Lakes & rivers of montane regions of J&K, UP, HP.
9. Wetlands of Bay of Bengal & Arabian Sea.
10. Coastal brackish waters of East & West Coast.

These wetlands perform important functions of flood control, stabilization of sea shores against erosion and recharge aquifers. For the conservation of wetland ecosystem an international treaty was adopted in 1971 (Ramsar Convention) and India became signatory to the treaty in 1981. There are six Ramsar sites in the country.

- Chilka lake of Orissa.
- Bharatpur National Park of Rajasthan.
- Wular lake of J&K.
- Harike lake of Punjab.
- Loktak lake of Manipur.
- Sambhar lake of Rajasthan.

Coastal and Marine Ecosystems

The total area covered by this ecosystem in India is 2.1 million sq km. The available data reveals that marine biodiversity represents more than 15% of the total faunal diversity of the country.Mangroves are the salt tolerant system with specially adopted species having pneutophorers, vivipery and specialized root cell membranes. Some of the world's best mangrove systems are found in India in Eastern parts of the country and in Andaman & Nicobar Islands. Around 6700 sq km area under these systems amount to around 7% of world's mangroves. These systems are important for providing food (fish etc.) fuel, fodder and medicines. The coral reefs are formed by the calcareous skeletons of stoney coral polyps. Fringing reefs, barrier reefs and atolls are the three main types of the coral reef.

Desert Ecosystems

Around 2% landmass of the country falls in this category. The three main desert types in India are:

- Thar deserts of Rajasthan & adjoining states characterized by shifting and fixed sand dunes with rocky out crops and inter dunal spaces.
- The salt deserts of Rann of kutch of Gujarat characterized by exceptional salinity.

- The cold deserts of Himalayan ranges forming a plateau extending from 4500 to 6000 m in J&K and HP.

Species Diversity

India is situated at the tri-junction of three realms viz. the Ethiopian, the Oriental and the Palaearctic realms. This location of the country makes it rich in biodiversity at all the three levels. Floral and mammalian diversity-wise India ranks tenth and by the number of endemic species of higher vertebrates it ranks eleventh in the world. It is, therefore, considered to be one of the twelve mega-biodiversity countries of the world. Only around 70% of the country's area has been surveyed. As per the data available so far there are over 47000 plants and over 89000 animal species. Species wise India contributes over 7% of the 1.7 million species recorded so far. A significant contribution to world biodiversity in the forms of endemism comes from India. About 4900 flowing plants, 62% of known amphibian and 50% of lizards of India are endemic. Western Ghats & E.Himalayas are biodiversity of spots of India.

Genetic Diversity

Compared to the ecosystem and species diversity the genetic diversity is less surveyed and studied in India. Wild relatives of cultivated crops and domestic animals have been surveyed.

The threats

Habitat Fragmentation and Shrinkage

With growing population and honey-combing of forest areas in the country the habitats are shrinking and they are getting fragmented. While this is happening world over it is especially important for India because this is a mega-biodiversity country and also because we have a large number of endemic species. There are twenty-six identified endemic centers. With habitat fragmentation, shrinkage and continuously reducing population there is loss of genetic diversity which ultimately threatens the very process of evolution. Although it is a long-term consequence but once lost it can not be recovered and, therefore, adequate care is required on this account.

Invasive Alien Species (IAS)

The destruction to biodiversity by invasive species *like Lantana camera, Parthenium hysterophorus and Mikania macarantha* needs no mention. African Cat Fish (*Clarias gariepinus*) and *Phenacoccus solenopsis* are the new invasive species that are creating serious habitat destruction problems. African Cat Fish is destroying our aquatic ecosystem but unfortunately we are not serious about its invasive problems.

Vanishing Pollinators and Biodiversity

Honey bees, bumble bees and butterflies are ecological soldiers that serve humanity by pollinating crops and a number of forest plants. More than 80% of the known 2.5 lakh plant species (and equal number remains to be explored) are pollinated by honey bees and other pollinators. We all need to thank them for their ecological services. These pollinators which are at the forefront of the food chain, are in danger. Various reports reveal that almost fifty percent of the bees and pollinators have already vanished. Vanishing bees is an ecological disaster and as a result, the entire global food chain is in danger. There is no doubt that if the bees are of the face of the earth, hundreds of the plants will be lost in one stroke. Warning bells have already been rung for the crops. This is only part of the bigger problem

that is going to happen as a result of disappearance of bees. The impact on ecological diversity is going to be manifolds as the role of honey bees in pollinating the herbs, shrubs and climbers in the forest is not documented in view of the focus on management of forest on trees for timber production and revenue generation in the past. Bees and butterflies (Except *Apis mellifera*) are covered under wildlife act and destruction of their hive amounts to destruction of habitat which is an offence.

Biodiversity and Climate Change

By now, all agree to the fact that the earth is heating up and the climate is changing. And as a result of this, the biodiversity will be severely affected. All species of plants and wildlife will be affected as they may not be able to adapt to the changing conditions. Clear reports are pouring in from the world Mountain Pine Beetle *(Dendroctonus ponderosae*) is a pest of conifers in Canada and US. It hibernates at negative twenty degree Celsius. It was not a very serious pest earlier as minus twenty degrees temperature was very common in many parts of canada. But now, with the change in the climate that Canada is experiencing, the temperature does not drop sufficiently during winter. As a result, the beetle does not undergo hibernation now and continues feeding and breeding on pines especially *Pinus ponderosa*. The result is that annually about fifteen million trees are being killed by this beetle. In India too, climate change has started showing ill effects in the form of early flowering and fruiting and sometimes no flowering, fruiting and seeding. *Salvadora oleoides* in Haryana is not setting seeds for the last three decades or so. Only sporadic seeding is observed once in five to six years. As a result, its zone is shifting from northern part to western and southern part.

Sustainable use

The concept of sustainability has been defined by CBD as "the use of the components of biological diversity in a way and at a rate that does not lead to the long term decline of biological diversity thereby maintaining its potential to meet the needs and aspirations of present and future generation". This concept of sustainability is well recognized and studied in Forestry sector but had been confined mostly to wood production. "Before the word environment was in popular use and certainly before the term "sustainable development" was coined foresters were in the forefront of action for the conservation and wise use of natural resources". Some environmentalists, however, believe that sustainability is a notion because of the "inadequacies of intricate scientific methodologies of determining sustainability of the system as a whole and inter linkages of various species known and unknown". Whereas it is true that there are "inadequacies in scientific methodologies" but at a practical level it is possible to sustain a system with adequate care and precautions. Moreover, most systems are sufficiently stable to withstand some amount of disturbance.In the concept of sustainability comes the question of time horizon. In the context of natural resource management and biodiversity conservation this time horizon is "in perpetuity". It is also important to remember that basing the conservation strategies on the present day human impact is wrong because entirely new threatening processes are emerging and will continue to do so.

Biodiversity and Food Security

Biodiversity has key role in food security. Four pillars of food security i.e., availability, affordability, accessibility and utilization are well recognized. Availability of food means that sufficient food should be available on consistent basis. While affordability is in terms of purchasing power, accessibility means that the food should be within the reach of everybody. Utilization refers to proper distribution, knowledge about the food components

and use. All these pillars may be fine for the time being, but what required is the stability of these pillars. Climate change is going to play a very big role in food security. There is in fact big instability within proposed stability. It is now being widely accepted that the climate change is going to create water logging/soil salinity at some places and water crisis at others. Land degradation, floods, droughts, ocean acidification, etc. will be very common but still at uncertain locations. There is going to be a very big threat to food production system from the emerging new insect-pests and diseases. It is going to affect not only to crops/varieties but to natural biodiversity as well. In view of these changes/threats, a crop or variety, which was suitable to a particular area may become unsuitable, which may put our food security at risk. The biggest threat to global food security is from our narrow dependence on food items. It is a well recognized fact that 60% of our calories come from just three species of cereals i.e. paddy, maize and wheat. 90% calories in human diet come from just fifteen species of plants (250 plant species are used for food all over the world). In India, 120 species of plants have been recognized important at national level and less than 150 species of plants are cultivated today. World over about 30,000-40,000 species of plants can be used as source.

The National Forest Policy

The second Forest Policy of India was adopted in 1952. However, over years the forests in the country suffered serious depletion. In order to review the situation and to evolve a new strategy for the conservation of forest resources a new Forest Policy Resolution was adopted in 1988.The principal aim of National Forest Policy (NFP) is 'environmental stability' and 'maintenance of ecological balance'. The derivation of direct economic benefits has been subordinated to principal aim. The NFP recognizes the vast variety of flora and fauna of the country and stresses for the conservation of the same as one of the basic objectives. The NFP also records the need for strengthening and extending adequately the Protected Area network for the conservation of total biological diversity. The NFP strategy recommends appropriate prescriptions for the wildlife conservation and also for the provision of "corridors" for linking Protected Areas to maintain genetic diversity and indirectly to ameliorate the situation arising out of habitat fragmentation. The National Forest Policy, therefore, has made adequate provisions for the conservation of biodiversity and has duly recognized its importance. In pursuance of Article 6 of the CBD recommendations the Government of India announced their policy and macrolevel action strategy for the conservation of the biodiversity in the year 1999.

Laws and IAS

Existing laws are silent about Invasive Alien Species. No clear legal provision exists to deal with invasive species. Strong Indian Forest Act, Wildlife Protection Act, Forest Conservation Act and Biological Diversity Act are silent about invasive species. Under provisions of section (29) of Wildlife Protection Act-1972, chief wildlife warden of the state can permit removal or destruction of IAS provided he is satisfied that it is necessary for the habitat management.

Action Strategies

Legislative & Policy Framework

Review and revise regulations governing access, ownership and management of natural resources; transfer, handling etc. of GMOs, protection of grasslands and wetlands.

Survey of Biodiversity and National Data base

Survey and monitoring of the status of biodiversity; traditional knowledge, innovations, and related information database.

***In situ* Conservation**

Expansion of PA network & their management, protection outside PA, restoration of degraded habitats, measures for conservation of species, inter-sectoral measures, reducing threats to biodiversity of PA.

***Ex situ* Conservation**

Establish linkages with *in situ* measures, encourage cultivation of plants of economic importance, study feasibility of private zoological parks, botanic gardens, establish a central authority for botanic gardens, inter-sectoral linkages and measures.

Indigenous Knowledge Systems, Practices, Innovations and Benefit Sharing

Documentation of traditional knowledge, Biodiversity registers, protection to these knowledge systems for benefiting the community, suitable mechanism for benefit sharing;

People Participation

Reduction of biomass pressure, biodiversity conservation concerns in CPR management, meet subsistence needs of local people, strengthen traditional conservation measures.

Institutional Framework

Strengthen BSI, ZSI, NBAGR, NBPGR, NBFGR, for inventory and monitoring, expand the network of botanic gardens, coordinate activities related to agriculture, animal husbandry, forestry, fishery; capacity building programmes, developing a system of natural resource accounting, cess on industries for biodiversity conservation, monitoring biodiversity through villages, block etc. levels work. Earmark 1% of the state & central resources for biodiversity conservation;

International Cooperation

Consolidate global cooperation; regional cooperation, bilateral cooperation for sustainable use and conservation.

Register Of Biodiversity and Local Knowledge

The format for the preparation of biodiversity register has been prepared which needs to be compiled and maintained for future use. This is an excellent entry level activity and works as a tool for documentation of information and conservation extension activity. The forest department may adopt preparation of this as a regular activity.

Forest Management Practices

In the working plans reference to some species as 'Miscellaneous' be replaced by the term 'less valuable species'.

a) The prescription like "remove miscellaneous species" during thinning and main fellings be banned. Only those species be felled or marked for felling which are planted or regenerated on large scale.
b) The purpose of soil conservation measures undertaken in forest area is also for the protection/preservation of eco-system. This needs to be clarified in the working plan.

c) In the regular plantation programmes of forestry departments, plantation of some percentage of lesser known species be made mandatory specially those which are threatened.
d) Jungle clearance by whatever name it is referred to (rab burning) be kept to minimum while undertaking plantation.

Biodiversty and Indian Traditions

Living in harmony and respecting nature has been an integral part of Indian culture since ages. This has been reflected in our traditional practices, religious beliefs, rituals, folklore, arts and crafts, and in the daily lives of the Indian people. Indian society has flourished on the principles like "*Live & Let Live*" and "*Ahinsa Parmo Dharma*". We do not unnecessarily want to kill animals and cut trees. As a matter of respect to animals we offer a portion of our meals to cow which is called "*Goansh*". We also feed dogs, feed grains to birds and ants. A number pots can be seen hanging in the households during summer for offering water to the birds. This tradition has to be kept going.

Conclusion

The utilisation of various forms of plants and animal life has been an essential and integral part of human civilisation. There have also been conscious efforts to conserve biodiversity in practice since ages through various social, religious and agricultural traditions, and forests and wildlife management practices in our country. But the deliberate efforts to conserve the entire gamut of biological resource got impetus after the Convention on Biodiversity in 1992. This has mainly been because of the realisation of the economic importance associated. Biodiversity conservation is a serious job. Biodiversity conservation, its sustainable use and role in ensuring food security and threat to it from climate change is one of the core issues of UN's sustainable development goals. The existing Indian environment laws are however, silent about (IAS). Only Forest Conservation Act refers to protecting native species by not permitting to plant species not native to the habitat. Practical aspects of biodiversity conservation and field efforts made in this direction have been discussed in the forgoing

Diversification of Cropping System- A Way to Higher Profitability and Livelihood Security of Hill Farmers

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India witnessed a paradigm shift in food grain production and from a food deficit state at independence, became a food surplus nation. The food grain production shot up from 51 million tonnes (mt) from 97 m ha (1950-51) to a record of 275.68 million tons in 2016-17. This showed a growth rate of 360 per cent with a meagre 24 per cent increase in gross cultivated area. This was possible through a combination of development of high yielding varieties and use of improved crop production technologies. The cereal based cropping systems (Rice – wheat, rice – rice and maize/pearlmillet – wheat etc) contributed mostly to the food basket. However, this also led to many second generation problems in post green revolution phase in all intensively cultivated areas, threatening the very sustainability of the important agricultural production systems, and thereby national food security. It is estimated that India would need about 345 mt food grains to feed around 1.5 billion population by 2030. Similarly, the increased demand for feed and fodder, resource degradation, climate change, new pests and diseases, slow growth in farm income, changing dietary pattern of the population and policies demand a new paradigm shift in our future research and development planning. All these call for a system's approach vis a vis crop diversification to deal with the emerging issues and new challenges.

Diversification of agriculture refers to the shift from the regional dominance of one crop to regional production of a number of crops, to meet ever increasing demand for cereals, pulses, vegetables, fruits, oilseeds, fibres, fodder and grasses, fuel, etc. It aims to improve soil health and a dynamic equilibrium of the agro-ecosystem. Crop diversification takes into account the economic returns from different value-added crops. Crop diversification may also be viewed to shift from one crop to another in order of changing needs such as

- Low value to High value crops;
- Water Loving crop to Water Saving crop (Aerobic rice, SRI)
- Single crop to Multiple / Mixed crop
- Crop alone to crop with Crop-livestock-fish-apiculture
- Agriculture Production to Production with Processing and Value Addition.

Crop diversification is intended to give a wider choice in the production of a variety of crops in a given area so as to expand production related activities on various crops and also to lessen risk. Crop diversification in India is generally viewed as a shift from traditionally grown less remunerative crops to more remunerative crops. The crop shift (diversification) also takes place due to governmental policies and thrust on some crops over a given time, for example creation of the Technology Mission on Oilseeds (TMO) to give thrust on oilseeds production as a national need for the country's requirement for less dependency on imports. Similarly Horticultural Mission brought about significant achievement in fruit and vegetable production. Market infrastructure development and certain other price related supports also induce crop shift. Often low volume to high-value crops like spices also aid in crop diversification. Higher profitability and also the resilience/stability in production also induce crop diversification, for example sugar cane replacing rice and wheat. Crop diversification and also the growing of large number of crops are practiced in rainfed lands to reduce the risk factor of crop failures due to drought or less rains. Crop substitution and shift are also taking place in the areas with distinct soil problems. For example, the growing

of rice in high water table areas replacing oilseeds, pulses and cotton; promotion of soybean in place of sorghum in vertisols (medium and deep black soils) etc.

Approaches

Horizontal diversification

This is the primary approach to crop diversification in production agriculture. Here, diversification takes place through crop intensification by adding new high-value crops to existing cropping systems as a way to improve the overall productivity of a farm or region's farming economy.

Vertical diversification

In this approach farmers and others add value to products through processing, regional branding, packaging, merchandising, or other efforts to enhance the value of the product.

Indian Perspectives

With the advent of modern agricultural technology, especially during the period of the Green Revolution in the late sixties and early seventies, there is a continuous surge for diversified agriculture in terms of crops, primarily on economic considerations. The crop pattern changes, however, are the outcome of the interactive effect of many factors which can be broadly categorized into the following five groups:

1. Resource related factors covering irrigation, rainfall and soil fertility.
2. Technology related factors covering not only seed, fertilizer, and water technologies but also those related to marketing, storage and processing.
3. Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity.
4. Price related factors covering output and input prices as well as trade policies and other economic policies that affect these prices either directly or indirectly.
5. Institutional and infrastructure related factors covering farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

Obviously, these factors are not water tight but inter-related. For instance, the adoption of crop technologies is influenced not only by resource related factors but also by institutional and infrastructure factors. Similarly, government policies - both supportive and regulatory in nature - affect both the input and output prices. Likewise, special government programmes also affect area allocation and crop composition. More importantly, both the economic liberalization policies as well as the globalization process are also exerting strong pressures on the area allocation decision of farmers, essentially through their impact on the relative prices of inputs and outputs. Although the factors that influence the area allocation decision of farmers are all important, they obviously differ in terms of the relative importance both across farm groups and resource regions. While factors such as food and fodder self-sufficiency, farm size, and investment constraints are important in influencing the area allocation pattern among smaller farms, larger farmers with an ability to circumvent resources constraints usually go more by economic considerations based on relative crop prices than by other non-economic considerations.

Crop Pattern Changes: Analysis

The analysis of crop pattern changes to be attempted at the macro level (India, China and the world) will focus on two main aspects (Table 1). These aspects are: a) the nature and direction of area shifts across crops and crop groups observed through time, b) the

implications of these shifts for crop diversification and balance in the inter-crop allocation of existing and additional areas brought under cultivation.
The temporal behaviour of crop pattern changes at the China, India and the world level can be seen from Table 1 that show, respectively, the area share of main crop groups for the six periods. Though obvious, it needs to be stated that the changing area share of crops is due as much to shift in area under other competing or alternative crops as to the relative area allocation of fresh areas brought under cultivation. In any case, the changing area share of crops does capture the ongoing changes in the comparative advantage calculus of farmers. The changes in the comparative advantage of crops reflect, in reality, the ongoing changes in relative prices of inputs and outputs, production conditions (including irrigation expansion), development and spread of new crop and farm technologies, extension and input support policies and trade policies and domestic regulations. As such, the changing area share of crop pattern, though looking deceptively simple, becomes a useful tool for understanding the direction in which crop pattern changes are influenced by the variations in the comparative advantage of crops and crop groups.

Constraints

Crop diversification in the country is taking the form of increased areas under commercial crops including vegetables and fruits since independence. However, this has gained momentum in the last decade favouring increased area under vegetables and fruits and also to some extent on commercial crops like sugar cane, cotton and oilseeds crops specially soybean. The major problems and constraints in crop diversification are primarily due to the following reasons with varied degrees of influence:

1. Over 117 m/ha (63 percent) of the cropped area in the country is completely dependent on rainfall.
2. Very weak agro-based industry.
3. Weak research - extension - farmer linkages.
4. Inadequately trained human resources together with persistent and large scale illiteracy amongst farmers.
5. Host of diseases and pests affecting most crop plants.
6. Poor database for horticultural crops.
7. Decreased investments in the agricultural sector over the years.
8. Sub-optimal and over-use of resources like land and water resources, causing a negative impact on the environment and sustainability of agriculture.
9. Inadequate supply of seeds and plants of improved cultivars.
10. Fragmentation of land holding less favouring modernization and mechanization of agriculture.
11. Poor basic infrastructure like rural roads, power, transport, communications etc.
12. Inadequate post-harvest technologies and inadequate infrastructure for post-harvest handling of perishable horticultural produce.

The substantial area shift from cereals to non-cereals is presented in Table 1. Although cereals gained a marginal increase in area share in times of the Green Revolution, Their area and share declined gradually thereafter. The oilseeds, fruits and vegetables category show a gain in their area share over the years.

Role of vegetables in crop diversification

India is the world's second largest producer of vegetables after China. However, hardly 2% of the vegetable is processed. The availability of prompt and reliable market information for different commodities would considerably improve the decision making capacity of farmers

in the country. Vegetables are a vital source of minerals, vitamins and dietary fibres and play an important role in human nutrition in supplying adequate quantity of free radicals, anti-oxidants and micronutrients.

Table 1. Area shift (Thousand ha) under Crop Groups in China, India and the world

Item	1961	1970	1980	1990	2000	2010
			China			
Cereals	90553	93712	95054	93583	85640	90132
Citrus Fruit	81	131	269	1102	1305	2011
Coarse Grain	37940	35170	31381	29310	28685	35759
Fibre Crops Primary	4110	5386	5518	6094	4304	4992
Fruit excl Melons	624	1195	1890	5240	9086	11402
Jute & Jute-like Fibres	77	139	313	300	51	19
Oilcrops Primary	17584	17286	19409	24466	29204	27985
Pulses	9727	7625	5434	3805	3360	2786
Roots and Tubers	12315	11178	10548	9454	10877	9134
Treenuts	0	0	0	158	317	660
Vegetables &Melons	5756	2896	3931	7658	18108	21048
			India			
Cereals	92239	100377	104067	102537	102402	92610
Citrus Fruit	93	150	150	215	458	1029
Coarse Grain	44618	46160	41744	36348	30204	27140
Fibre Crops Primary	9266	8850	9249	8528	9593	11880
Fruit excl Melons	1549	1822	2207	2526	3806	6881
Jute & Jute-like Fibres	1547	1242	1429	1089	1017	880
Oilcrops Primary	23669	25045	25818	32291	34621	37446
Pulses	23810	22358	22910	23415	19472	26166
Roots and Tubers	812	1064	1244	1339	1678	2186
Treenuts	214	297	467	555	716	955
Vegetables &Melons	2779	3489	4351	4793	5468	7196
			World			
Cereals	647998	675465	717196	708473	672717	681896
Citrus Fruit	2284	3081	4140	6069	7441	8644
Coarse Grain	328506	334668	335622	330250	303220	311470
Fibre Crops Primary	38730	40872	40767	37794	35186	35005
Fruit excl Melons	24635	28914	32894	41127	49405	55738
Jute & Jute-like Fibres	2849	2949	2902	2256	1683	1471
Oilcrops Primary	113621	132028	162118	185379	222283	266430
Pulses	64008	64389	61280	68802	64843	76003
Roots and Tubers	47590	48167	45887	46040	53221	52138
Treenuts	1895	2563	3135	4975	7281	9092
Vegetables &Melons	23747	22625	25702	31745	46607	52678

Researches show that the consumption of vegetables, especially cole crops reduces the risk of cancer of alimentary canal and respiratory tract of humans. Attention has been paid to vitamins such as vitamin C, pro-vitamin-A and dietary fibre in all these vegetables. In recent years it has shown that the plant tissue contains a whole variety of potential anti-carcinogenic secondary metabolites. These include flavonoides, glucosinolates and isothycyanates. Thus vegetables are the main source of these antioxidant and anti-carcinogenic plant substances which prevent cancer diseases.

India & World: India has been bestowed with wide range of climate and physic-geographical conditions and as such is most suitable for growing various kinds of horticultural crops such as fruits, vegetables, flowers, nuts, spices and plantation crops (coco nut, cashew nut and cocoa). Its horticulture production has increased significantly over the

last two decades and as per the final estimates, by 2013-14, it has increased to about three times (2.87) since 1991-92 and to about twice (1.90) compared to the production in 2001-02. This has placed India among the foremost countries in horticulture production, just behind China. As per National Horticulture Database 2014, during 2013-14, India's contribution in the world production of fruits & vegetables was 13.6 % & 14% respectively. Total production of fruits during 2013-14 was about 89 million tonnes while that of vegetables was 163 million tones whereas the third advance estimates put the production at 86 million tonnes and 167 million tonnes respectively for 2014-15.

India is the largest producer, consumer and exporter of spices. It is the second largest producer of fruits and vegetables in the world and occupies first position in the production of fruits like mango, banana, papaya, sapota, pomegranade, acid lime and aonla and vegetables like peas and okra . it is next only to china in production of many vegetables like potato, tomato, onion, brinjal, cabbage, cauliflower and broccoli etc.

As per National Horticulture Database 2014, India's significant horticulture production is despite its comparatively lower productivity. Both in case of fruits & vegetables productivity of India (12.3 & 17.3 tonnes per hectare respectively) is about half of the productivity of USA (23.3 and 32.5 tonnes per hectare). During 2013-14, India's productivity was marginally better than the world average in case of fruits (11.4 tonnes per hectare) whereas it was below the world average (19.6 tonnes per hectare) in case of vegetables. Comparison of India's horticulture productivity with that of China, the leading producer of fruits & vegetables, also gives identical results as in case of overall global productivity with significantly lower vegetable productivity whereas the productivity in case of fruits surpassing that of China. In case grapes production India's yield is best amongst the major producers of the fruit.

Export

Besides meeting the increasing demand of the domestic population, which continues to grow, India exports some portion of its horticulture produce. During 2013-14 total exports of horticulture produce by India was 3.69 million metric tonnes which amounted to about Rs 143.6 billion. Even though the quantum of export decreased in comparison to the year before i.e. 2012-13 when it was 3.7 million metric tonnes , the value of export of horticulture produce increased by about 35.6 % from Rs 105.9 billion in 2012-13. Except for 2010-11 when the exports of horticulture declined by about 7%, the export of horticulture produce has seen an increased during the last six years.

Trends in Horticulture Production

As per the data available in National Horticulture Database 2014, increase in horticulture produce has far outpaced the increase in area of crops under horticulture. Comparison of 2013-14 (final estimates) with 1991-92 reveals that while the area has about doubled, the production has become three times of the level since 1991-92. This is indicative of improved productivity. The third advance estimate released by Ministry of Agriculture also corroborates the same as it indicates that the area under horticulture decreased from 24,198 thousand hectares in 2013-14 to 23,216 thousand hectares in 2014-15 whereas the production is estimated to have increased from 277,352 thousand MT in 2013-14 to 277,743 thousand MT in 2014- 15. Despite of improvement in productivity, the same is yet to catch up with the world leaders, especially in case of vegetables where the productivity is lower than the world average. 9.6 Among fruits, banana and mango accounted for more than half (55 %) of total fruit production both during 2013-14 and 2014-15, with production of banana alone accounting for about 33 %. Share of Citrus fruits was also significant and they accounted for about 13-14 % of overall fruit production. Among vegetables, potato

production comprised the major share with 26 % and 28% of overall vegetable production in 2013-14 and 2014-15 respectively. Together with tomato & onion (each accounting for 11-12 % of total vegetable production during 2013-14 & 2014-15) and brinjal (7-8% share in vegetable production during 2013-14 & 2014-15), potato accounted for about 57-58% of vegetable production during 2013-14 and 2014-15. During 2013-14, the 0.4 % annual growth rate in production of vegetables was much less than 9.5 % growth rate in case of fruits .However, as per the third advance estimates, the fruit production has declined by 3 % during 2014-15 even though the vegetable production has increased by 3% during the period. Overall annual growth rate in case of horticulture produce is estimated to be merely 0.1% during 2014-15. The same may be explained by about 4 % decline in area under horticulture crops with area under fruit crops declining by more than 13%. Coconut continues to account for more than 90 % of plantation crop (areca nut, cashwenut , cocoa, coconut) production during 2013-14 and 2014-15. Chilies accounted for about a quarter of total spice production during 2013-14 and 2014-15 followed by garlic with 21 and 23% share during 2013-14 and 2014-15 respectively. Among major spices, production of turmeric is estimated to decline steeply (by 28%) during 2014-15 compared to 2013-14.

Research Efforts in Vegetable Diversification

Cropping System Research deals with management of natural and other farm resources for cropping activity in such a manner that their maximum efficiencies are harnessed to attain and sustain potential yield level per unit land and per unit time without causing any deterioration in quality of environment of any level of ecological hierarchy. Thus cropping system approach, encompasses wide ranging issues, related to economic aspects of cropping activity, available resources and microenvironment at farm level in holistic manner. In sum a substance, it enables the researchers to address issue pertaining to

1) Maximizing System productivity on annual basis.
2) Utilization of resources with higher efficiency through due consideration of various interactions and direct, residual and cumulative effect occurring in soil-plant-environment system.
3) Intensive input use vis-a-vis quality of environment.
4) Sustainability of farm resources & environment in long term perspective. (TAC,CGIAR 1978)

Designing of efficient cropping system for different agroecological situations and farm resource base through intensification / diversification, is the major plank of cropping systems research. Cropping Systems Research, therefore, strives for higher yields, more net returns, higher resource use efficiencies & remain sustainable over a long period with regard to these parameters. In India farmers use many cropping systems. The systems include crop animal combinations (Rice-ducks, Fish-Vegetable) and a variety of crop contributions viz. Rice-veg-veg-rice, Soybean-sweet potato-vegetable, Maize-radish-onion etc. In general such systems include mixed cropping, intercropping, relay cropping, planting after harvest and so forth. Inclusion of vegetables in diversification of existing cropping systems as intercrops with other horticulture crops or with field crops and for immediate planting after harvest of a main crop assumes importance because of the following reasons:

1. Vegetable crops have been and always will be used in intensive cropping systems because of their high productivity, cash and nutritional values.
2. Most vegetables can be raised efficiently as seedlings, then transplanted, thereby shortening their growing period in the main field and minimizing competition with the principal crop.
3. Vegetable crops can be grown in open spaces between rows of horticultural crops such as papaya, coconut, rubber, apple peach, peanut, plum and so on.

4. Field crops such as rice, corn and sugarcane are often the principal crops with which vegetable crops can be either intercropped or relay cropped.

5. In numerous rainfed rice areas in Asia, the present cropping intensity is low and there is potential for intensive land utilization.

The continuous cultivation of rice-wheat (Prasad and Nagarajan, 2004), maize – wheat or any other cereal-cereal cropping system has created many problems related to low water use efficiency, land degradation problems, indiscriminate exploitation of ground water, inefficient land use, decline in factor productivity, imbalance in fertilizer use, build up of diseases, pests and concerns of environmental quality. Hence inclusion of efficient cropping systems in place of cereal-cereal cropping is the need of the hour. ICAR and State Agricultural Universities are in the run to develop most efficient, practicable and diversified cropping systems including vegetable based cropping systems. The zone-wise most efficient vegetable based cropping systems identified in the recent past are given in Tables 2 and 3.

Table 2 Zone-Wise Efficient Vegetable Based Cropping Systems Developed During 2001-2005 (Gangwar and Singh 2011)

State	Cropping System	Most Efficient Alternative Cropping System
Zone 1: Western Himalyan Region		
J&K	Subtropical zone (Irrigated areas of Jammu region)	
	Rice-Wheat	i.) Rice-Marigold- Frenchbean ii.) Rice-Potato/cabbage-Onion
	Intermediate Zone	
	Kathua, Udhampur and Reasi region	i.) Maize+Blackgram-Potato-Onion
H.P.	Mid Hills	
	Rice-Wheat	i.) Rice-Radish-Potato ii.) Rice-Pea-Frenchbean iii.) Rice-Palak-Cucumber iv.) Okra-Radish-Onion v.) Turmeric-Pea-Summer squash
	Maize-Wheat	i.) Maize (GC)+Frenchbean-Pea-Summer squash ii.) Maize (GC)+Asparagus bean-Pea-Summer squash iii.) Maize (GC)+ Asparagus bean-Radish-Onion
		Low Hills
	Rice-Wheat	i.) Rice-Potato-Potato ii.) Rice-Potato-Frenchbean
	Maize-Wheat	iv.) Maize (GC)+Frenchbean-Pea-Summer squash v.) Maize (GC)+Asparagus bean-Pea-Summer squash vi.) Maize (GC)+ Asparagus bean-Radish-Onion
UK	North Western Plains	
	Rice-Wheat	i.) Rice-Potato-Greengram ii.) Rice-Wheat(ZT)-Greengram(ZT) iii.) Rice-Veg Pea-Greengram
Zone 2: Eastern Himalayan Region		
Assam	Rice-Rice	i.) Rice-Toria-Cowpea ii.) Rice-Onion-Cowpea
Zone 3: Trans-Gangetic Plains		

State	Cropping System	Most Efficient Alternative Cropping System
Zone of Punjab	Rice-Wheat	i.) Maize-Potato-Onion ii.) Groundnut-Potato-Moong iii.) Maize-Potato-Moong iv.) Maize-Wheat-Moong
Zones of Haryana	Cotton-Wheat	i.) Pearlmillet-Potato-Moongbean
	PearlMillet-Wheat	i.) Soybean-Wheat-Cowpea
Zone 4: Upper Gangetic Plains		
South-West Semiarid zone of UP		
	Pearlmillet-Wheat	i.) Dhaincha(GM)- Potato-Okra ii.) P.millet-Potato-Clusterbean iii.) P.millet-Wheat-Moong
Central Plain Zone of U.P		
	Rice-Wheat	i.) Maize-Potato-Sunflower ii.) Maize-Garlic-Green gram iii.) Maize+Black gram-Potato-Onion iv.) Hybrid Rice-Wheat-Green gram
Zone 5 Middle Gangetic Plains		
Agroclimatic Zones of U.P		
	Rice-Wheat	i.) Rice(MD)NDR 359-Wheat(NS) HUW 234 ii.) Rice(MD)-Potato(C-140)-Green gram(NM-1) iii.) Rice(CD) Jal Lahari- Onion (Pusa Red)
Eastern Plain Sub Humid Zone of U.P.		
	Rice-Wheat	i.) Rice-Wheat-Greengram ii.) Rice-Mustard-Green gram iii.) Rice-Potato-Green gram
Agroclimatic Zone of Bihar		
	Rice-Wheat	i.) Rice-Wheat-Green gram ii.) Rice-Wheat-Maize iii.) Rice-Potato-Onion
Zone 6: Lower Gangetic Plains		
New Alluvial Zone of Weat Bengal	Winter Paddy-Summer Paddy	i.) Rice-Potato-Jute ii.) Rice-Rice-Cowpea Fodder
Zone 7 Eastern Plateau & Hills		
Zones of Jharkhand	Rice-Fallow	i.) Rice-Mustard-Green gram ii.) Rice-Lentil-Green gram iii.) Rice-Potato-Green gram iv.) Rice-Wheat+Mustard(8:2)-Green gram v.) Rice-Wheat+ Lentil(4:2)-Green gram vi.) Rice-Wheat+Potato(1:1)-Green gram
Zones of Chhattis-garh	Rice-Fallow	i.) Rice-Potato-Cowpea
	Rice-Utera	ii.) Rice-Brinjal-Green Moong
	Rice-Mustard	iii.) Rice-Onion-Green moong

State	Cropping System	Most Efficient Alternative Cropping System
	Rice-Chickpea	iv.) Rice-Wheat-Fallow
	Rice-Vegetable	v.) Rice-Mustard-Green Moong
		vi.) Rice-TablePea-Maize (Fodder)
Zone 8: Central Plateau & Hills		
Semi-Arid Eastern Plain zone of Rajasthan		
	Pearl Millet-Wheat	i.) Cluster bean- Rabi Onion(Irrigated Areas) ii.) Green gram-Mustard (For Rainfed areas)
Sub Humid Southern Plain Zone of Rajasthan		
	Soybean-Wheat	i.) Soybean-Onion ii.) Black gram-Mustard/Wheat
Kymore Plateau & Satpura Hill Zone of Madhya Pradesh		
	Rice-Wheat	i.) Rice-Barseem(Fodder+Seed)
	Rice - Chickpea	ii.) Rice-Vegetable Pea-Wheat
Central Narmada Valley Zone		
	Soybean-Gram	i.) Soybean-Pea-Sugarcane
	Soybean-Wheat	ii.) Soybean-Potato-Okra
Zone 9 Western Plateau & Hill Region		
Scarcity Zone of Maharashtra		
	Soybean	i.) Soybean-Onion ii.) Soybean-Wheat iii.) Pearl Millet-Chickpea
Plateau Zone of Maharashtra		
	Soybean-Wheat	i.) Soybean-Onion ii.) Turmeric-Castor iii.) Soybean-Onion-Wheat
Western Vidarbha Zone of Maharashtra		
	Soybean	i.) Soybean-Chickpea/Wheat/Sunflower/Sorghum ii.) Sorghum-Chickpea/Wheat/Sunflower iii.) Maize-Chickpea/Wheat/Sunflower iv.) Cotton-Summer Groundnut v.) Mung bean/Urd bean-Sunflower/Chiickpea
Malwa Plateau & Narmada Basin Zone of M.P.		
	Soybean-Wheat	i.) Soybean-Potato-Late Wheat
	Soybean-Gram	ii.) Soybean+Maize-Wheat
		iii.) Soybean+Jowar-Wheat
Zone 10 Southern Plateau & Hills Region		
Southern Telangana Zone of Andhra Pradesh		
	Rice-Rice	i.) Maize-Onion ii.) Maize-Tomato iii.) Maize-Castor

State	Cropping System	Most Efficient Alternative Cropping System
		iv.) Rice-Maize v.) Maize-Groundnut vi.) Maize-Bengal gram
Northern Telangana Zone of Andhra Pradesh		
	Rice-Rice	i.) Soybean+Red gram-Sesamum ii.) Soybean-Sunflower iii.) Red gram-Sesamum iv.) Rice-Rice
Southern Traditional Zone of Karnatka		
	Paddy-Paddy	i.) Maize-Groundnut ii.) Maize-Sunnhemp-Sunflower iii.) Maize-Sunflower iv.) Sorghum- Sunnhemp-Sunflower
North Dry Zone of Karnatka		
	Rice-Rice Maize-Bengal gram Cotton	i.) Rice-Rice for Low Lying Areas ii.) Maize-Bengal gram for upper reaches of the command areas iii.) Cotton hybrids Bunny BG I and BG II-Vegetable like ridge gourd/Tomato/Sesamum/Maize/Bajra
Agro-Climatic Zones of Tamil Naidu		
	Rice Based, Vegetable Based, Sugarcane Based, Groundnut Based, Pigeon pea Based, Cotton Based, Banana Based, Tapioca Based Cropping Systems	
1. North Eastern Zone		
		i.) Rice/Vegetable/Marigold-Maize-Pulses ii.) Vegetable-Maize-Pulses iii.) Sugarcane-Ratoon Sugarcane-Rice-Groundnut (3 year rotation) iv.) Rice-Groundnut-Sesame/vegetables v.) Vegetable-Maize-Pulses vi.) Maize/Vegetable/Pulses/Sesame/Green Manure-Rice-Pulses
2. North Western Zone		
		i.) Pigeon Pea+ Garden bean/Finger Millet/Little Millet/Barnyard/Millet-Minor Pulses ii.) Bhindi/Cluster bean/Watermelon-Rice/Finger millet iii.) Groundnut-Maize/Finger millet
3. Western Zone		
		i.) Turmerice-Rice ii.) Rice-Finger Millet-Pulses iii.) Turmeric-Maize/Hybrid Tomato/Capsicum-Green Chillies iv.) Cotton-Millets/Vegetables-Groundnut v.) Maize-Sorghum/Pearl Millet-Vegetables
4. Cauvery Delta Zone		
		i.) Vegetable-Rice-Pulses ii.) Pulses/Groundnut/Seasame-Rice-Groundnut/Green gram/Pulses iii.) Rice/Pulses/Groundnut/Sesame-Rice-Groundnut/Green

State	Cropping System	Most Efficient Alternative Cropping System
		gram/Pulses iv.) Sesame-Cotton+Coriander v.) Rice-Finger Millet-Pulses vi.) Maize/Pulses/Vegetables-Rice-Pulses/Cotton/Seasum/Sunflower vii.) Maize/Vegetables-Rice-Pulses/Cotton+Onion/Seasum/Sunflower
5. Southern Zone		
		i.) Rice-Rice-Pulses ii.) Rice-Cotton iii.) Cotton+Black gram/Chillies iv.) Groundnut+Pulses v.) Chillies/Groundnut/Rice-Cotton vi.) Rice-Rice-Pulses/Sesame vii.) Vegetables/Groundnut-Cotton viii.) Groundnut/Pulses/Vegetables-Rice ix.) Chillies/Groundnut/Rice-Cotton
6. High Rainfall Zone		
		i.) Tapicoa+Pulses ii.) Rice-Rice iii.) Rice-Pulses
7. Hilly & High Altitude Zone		
		i.) Tea, Coffee,Cutflowers,Frenchbean,Pepper,Avocardo,Potato,Cabbage,Ginger
Zone 11: East Coast Plains and Hills Region		
Coastal & Inland Zone of Orissa		
		East & South Eastern Coastal Plain & Mid Central Table Land Zone
	Rice Based Non Rice Based	i.) Rice-Maize-Cowpea ii.) Rice-Maize-Green gram
		West Central Table Land Zone
		i.) Rice- Groundnut-Green gram ii.) Rice-Groundnut-Sesamum
Zone 12: Western Plains and Ghat Region		
1. Zones of Kerala		
	Rice Based Cropping System	i.) Rice-Rice-Groundnut ii.) Rice-Rice-Bhindi iii.) Rice-Rice-Cowpea
2. Konkan Coastal Zone of Maharashtra		
	Rice Based cropping System	i.) Rice-Cowpea ii.) Rice- Groundnut iii.) Rice-Maize
Zone 13: Gujarat Plains & Hill Region		
1. North Gujarat Zone		
	Pearl millet-	i.) Groundnut-Potato-Summer Pearl Millet

State	Cropping System	Most Efficient Alternative Cropping System
	Mustard	
	Cluster bean-Mustard	ii.) Castor-Summer Green gram
	Castor-Fallow	ii.) Castor-Summer Fodder Sorghum
2. South Gujarat Heavy Rainfall Zone		
	Paddy-Paddy	i.) Paddy-fenugreek/Okra
	Paddy-Sugarcane	II.) Paddy-Onion-Cowpea
3. South Saurashtra Zone		
	Groundnut-Wheat Groundnut –Castor or Castor+ Groundnut Inter cropping, Groundnut-Pearl millet& Cotton-Fallow	i.) Groundnut-Wheat-Fallow ii.) Groundnut-Onion-Green gram iii.) Groundnut-Pearl millet-Green gram iv.) Groundnut-Wheat-Sesamum v.) Cotton-Continued-Pearl millet/ Groundnut vi.) Groundnut-Castor-Continued
ZONE 14: WESTERN DRY REGION		
Arid Western Plain Zone of Rajasthan		
	Pearl Millet-Wheat	i.) Pearl Millet-Wheat, ii.) Pearl Millet-Mustard, iii.) Pearl Millet-Isabgol iv.) Cluster bean-Wheat, v.) Cluster bean-Mustard, vi.) Cluster bean-Isabgol, vii.) Sesame-Wheat
Zone 15: Island Region		
Andaman & Nicobar Islands		
	Rice Based Cropping Systems	1. Hilly Areas i.) Coconut Based Cropping System ii.) Arecanut Based Cropping System
		2. Low Lying Valley Areas i.) Rice Based Cropping System

Table 3: Efficient alternative cropping systems developed under the aegis AICRP-IFS from 2006 to 10 (adapted from PDFSR 2011)

Location	Efficient Cropping System	Gross Return*	Energy (K.cal./ha/Year)
Arid Ecosystem			
Hisar	Cotton-wheat	2,19,518	51.28 x 10^6
S.K.Nagar (Gujrat)	Castor-Green	1,23,168	
	Cotton+Green gram- Pearl millet	1,21,993	
Sriguppa	Rice- Fenugreek	1,24,170	
Semi Arid Ecosystem			
Ludhiana(Punjab)	Cotton+Sesbenia-redish+rapeseed	3,57,495	100.10 X 10^6
	Maize+Turmeric-Wheat+Linseed	3,30,819	
	Maize+Turmeric-Barley+Linseed	3,18,891	
Kanpur (U.P.)	Maize-Garlic-Green gram	3,21,326	28.53 X 10^6
BIchpuri (U.P.)	Pearlmillet-Potato	97,290	33.50 X 10^6
	Sesbania (Green manure)-Potato	88,586	28.64 X 10^6
	Pigeon pea-Wheat	85,635	20.06 X 10^6
Junagarh(Gujrat)	Groundnut-Onion-Sorghum (F)	1,80,170	28.01 X 10^6
Durgapura (Rajasthan)	Groundnut-Isabgol-Sesbania(Green mannure)	1,10,084	24.70 X 10^6
	Green gram-Mustard	83,474	18.85 X 10^6
Kota(Rajasthan)	Maize-Garlic	3,90,953	29.26 X 10^6
Indore (M.P.)	Soybean-Onion-Lady's Finger	1,83,197	26.92 X 10^6
Akola (Maharashtra)	Soybean-Coriander+Wheat	2,06,130	36.72 X 10^6
Rajendernagar (A.P.)	Maize-Sunflower	65,233	22.06 X 10^6
Rudrur	Rice-Rice	1,13,476	
	Rice-Maize	1,03,839	38.27 X 10^6
Rahuri	Soybean-Onion	1,41,369	23.83 X 10^6
Parbhani (Maharashtra)	Turmeric+Castor-Fallowystem	4,76,003	53.82 X 10^6
Coimbatore (TN)	Sugarbeet-Maize-Groundnut sequence	1,83,822	37.96 X 10^6
	Cotton+Green Gram-Maize-sunflower	1,45,458	36.79 X 10^6
	Sugarbeet- Green Gram – Maize+Cowpea (vegetable)	1,13,230	27.12 X 10^6
Sub Humid Ecosystem			
Pantnagar (Uttrakhand)	Rice(direct seeded)-Potato-Greengram	1,43,243	40.23 X 10^6
Varanasi (U.P.)	Rice- Potato- Greengram	1,52,236	41.77 X 10^6
Masodha	Rice- Potato- Greengram	1,56,333	45.67 X 10^6
Sabour	Rice-Cabbage+Radish-Ladysfinger+Green Gram	2,89,130	34.89 X 10^6
Ranchi (Bihar)	Rice-Wheat+Potato- Green Gram	1,60,195	46.79 X 10^6
Raipur (M.P.)	Rice-Wheat+Fenugreek-Cowpea (Fodder)	1,35,414	29.81 X 10^6
Jabalpur (M.P.)	Rice-Garlic-Maize(F)+Cowpea	2,11,722	52.89 X 10^6
Rewa (M.P.)	Rice-Garlic	3,31,991	40.03 X 10^6
Powaarkheda (M.P.)	Soybean-Field pea	3,04,971	72.95 X 10^6
Chiplima	Rice- Groundnut- Vegetable Cowpea	1,63,592	43.64 X 10^6
Kathalagere	Rice-Groundnut	1,39,996	43.21X 10^6
Humid Ecosystem			

Chatha (J & K)	Rice-Garlic-Cowpea	5,47,856	39.48 X 10^6
Palampur (H.P.)	Hybrid Maize-Vegetable pea-Summer squash+Frenchbean (Pole)	2,46,051	32.86 X 10^6
	Babycorn-Veg pea-Summersquash	2,52,927	33.37 X 10^6
Jorhat (Assam)	Rice-Cabbage-Green gram	94,104	15.53 X 10^6
Kalyani (West Bengal)	Brinjal+Coriander-Bitter gourd	1,77,663	14.08 X 10^6
Coastal Ecosystem			
Bhubaneshwar (orissa)	Rice-Radish-Seasame	1,34,643	28.79 X 10^6
Maruteru			
Karmana (Kerla)	Rice-Rice-Pumpkin	1,94,867	30.63 X 10^6
Karjat	Rice-Brinjal	1,13,583	25.21 X 10^6
Navsari (Gujrat)	Rice-Wheat	1,12,620	20.97 X 10^6

***(Rs/ha/Year)**

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Organic Agriculture as a Remunerartive Enterprise

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Indian agriculture especially, Punjab State has seen tremendous strides under the impact of green revolution which resulted in introduction of new high yielding varieties (HYV's) of wheat and rice crops. The increasing yield of wheat and rice crop in Punjab fetches out good economic returns to the farmer's and also helped by giving them financial support to adopt new technology. By which, farmers started usage of new farm machinery, chemical fertilizers, pesticides, insecticides to increase the returns from their limited source (land) which adversely affected the quality of soil. This led to adoption of plant protection measures resulting of which the production of many crops has shown a drastic change but also give birth to many other environmental issues. Thus the agricultural development in Punjab has been facing serious challenges (Singh 2012). So now is the time when agricultural productivity has been stagnated and soils are getting exploited and is not good for the health of soil to bear the effect of chemicals and their residual effect.

Pesticide contamination of food and feed in Punjab were studied by Dhaliwal *et al* (2000) and sizeable amount of contamination was found in grains, vegetables, feed and milk (Table 1). Among 30 samples of cereals, 99 samples of rice grain, 15 samples of animal feed and 105 samples of animal feed and fodder, all the samples were contaminated with pesticides. Out of 24 samples of milk, 23 samples were contaminated with pesticides.

Table 1: Pesticide Contamination of Food and Feed in Punjab

Commodity	Number of Samples	
	Analyzed	Contaminated
Cereals	30	30
Rice grain	99	99
Vegetable	96	64
Animal feed	15	15
Animal feed + fodder	105	105
Milk	24	23

Source: Dhaliwal *et al* (2000)

The average dietary intake of pesticide residues (Table 2) by vegetarian Indian is 362.5 mg/day and non-vegetarian Indian is 356.3 mg/day as against developed countries varying from 7.6 to 149.0 mg/day (Ghosh 2000). The heavy metals and other potentially toxic elements are the most serious soil pollutants. Amines produced from the nitrogenous fertilizers cause cancer in human beings. Herbicide residues affect the central nervous system, respiratory system and gastro-intestinal system of human beings. These chemical residues also cause depression, insomnia, oral automatism, myoclous and hyper-reflexia of man. Such harmful effects are now being focused at various forums on account of alarming health hazard situations. To negate such harmful effects organic farming is one of the important options for adoption (Walia *et al*. 2007a).

Weed Management

No herbicides are applied in organic farming as they lead to environmental pollution (Palaniappan and Annadurai 1999). In organic farming weeds are controlled by cultural methods, bioherbicides, biological control using insects and pathogens. Cultural methods include tillage combined with irrigation timings, seeding rates and cultivar selection, cropping

systems, use of animals, flooding, mulching, composting, hoeing, hand weeding, farmers' care and straw disposal (Kler *et al*. 2001). They further reported that there are a number of fungal and bacterial pathogens parasitizing different weeds. Two mycoherbicides have been registered in USA for commercial use for weed control. One of soil borne fungus is *Phytopthora palmivora* against strangler vine (*Morrenella odorata*) and the other formulation is of *Collectotrichum gloeosproides* against selective control of northern jointvich (*Aeschynomene viriginalaca*). Dairy manure contains weed seeds and poultry manure is nearly weed free. So, with use of dairy manure weed problem is expected in organic farming where herbicides are not used to control weeds. However, with composting the manure the number of viable weed seeds decreased (Cudney *et al*. 1992).

Table 2: Average Dietary Intake of Pesticide Residues

Country	Average Dietary Intake (mg/day/person)
Germany	149.0
Australia	20.0
Canada	13.3
United Kingdom	12.0
USA	7.6
India	
Vegetarians	362.5
Non-vegetarians	356.3

Source: Ghosh (2000)

Pest Management

Bio pesticides obtained from plants like neem (*Azadirachata indica)*, pongamia (*Pongamia glabra*), tulsi (*Ocimum sanctum*), sorghum, marigold and bouganvillaea have been found effective against a number of diseases and insect-pests. Many neem based formulations like Neemark, Neemguard, Neemazal, Nimbicidin, Wellgro, Agricef, Neoconeem and Limnonol are available in market and are in great demand (Singh 1993). Bio –pesticide agents are abundantly available in nature. Several pathogens including viruses such as nuclear polyhedrosis virus (NPV) and granuosis virus (GV), bacteria like *Bacillus thurienglensis*, *Veticillium* and protoaoan like *Schizogregrine* cause diseases in insects and destroys them. Similarly, several insect parasitoids (parasites thriving on insects) are also known in nature. *Trichoderma* is an egg parasitoid of several pests (Singh *et al*. 1997).

Selective microbial pesticides offer particular promise, of which strains of *bacillus thuringiensis* is an example (Palaniappan and Annadurai 1999). Biopesticides prepared from neem have shown satisfactory results against 300 pests-insects of agricultural, horticultural, vegetable crops, house hold pests, locusts, grass hoppers, catterpillers, stem borers, pod borers, beetle, jassids, aphids, mealy bugs, whiteflies, plant hoppers, fruit flies and mosquitoes. Neem formulations are environment friendly and also save farmer friendly insects (Ghosh 2000). *Goniozus, Elamus, Eriborous, Bracon, Trichopirillus, Tetratichus* and *Chelonus* are some of other parasitoids attacking insect pests. Insect predators such as *Crytorihinus, Pharoscymnus* and predatory nematodes like species of *Neoplectana* and *Heterorhabditis* destroy insects by causing diseases in insects and by predation. Fungi namely, *Trichoderma, Aspergillus, Chaetomium* and *Agrobacterium* are effective against different diseases (Kler *et al*. 2001). The use of organic source of nutrients (vermicompost and FYM) proved significantly superior in controlling the fruit borer in *bhindi* over chemical fertilizers . These findings were in accordance with the reports of Choudhary and Kashyap (1987) on cotton boll worm and Venketeswara Rao (1989) on chilli pod borer and it was mainly attributed on account of regulated growth of crop plants which discouraged shelter to the insect-pest and encouraged predator with more perched places to feed on insect-pest because the canopy is not thick and

avoid over shaded micro environment beneath the plants. It also avoids ovipositor to the pests and as a result pest population remains less.

Pesticides/ Insecticides

The use of insecticides and weedicides has played a crucial role in yield exploitation and stability in state agricultural production. The pest problem accentuated with the introduction of high yielding varieties of crops, intensive use of inputs and development of new cropping patterns. Crops like cotton, sugarcane, paddy, oilseeds and vegetables have shown greater reliance on pesticides. Problem of weeds also increased with increase in cropping intensity and fertilizer use particularly in irrigated areas like Punjab. Table 3 showed the consumption of pesticides and insecticides in Punjab has almost doubled with consumption from 3200 kg in 1980-81 to 5975 kg in 2012-13 while consumption of insecticides increased from 1280 kg in 1980-81 to 2390 kg in 2012-13.

Table 3: Consumption of Pesticides and Insecticides in Punjab (kg in Tech. Gr.)

Year	Pesticides*	Insecticides
1980-81	3200	1280
1990-91	6500	1850
2000-01	6970	3456
2007-08	5900	2650
2008-09	5760	2690
2009-10	5745	2600
2010-11	5600	2602
2011-12	6150	2340
2012-13 (P)	5975	2390
Growth Rate (%)	1.96	2.03

*Weedicides, fungicides and rodenticides, Source: Dhawan and Singh (2015)

The major increase for pesticides was recorded during 90's when in 1990-91, its consumption was 6500 kg (in technical grade) due to inclement weather resulting in pest attack during those years particularly in case of cotton crop due to attack of American Bollworm. Punjab farmers had used weedicides effectively in weed management of field crops particularly in crops like wheat, paddy, potato, etc. This resulted into tremendous increase in demand of pesticides and weedicides over time. The total consumption of plant protection agro-chemicals including weedicides, fungicides and rodenticides in Punjab was at 5900 kg (technical grade) in 2007-08 which declined to 5600 kg in 2010-11. The decline may be attributed to the large scale adoption of Bt cotton and availability of new chemicals requiring application in relatively small doses. However, the estimated consumption of these during 2012-13 was 5975 kg. Certain harmful effects of extensive use of these chemicals being observed include chemical residue in agricultural output, development of strains of resistance, undesirable side effects on non target flora and fauna and resurgence of certain insect and weed species along with appearance of secondary pests/weeds. Regular monitoring and surveillance of these problems in state is the need of the hour (Dhawan and Singh 2015).

Organic Farming

Organic farming is one of the alternate forms of agriculture that is aimed at sustainable agricultural production along with the conservation of natural resources. It is a holistic way of farming in which quality agricultural production is achieved with an aim to conserve rather improve our natural resources. It relies on crop rotations, green manures, organic manures, bio-fertilizers, composts and biological pest management for crop production excluding or strictly

limiting the use of synthetic fertilizers, chemical pesticides, plant growth regulators and livestock feed additives.

The word 'organic' in organic farming is a process claim and not a product claim. Chemically, every food is organic but here it is the production process which makes the food organic. India's National Programme for Organic Production (NPOP) defines organic farming as, 'A system of farm design and management to create an eco system, which can achieve sustainable productivity without the use of artificial external inputs such as chemical fertilizers and pesticides. Organic farming is based on the concept that nature is the best role model for farming since it does not believe in mining of the soil of its nutrients and degrading it for present needs. The soil is considered as a living entity and soil's living population of microbes and other organisms occupy an important place in sustaining the soil fertility and this living population must be protected and nurtured. Enhancing soil health through 'feed the soil, not the plant' concept is the cornerstone of organic farming. The nature has been taken as a role model since it does not use any external inputs. The emphasis remains on improving the general health of soil with minimal use of off-farm inputs. The ultimate aim of organic farming is to develop economically viable, socially acceptable and ecologically safer agricultural systems by mutual coexistence with the ecosystem rather than dominating it. Thus organic farming is not just chemical free farming; it also covers the sustainability, environmental, economic and social aspects.

Characteristics

It, in the light of principles of organic farming, should:

- Encourage and enhance the biological cycles.
- Maintain the long term soil fertility.
- Mobilize organic matter and nutrients locally within closed systems.
- Use, as far as possible, renewable resources in locally organized agricultural systems.
- Avoid all forms of pollution.
- Maintain biodiversity at the regional/ and local level.
- Allow the livestock to express innate behaviour.
- Produce, socially and economically acceptable, quality food in sufficient quantity.

Indian Scenario

Currently, India ranks 33rd in terms of total land under organic cultivation and 88th in agricultural land under organic crops to total farming area. According to the Agricultural and Processing Food Product Export Development Authority (APEDA), the cultivated area under certified organic farming has grown almost 17-fold in last one decade, i.e. from 42,000 ha in 2003-04 to 7.23 lakh ha in 2013-14. The state wise statistics showed Madhya Pradesh has the highest area under certified organic agriculture (2.33 lakh ha), followed by Maharashtra (0.86 lakh ha) and Rajasthan (0.66 lakh ha). Among the hill states, Sikkim has the highest (0.61 lakh ha) and Arunachal Pradesh has the lowest area (71 ha) under organic agriculture. Among the Southern states, Karnataka has the highest (0.31 lakh ha) and Tamil Nadu has the lowest area (3640 ha) under certified organic agriculture. The Government of India has implemented the National Programme for Organic Agriculture (NPOP) in the year 2001, which involves the accreditation programme for certification agencies, norms for organic production, promotion of organic farming etc. The states such as Uttarakhand, Karnataka, Madhya Pradesh, Maharashtra, Gujarat, Rajasthan, Tamil Nadu, Kerala, Nagaland, Mizoram and Sikkim have been promoting organic farming in a big way. The states of Uttarakhand and Sikkim have declared themselves as organic states. Besides, a large number of farmers' organizations and NGO's have come- up with the passage of time, which are not only practising organic agriculture but also experimenting with it. The certified area under organic farming in India

was presented in Table 4. The total area under organic farming was 723039.00 ha during year 2013-14. Out of which Madhya Pradesh covers maximum area of 232887.4 ha followed by Maharashtra (85536.66 ha), Rajasthan (66020.35 ha), Sikkim (60843.51 ha), Odisha (49813.51 ha) and Gujarat (46863.89 ha) etc.

Table 4: Area Under Organic Certification (Top 10 States/UTs)

State	Area (ha)*
Madhya Pradesh	2,32,887.4
Maharashtra	85,536.66
Rajasthan	66,020.35
Sikkim	60,843.51
Odisha	49,813.51
Gujarat	46,863.89
Uttar Pradesh	44,670.1
Karnataka	30,716.21
Uttaranchal	24,739.46
Kerala	1,5020.23
Others	65,931.00
Total area	**7,23,039.00**

Source: APEDA (2013-14), *excluding forests

The certified area under organic farming in India vis-a-vis Punjab over the years was depicted in Table 5. In year 2005-06 the area covered under organic agriculture in India were only 173682 ha which has increased to 5550405.00 ha in year 2011-12. Thus Punjab covers an area about 3779.31 ha under organic farming in year 2005-06 which has increased to 6925.00 ha showing an increase of 83 per cent in year 2011-12. Thus, Punjab comprises only 0.12 percent of total area under organic production in the country.

Table 5: Growth of Area (ha) under Organic Agriculture

Year	India	Punjab
2005-06	1,73,682	3779.31
2006-07	5,38,170.55	1600.42
2007-08	8,65,323.09	3320.02
2008-09	12,07,055.18	4192.52
2009-10	10,85,648.45	5263.61
2010-11	44,27,519.00	6025.78
2011-12	55,50,405.00	6925.00

Source: Kaur and Toor (2015)

Organic Food: Market and Export

Organic products are increasingly preferred in developed countries, and also in major urban centres in India. There is a huge demand for Indian organic products especially tea, coffee, cotton, etc in the international market. The other organic products for which India has a richest market are spices and fruits. There is also good response for organic basmati rice, vegetable, coffee, cashew, oilseeds, wheat and pulses. Among the fruit crops, bananas, mangoes and oranges are the most preferred organic products. It is estimated that more than 85 per cent of organic production, excluding wild herbs from Uttar Pradesh and Madhya Pradesh is exported. The global trade during 2013-14 was USD 60 billion (Rs. 3,60,000 crores) and may touch USD 100 billion within the next five years. Trade in India may reach Rs. 5000-6000 crore, which is about 1 per cent of the global trade. The International Competence Centre for Organic Agriculture (ICCOA) estimated that the domestic market for organic products in

the year 2011-12 was Rs. 300 crore which grew to Rs. 600 crore in 2012-13, registering a growth rate of 100 per cent.

Table 6: Commodity-Wise Production- 2011-12 (Top Ten Products)

Commodity	Organic Production (MT)	Conversion Production (MT)	Total Production (MT)
Cotton	107591	3792	111383
Cereals & millets*	33888	6898	40786
Rice	17345	5329	22674
Pulses	12504	453	12957
Fruits and Vegetables	7801	427	8228
Tea	5272	1.0	5273
Oil seeds**	2835	15	2850
Coffee	1139	238	1377
Dry fruits	490	32	522
Medicinal and herbal plants	189	0	189

*excluding Rice, ** excluding Soybean, Source: APEDA accessed on 27April 2017

The production scenario of different organic products was depicted in Table 6. Maximum production of cotton crop was recorded whose organic production was 107591 MT and in conversion production was 3792 MT, production of cereals and millets (excluding rice) was 33888 MT and 6898 MT organic and in conversion production, respectively in the year 2011-12. Cereals and millets followed by rice, pulses, fruits and vegetables etc. Organic tea was to the tune of 5272 MT and in conversion tea was only 1.0 MT but the organic production of herbal and medicinal plants was only 189 MT during the same year. The export of organic products was increasing to different countries. Out of all countries major share of organic products was goes to only three countries viz. European Unions, USA and Canada

Constraints

Developing countries like India are already producing a wide range of Organic products and many are thriving well. However, most of them are often faced by a number of constraints like shortage of organic inputs, lack of technical knowledge and training, high labour requirement etc.

i) Shortage of organic inputs: As majority of farmers go for chemical fertilizers and pesticides use for crop cultivation, so the country lacks availability of organic manures and bio-fertilizers.

ii) Lack of technical knowledge: Most of the farmers are illiterate and even not know about technical way to grow out organic crops. For example organic farming practices and production methods, and lack of market information like which products to grow, which markets and distribution channels to choose, competition, market access, etc. with producers in developed countries, is that of certification, which posses not only a technical problem but adds considerable costs to the product, which have to be borne by the consumer in one way or another.

iii) Highly labour requirement: For weeding and harvesting of organically prepared crops lot of labour is required.

iv) Lack of training: Exposure to more trainings as well as increase in technical guidance would enhance the productivity and efficiency of organic farms in India. Organic farming council of Punjab set up in 2006 has so far trained only about 1400 farmers and there is no ongoing project with it (Kaur and Toor, 2015).

v) Lack of marketing facilities: The mechanism of organic marketing is quite different from that of regular marketing. About 85 per cent of the total organic production in the country heads for the export market. The domestic market for organics is thus undeveloped in India. Lack of domestic marketing channels adds to the difficulties faced by the farmers converting to organic methods in agriculture.

Table 7: Export Of Organic Food Products From India

Country	2011-12		2012-13		2013-14	
	Quantity (MT)	Value (Rs in Cr)	Quantity (MT)	Value (Rs in Cr)	Quantity (MT)	Value (Rs. in Cr)
Canada	19848.9	66.6	33645.8	148.0	38545.5	182.4
EU	51138.8	505.3	82835.3	678.5	56946.7	553.8
USA	37630.2	197.9	34292.3	228.7	74942.7	498.8
Taiwan	31.5	0.6	27.6	0.4	47.8	0.5
Switzerland	2161.5	21.0	3455.2	27.5	4306.5	33.8
New Zealand	499.0	2.9	409.6	2.5	599.8	4.2
Australia	349.1	5.1	468.2	6.6	749.9	14.5
Israel	871.4	2.5	610.0	2.3	312.9	3.7
Japan	232.7	8.8	199.2	11.1	309.0	16.1
UAE	167.0	2.0	1728.4	10.6	171.3	4.2
Others	2486.8	26.2	2604.8	39.3	832.7	16.2
Total	**115417.2**	**839.3**	**160276.**	**1155.8**	**177765.2**	**1328.6**

EU- European Union, Source: APEDA

Future Prospects

Consumer Acceptance

Consumers are now turning to organic food because they believe it to be tastier, as well as healthier, both for themselves and environment. Despite the higher cost for organic products, consumers are willing to pay for their preference. Economically, organic fruit growing is comparatively healthy, but depends on a higher farm gate price for product. Another reason for Organic products prominence is the opposition to genetically modified food.

Higher Nutrition

India is endowed with various types of naturally viable organic form of nutrients across different regions of the country which will be helpful in organic cultivation of crops (Butterworth *et al* 2003; Reddy 2001). This will help substantially in organic cultivation of crops. Organic agriculture also help to conserve and improve precious resource-the topsoil, compaction, nutrient loss and erosion, organic farmers use trees, shrubs, leguminous plants to stabilize and feed soil dung and compost to provide nutrients, and terracing which prevent erosion and conserve ground water (Parrot and Marsden, 2002).

Pest Control

Organic farming is environmentally friendly. This is because it is well known that chemicals have destroyed many beneficial insect species and have caused environmental degradation. For instance, Korean researchers had reported that avoiding pesticides in paddy fields encourages the muddy loach fish, which effectively control mosquitoes that spread malaria and Japanese encephalitis (Bonner 2002).

Quality Food

Organic farming is a form of agriculture, which avoids the use of synthetic inputs such as synthetic fertilizers, pesticides, herbicides, and plant growth regulators. As for as possible organic farmers rely on crop rotation, crop residues, animal manures, and mechanical cultivation to maintain soil productivity, supply plant nutrients and to control weeds, insects and other pests. Conventional agricultural practices based on chemical fertilizer causing greater contamination of food in absence certification and in the wake of unhygienic handling. It reduces food contamination and increases food equality.

Conclusion

It is concluded from the study that the interest in organic agriculture in developing countries is growing because it requires less financial input and places more reliance on the natural and human resources available. It was propounded that organic farming is considered as best option, which promotes and enhances environmental health, biodiversity etc. The application of organic sources helped to improve the physico-chemical and biological properties of the soil. In organic farming systems, pest and disease management strategies are largely preventive rather than reactive. In general, pest and disease incidence is less severe in organic farms compared to conventional farms. The government is also concerning about to increase the area under organic agriculture.

Problems and Prospects of Organic Farming in Mountain Agricultural System

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Organic agriculture is a unique production management system that promotes and enhances agro-ecosystem health, including biodiversity, biological cycles and soil biological activity, and this is accomplished by using on-farm agronomic, biological and mechanical methods in exclusion of all synthetic off-farm inputs. FAO promotes this understanding and perception about organic agriculture, in its own advocacy and programmes as well as among the member nations. Countries like USA, where organic agriculture, is mainstreamed, acknowledges *"organic farming as a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additives etc.), and to the maximum extent feasible rely upon crop rotations, crop residues, animal residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection."*

IFOAM Definition

According to the International Federation of Organic Agriculture Movements (IFOAM) 2002 Basic Standards, "*organic agriculture is a whole system approach based upon a set of process resulting in a sustainable ecosystem, safe food, good nutrition, animal welfare and social justice*". However, organic is not only about replacing inputs, which is the starting point of the process, it goes beyond, as enshrined in the four principles of organic farming advocated by IFOAM, which are aimed to inspire developing a holistic vision and strategies.

i. **Principle of health:** Organic agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.
ii. **Principle of ecology:** Organic agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
iii. **Principle of fairness:** Organic agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.
iv. **Principle of care:** Organic agriculture should be managed in a precautionary and responsible manner to protect the health and well being of current and future generations and the environment.

Objectives and Importance

1. To cope-up with increasing demand of chemical fertilizers and their residues in food grains.
2. To promote the rainfed farmers particularly of hills.
3. To meet the demand of safe food without chemical residues
4. To create opportunities of employment for youth on sustainable basis.
5. To enhance the productivity on sustainable basis.
6. To maintain the soil health.

Potential

Tremendous progress in promoting organic agriculture in India has been made during last fifteen years. Eleventh plan document on Organic sector and National Commission on farmers has recommended organic farming as a tool for 2nd Green Revolution. FAO with the

help of IFOAM and other International Agencies recommended Organic Farming as a tool to address Millennium Development Goal (MDG) 1&7. **The first MDG** is the eradication of extreme poverty and hunger, whereas, **the seventh MDG** is to ensure environmental sustainability. Organic agriculture in India has a large potential. This is due to a number of factors, *viz*.

- Large geographical and arable area, with a wide variety of agro-climatic zones.
- Two thirds of the arable area if under rain-fed conditions. These areas, spread over India have not been touched by the Green Revolution techniques, as the expected yield is modest and it was not considered to be worth the investment.
- Irrigation potential has reached a limit and hardly any further grown can be expected. All Green Revolution techniques are directed towards irrigated areas. The Green Revolution success stories relate to Haryana, Punjab and Western Uttar Pradesh. These are the areas where farmers increasingly experience difficulties. Owing to over-use of water and chemicals, and under-use of organic matter, soils have become ill and yields can only be maintained with a heavy increase in inputs and increased costs of production.
- India has a thousand-year old culture, in which the earth is referred to as mother, where "organic" techniques are provided to enhance the health of soils, plants, animals and human being. Organic agriculture has the capacity to make use of this culture.
- The demand from the global market can provide premium prices. As demand is growing rapidly and supply is still behind, India can profit from this situation.
- However, there are a number of limitations, leading to take up. These will be discussed in the following paragraphs.

Limitations

The most important limitations are:

- Lack of adequate information to farmers and consumers about the advantages and products.
- Lack of domestic and international market information on suppliers, prices and qualities.
- Lack of training, organic farmers' field schools and the non-existence of an adequate extension system, except in those areas covered by NGOs and private traders making use of contract farmers.
- Lack of adequate storage facilities.
- Lack of a guarantee system for the domestic market. The consumer wants to know whether the organic products to be bought are truly organic or not.
- A stagnating local market, owing to a lack of consumer awareness, but also because a limited number of processed products are offered.
- Lack of sufficient government support.
- High costs of certification, especially for small farmers.
- Lack of scientific and socio-economic data on organic agriculture.

Challenges for Future Developments

- To increase and enhance government policy initiatives and assistance, especially for and during the conversion process.
- To create organic agricultural faculties at the agricultural universities.
- To introduce organic extension services and training for farmers' field schools

- To build up adequate infrastructure for transport, storage, processing and market facilities.
- To create a guarantee system for the domestic market.
- To increase consumer awareness about the safe and environment friendly food production.
- To add organic information to the existing oversees reports on markets.
- To spur production and supply of organic seeds, organic manures, bio-fertilizers and bio-pesticides
- To provide funds for proper scientific studies on income generation, household income and food security, yields and soil improvement from organic agriculture

Recommendations for Promotion of Organic Farming

The Ministry of Agriculture should introduce favorable government policies and strategies for the promotion of organic agriculture, which should include

- A programme of assistance to farmers who want to convert their lands to organic farming.
- An increase in investment and research in organic agriculture and a scale-up of projects that have already proven successful. There should be an emphasis on comparative research of the costs of production, productivity and other benefits accruing from organic farming as compared to conventional agriculture. To this end, the Indian Council of Agricultural Research could initiate organic faculties in key agricultural universities.
- A strengthening of links and cooperation between the government, the private sector and NGOs on the national level.
- Government assistance in micro-credit and micro-enterprises to self-help groups of landless agricultural families, particularly women, for organic compost, bio-pesticides and bio-fertilizers (accessing usufruct rights of common property resources, such as waste land, exclusively for resource poor)
- Awareness campaigns on the benefits of organic agriculture products.
- Support structures should be introduced for small farmers' group certification.
- The establishment of a monthly information bulletin for organic farmers on local and international prices of the most common food items should be supported.
- There should be special emphasis placed on supporting the implementation of the IFOAM Accreditation system as a basis to enable reciprocity of guarantees, and to reduce overlapping certification work, bureaucracy and costs.

Certification

The consumer wants healthy and environmentally sound products and is willing to pay a higher price for them. Certified farmer produces according to defined organic standards and can sell his products at a higher price. Any agricultural produce can be designated as organic only after it is certified as organic. Organic certification is a process in which organic food producers and processors are certified to have produced various products by following fixed standards and under fixed regulations. **Organic certification is basically an auditing process that assures that the organic growers and product manufactures abide by the fixed standards and regulations.** In general any vocation which is directly involved in the production and marketing of organic produce can be certified and this includes seed suppliers, organic food producers, food processors, retailers and even restaurants which serve organic food to its client.

Third Party Certification

India already has policies and mechanisms in place for maintaining standards and trust of certified organic products. National Program on Organic Production being operated under FTDR Act and APGMC Act meet the requirements of quality assurance in organic for export, import and domestic markets. Even though there are 16 certifying agencies across the country but keeping in view the Mission 2020 goals, their number will prove inadequate. Therefore Mission 2020 should include a program on expanding the number of certifying agencies in the country.

- Financial assistance be allocated for setting up of new certification bodies, especially in states with at least one agency in each state.
- Supporting ICS management and certification by the grower group certification system through service providers and data management for thorough traceability. Support may be provided for setting up of National/ Regional web hosted data base system to develop repository of organic farmers and organic products.
- Funding establishment of 20 new residual testing laboratories across the country, preferably under PPP mode.

Farmers' Participatory Guarantee System (PGS)

To ensure low cost farmer guaranteed alternative quality assurance system, there is a need to promote PGS or any other form of system. It will encourage farmers to understand the benefits of quality assurance and it should encourage them to use it as a precursor to certification by third party. The PGS system should be based on National Standards of Organic Production. Further PGS system developed for the country should ideally be based on peer evaluation system rather than individual farmers' record maintenance.

Infrastructure for organic supply chains

Promotion of organic farming is directly linked with the market development. Therefore, efforts are needed to ensure adequate support to strengthen supply chains. The mission strategies should therefore include provision for providing financial support to develop dedicated organic supply chain components, namely, grading, cleaning, primary processing units for dal making and flour making etc, packing units and storage units with organically compatible fumigation/ protection during storage.

Organic Farmer groups should be encouraged to form producer companies for creating value addition, storage infrastructure development and for direct marketing. Organic Farming Mission may support such dedicated farmer group owned producer companies.

Insect Pollinators as an Important Resource to Enhance Crop Productivity and Farmer's Income

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Insect pollinators hold immense importance in agriculture as they help in pollination services. Bees, Lepidoptera (butterflies and moths), wasps, flies, ants and beetles are very important pollinators and Honey bees hold more importance amongst them all. Rearing of honey bees is an agro-based activity which is being undertaken by farmers/landless labours in rural area as an integrated farming practice. It supplements income & employment generation and nutritional intake of rural population. Though the honeybees are best known for the honey they produce, their economic role in nature is to pollinate hundreds and thousands of flowering plants and assure setting of seed or fruit. Honeybees have been offering services to the society through ensured pollination in cross-pollinated crops as well as by providing honey and a variety of beehive products. Honey Bees have vital role in sustaining plants bio-diversity resulting in environmental stability.

Insects for Human Welfare and Environment

Insects overwhelm all the other organisms on the earth constituting more than half of all living species (SteffanDewenter and Tscharntke 2002). Terrestrial ecosystems would otherwise collapse but for the key ecosystem services like pollination and nutrient recycling rendered by the insect community it is sustained (Ritchie and Olff, 1999). Most insects have heavy dependence on plant community for food and shelter, and in turn caused many plants to co-evolve to suit the needs of beneficial insects or to avoid damages from them through production of various defensive phytochemicals or other physical means such as increased hairiness on tender parts, thick cuticle, wax layers etc. Great majority of flowering plants, including agricultural crops are insect pollinated (Kevan 1999). Among the insect community the honeybees render foremost service as pollinators. Honeybees constitute a group of social insects which are today widespread in the world in habitats that are suitable to them. Although honey continues to be an important product of honeybees, their most valuable service is pollination, the magnitude of which is yet underestimated by humans (Ramachandra *et al*. 2012).

Honey Bee species: Indian Scenerio

India has 4 species of *Apis*, i.e., *Apis florea*, *Apis dorsata*, *Apis cerana* and *Apis labriosa* and exotic species, *Apis mellifera*, a European species and several species of stingless bees of the genus *Tetragonula*. Of the *Apis cerana*, 3 sub species have so far been identified. Kshirsagar (1976) and Verma (1992) indicate that a total of at least 7 races under three recognised sub species occur. Similar variations are expected to be present in other species as well (Abrol and Shankar, 2016). *Apis cerana* is available in all pockets of the country. The *Apis cerana* in India has several ecotypes with wide range of morphological characters like body size, cubital index, tongue reach etc. and genetical characters like absconding, swarming, higher honey yield, temper etc varying from south to North. Hence the selective breeding of desired characters is possible with *Apis cerana* which can increase productivity. In the northern hills and in Himachal Pradesh, *Apis cerana* beekeeping is a small household activity providing some income and nutrition to the poor and tribals. They keep log hives in the house walls and revetments. In central India, in Mahabaleswar, Kolhapur, Pune etc.*Apiscerana* beekeeping is common and taken up in small scale and as hobby. In West

Bengal, Sikkim, Arunachal Pradesh in hills and in Andhra Pradesh, Bihar, Orissa, mostly tribals have taken up *cerana* beekeeping. In Karnataka, Kerala and Tamil Nadu, people are involved in *Apis cerana* beekeeping large quantity of honey is being produced from rubber estates. *Apis dorsata*, (the rock bee or giant bee) is found in foot hills of Himalayas and northern regions of the country. In central India in the forests and plains large numbers of dorsata colonies are present.

Apis florea (Little bee), is common in central part of India, occurs in arid and desert region of extreme climates, and also in plains and forests. *Apis cerana indica***,** Indian honeybee or Eastern honeybee is the well known bee species in India and before the introduction of Italian bee this was the only rearable *Apis* bee spp in India. It is also found and domesticated in Pakistan, Nepal, Burma, Bangladesh, Sri Lanka and Thailand.

Stingless bee or dammer bees are of smallest size compared to other honey-yielding bees (less than 5mm). These bees are widely known as dammar bees in India (Rasmussen, 2013), (dammar is resin from in amongst dipterocarp trees) with additional local names commonly applied, e.g., "putka" in Sikkim and Nepal, "ngapsiwor", "ngaphamang", and "ngapkhyndew" in Khasi language (Pugh 1947), "cherutheneecha" and "arakki" in Kerala (Nair, 2003

Honey Bees in Agriculture

Honey bees, birds, bats and insects are important in pollination of most fruits and vegetables. Over 90% of all flowering plants and over three-quarters of the crop plants rely on animals for pollination. Honey bees travel from flower to flower, collecting nectar and pollen grains. The nectar thus collected is stored in combs and later converted into honey. The bee collects the pollen by rubbing against the anthers. The pollen collects on the hind legs, in a structure called "pollen basket". As the bee flies from flower to flower, some of the pollen grains are transferred onto the stigma of other flowers. Nectar provides the energy for bee nutrition; pollen provides the protein. When bees are rearing large quantities of brood, bees deliberately gather pollen to meet the nutritional needs of the brood.

Pollination is essential for the production of fruit and seed. There are many plants that cannot produce fruit and seed if pollinated by their own pollen and so require cross pollination. Such plants include those in which male and female parts are either borne on separate plants or on separate parts/flowers of the same plant. Cross-pollination is also essential in those crops in which male and female parts are borne on the same flower but they are physically excluded from each other.

Diversification of Hive Products

There is a vast potential and scope from diversification in apiculture. Besides honey, it offers scope for production and marketing of other bee products like pollen, propolis, royal jelly, bee wax and bee venom. Also sale of bee packages and rearing and sale of pedigree queen bees offers a tremendous scope. Honey bees can also be managed as and when required for pollination of field and horticultural crops and for hybrid seed production in vegetables and other bee pollinated crops. Thus renting out bee colonies for pollination can also be another source of income to the bee keepers. Increasing colony productivity by adopting an apicultural diversification will help making bee keeping internationally competitive and pave way for the country to enter into the global market of other bee products too thus enhancing the income of the bee keepers. Apart from direct employment to the bee keepers, there would be need for good artisians, hive manufactures, apiculture equipment and machinery manufacturers. Transport system for irrigation of colonies, traders, product quality experts, packers, sellers, raw material dealers and all allied industries. This industry has so far remained unexplored, offers tremendous scope.

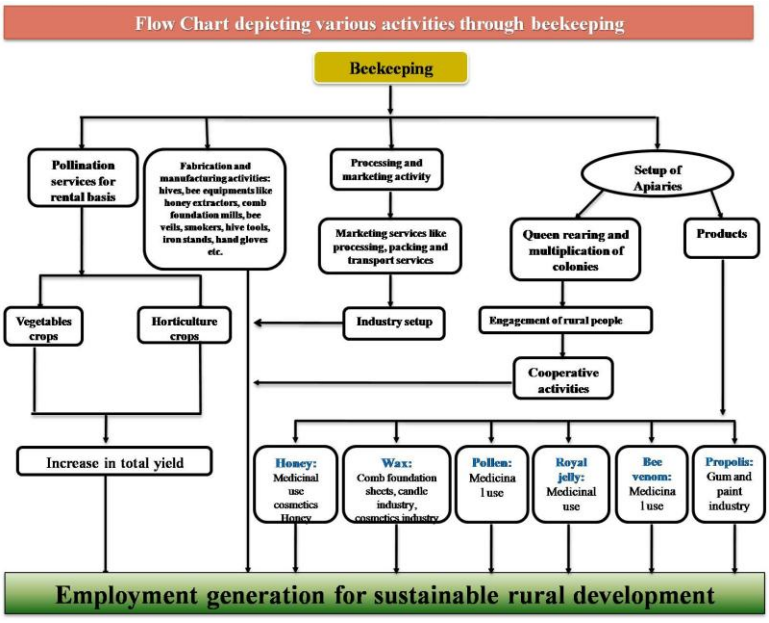
Technologies for the production of different products like royal jelly, wax, pollen etc are now available in India (Thakur, 2016).

Honey

Honey is one of the beehive's principle food resources. It is produced from droplets of flower nectar gathered by worker bees. The nectar is temporarily held in the bee's foregut where enzymatic action begins to convert sucrose into dextrose (glucose) and levulose (fructose). In the hive, this nectar-enzyme mixture is transferred to waxen cells, reduced in volume by evaporation of water, and allowed to ripen into honey. The bees seal each cell with a wax cap when the process is complete. India has a potential to keep about 120 million bee colonies that can provide self employment to over six million rural and tribal families. In terms of production, these bee colonies can produce over 1.2 million tonnes of honey and about 15000 tonnes of bee wax. Organised collection of forest honey and bee wax using improved methods can result in an additional production of at least 120, 000 tonnes of honey and 10,000 tonnes of bee wax.

Other Products

In recent years, there has been a growing market for bee pollen, royal jelly, bee wax, bee venom, other products derived from honey bees. The pollen is collected when worker bees squeeze through a special screen at the hive entrance which dislodges pollen from the hind legs. Some nutritionists regard bee pollen as a "complete" dietary supplement. It is sometimes sold in health food stores, often with astonishing claims for its medicinal or restorative powers. Royal jelly is a glandular secretion that nurse bees feed to larvae of future queens. It is rich in vitamins and proteins, and is also sold for its curative properties. It has become a major ingredient in some expensive skin care products that promise to reduce wrinkles and retard aging. Bee wax also holds a great demand in pharmaceutical and cosmetic industry, propolis is a resinous substance collected by bees and has medicinal properties and is a natural antibiotic. Besides, bee venom is an unexploited source and has many medicinal values in allopathic and unani medicine.



Income Generation

Everybody's livelihood depends upon access to many different types of assets. In order to make it possible to think about people's differing livelihoods, and to allow analysis, all assets may be allocated into one of five fundamental categories: human, physical, financial, social and natural. To understand this well, think about your own livelihood and all the diverse assets it depends upon: your skills; access to transport; equipment; telecommunications; the social networks you have been born into or have created yourself. No single category of capital asset – for example finance – is on its own a sufficient basis for creating a livelihood. Beekeeping is a useful means for strengthening and creating people's livelihoods because it both uses and creates a range of different capital assets.

Management of Bee colonies

Hive Inspection

It should be done at least twice a week to maintain each hive for

- Presence of queen
- Presence of eggs and brood.
- Honey and pollen storage
- Presence of bee enemies like wax moth, mite, disease

Expanding Brood Net

It is done by providing comb foundation sheet (CFS) in empty frame during honey flow period. Comb foundation sheet made of bees wax is fixed to an empty frame which is provided in between two drawn combs full of bees so that the comb is quickly drawn. A comb foundation sheet cut as triangle (with board end at the top and tapering end at the bottom) is found to be sufficient even though providing rectangular sheet is preferred.

Supering

This is done when brood chamber is filled with bees and all frames are covered. Empty brood comb is cut horizontally into three pieces and provided in three super frames in super chamber. The bees immediately accept the combs and raise fresh comb over the pieces of the provided combs.

Provision of Drinking Water

A source of fresh water within a short distance of an apiary is essential. Water is required to blend with the food and to lower the temperature of the hives during hot weather. Water is supplied in a tank or an earthen pot set up so as to permit the water to drip. The water can be given in a glass bottle inside the hive also.

Uniting

The question of uniting stock of bees arises only when the colony becomes weak or queenless and all attempts of requeening fail. It is then necessary that weak colonies be united. As each colony has its own peculiar odour, it is necessary either to blend the odours of the two colonies slowly or suppress both by a stronger one. If this is not done the bees of the two colonies fight. The colonies to be united are brought near each other by moving them closer, 0.5 to 1.0 m each day, so that incoming bees may not drift back to old site when the colonies are sufficiently close. Two other methods described below can also be used for uniting the colonies.

Newspaper Method

The colonies are brought side by side by moving 30 cm/day

- Queen is removed from the weak colony
- A newspaper is kept on top of brood chamber of queenright colony
- Holes are made on the paper
- The queenless colony is kept on top of right colony.
- The hive entrance is closed so that the smell of bees get mixed in both the colony
- The bees are united to the brood chamber and made as one colony.

Smoke Method

Both the colonies are smoked heavily and then dumped into one hive. More smoke is blown into the common hive.

Swarm Management

The strength of colonies gets diminished as a result of swarming. Swarming is prevented by clipping off special queen brood cells as they are constructed, since a colony does not send out a swarm unless a new queen is ready to take the place of the reigning queen. There are a few other methods of swarm control in which the natural instincts of the bees for dispersal and perpetuation of species are not curbed but aim at relieving the spatial congestion and readjustment of different castes and categories of population (a) Primary swarm is allowed to take off but trapped in a swarm trap and hived as a separate colony. The after-swarms are prevented by destroying the remaining queen brood cells (b) One or two brood combs in the strong colonies which are inclined to issue swarms are removed and given to weak colonies. (c) A brood comb with the reigning queen and a few workers taken out and put in a separate hive and thus the colony is divided, (d) Inter-change of positions between a strong and weak colony.

Dearth Period Management

The bee flora of a particular region is very important for the bee industry. Whenever there is a dearth of nectar and pollen in nature and the stock of these materials is not in the hive, then artificial feeding becomes imperative. The dearth periods vary from region to region in this country. If the bees are not fed artificially during dearth period, they start starving and dwindling.

Pollen Substitute

Parched red gram or Bengal gram flour based pollen substitute containing parched, powdered and sieved flour, skimmed milk powder, glucose, powdered sugar and honey is a pollen substitute developed by TNAU and recommended to beekeepers. Comb drawing and brood production was substantially more in colonies provided with pollen substitute. White sugar syrup is a cheap substitute of honey. Sugar syrup is prepared by dissolving 100 g of sugar in 150-200 ml of hot water, boiled and cooled. It is offered in 400 ml glass-bottle with their mouth covered with a cloth held tightly with rubber band or thread. The syrup bottle is placed upside down in the super with or without inner cover. Sugar syrup is also provided inside the hive by pouring it into coconut shells and placing a few wooden sticks inside to prevent drowning of bees in sugar syrup. The colonies are fed on alternate days in the evening. The bee colonies are fed well during dearth period, especially in winter as well as windy periods. In such cases swarming is induced earlier and this helps a beekeeper in making the bee colonies strong before honey-flow season starts. Other management methods during dearth period include the following

- Removing empty combs and storing in air tight container.

- Using dummy division board to confine bees to small area
- Uniting weak colonies

Summer Management

The following steps are taken to make the bees survive intense heat and dearth period:

- Providing sufficient shade, under trees or artificial structure
- Increasing RH and reducing heat by sprinkling water twice a day on gunny bag or rice straw put on the hive
- Increasing ventilation by introducing a splinter between brood and super chamber
- Providing sugar syrup, pollen substitute and water

Winter Management

The following measures are taken in the colder period of the year.

- Maintaining strong and disease free colonies
- Providing new queen to the hives

Rainy Season and Monsoon Management

The following procedures are followed in rainy season

- Avoiddampness in apiary site. Providing proper drainage
- In rain when bees are confined to the hive, providing sugar syrup feeding

Pollination Services

Pollination is an essential agro-ecosystem service, as it enables plant reproduction and food production for humans (fruits and seeds) that depend, to a large extent, on the symbiosis between species, i.e., the pollinated and the pollinator. Approx., 73% of the cultivated crops, such as apples, mangoes, cashews, squash, and oil seeds are pollinated by some variety of bees, 19% by flies, 6.5% by bats, 5% by wasps, 5% by beetles, 4% by birds, and 4% by butterflies and moths. Of the principal crops that make up most of the food supply, only 15% are pollinated by domestic bees (mostly honey bees, bumble bees and alfalfa leafcutter bees), while at least 80% are pollinated by wild bees and other wildlife (globally there are an estimated 25,000 bee species, the total number of pollinators probably exceeds 40,000 species). Services that are provided by native pollinators (non-honeybee species) is significant to agriculture. Even though the contribution of pollinators to annual agriculture productivity in India is yet to be assessed, the value of the annual global contribution of pollinators to the major pollinator-dependant crops is estimated to exceed US$ 54 billion. Therefore, Pollinator management and conservation requires a nationwide initiative (in the form of AICRP-ICAR). The priority for the maintenance of ecosystem services dependent on pollination and pollinators is important for the sustainability of agriculture. The need to address the issue of declining pollinator diversity calls for a national Initiative, like the one being proposed, on the Conservation and Sustainable Use of Pollinators. Honeybees are not the only “manageable” pollinators. Use of a single species to obtain improved production in a diversity of crops will not work always. Wild pollinators are not only important for improving the productivity of agricultural crops but also for maintaining the reproductive viability of native plants, including wild relatives of crop species.

Managing Bees for Efficient Crop Pollination

Pollination Management is the label for horticultural practices that accomplish or enhance pollination of a crop, to improve yield or quality, by understanding of the particular

crop's pollination needs, and by knowledgeable management of pollenizers, pollinators, and pollination conditions. Different management strategies are:

Sufficient Food and Space

The honey bee colonies to be used for pollination should have sufficient number of empty combs for storage of honey by the worker bees and for queen bee to lay eggs so as to maintain brood rearing and colony strength.

Strong and Healthy colonies

There should be enough bees to cover six to ten combs. Four to six of those combs should be well filled with brood. Bees are best motivated to collect pollen and hence are more efficient pollinator, when they have young, uncapped brood. Very strong colonies are superior pollinators, and the beekeepers that provide them should get premium rental price. The colony to be used for pollination should have a young and prolific queen bee (Delaplane and Mayer, 2002).

Colonies Movement

Extract honey before moving the honey bee colonies to reduce the load and to avoid spillage of honey during transportation of these colonies. The colonies should be packed properly to avoid leakage of bees on the way and otherwise the escaped bees may create problem for workers during loading and unloading.It is best to use honey bees that are inexperienced at foraging in the area near the crop of interest. In this way, upon delivery to the orchard the bees will immediately begin working on the crop because they have not yet discovered other more attractive plants blooming in the area. To gain the benefit of in experienced bees, it is necessary to move hives into the crop after it has already flowering a little. If the colonies arrive before the crop starts blooming there is a strong likelihood that the bees will learn to forage on non-target plants. In case of almond the earliest blooms are the most productive. Moreover, there is little else blooming to distract the bees, and honey bees eagerly visit almond as soon as it starts blooming. So any delay in moving colonies to the crop may result in failure in achieving the desired level of pollination.

Number of Colonies for Pollination

On an average, five colonies per hectare are needed for fruit orchards, but the need vary with place-to-place and crop-to-crop. The number of bees required for pollination will depend upon the type of crop, the concentration of flowers and their attractiveness. Bee visits are also affected by spacing of plants, wind breaks, variety of the crop, infestation by insect – pests, use of fertilizers and number of irrigations etc. The colonies are moved to an orchard gradually, bringing in the maximum number when the crop is full bloom (Atwal, 2000).

Placement of Colonies

Orient the hives in such a way that they are exposed to early morning sun. This stimulates bees to visit flowers early, and pollination early in the day is important in many crops. Increase in distance of crop from the bee colony generally result in reduction in level of pollination.

Pollen Gatherers

Add frames with more unsealed brood to encourage bees to forage more for pollen. This increase in proportion of pollen foragers can also be accomplished by reducing the pollen store within the hive or by installing pollen trap at the entrance of the hives. Webster *et al*.

(1985) tested this hypothesis with honey bee colonies in almond and plum orchards and determined that colonies with traps had higher proportion of foraging bees with pollen loads than did colonies without traps.

Table 1: Honey Bee Colonies For Optimum Pollination in different Fruit Crops

Crop	Colonies/ ha	Crop	Colonies/ ha
Almond	5-8	Cucurbits	5-8
Apple	2-3	Okra	1-2
Citrus	2-3	Onion	5-8
Papaya	2-3	Radish	2-3, 5
Grapes	2-3	Turnip	2-3
Guava	2-3	Cardamom	2-3
Litchi	2-3	chillie	2-3
Mango	2-3	Coriander	2-3
Cabbage	5	Cauliflower	5
Carrot	5-8	Cucumber	1*, 8**

*1 for monoecious, ** 8 for dioecious

Bee Foraging and Crop Attractiveness

Floral Scent Feeding

Honey bees were conditioned to associate onion floral odor components with a reward. Isolated nucleus hives of honey bees were fed 30% sucrose solutions scented with a 0.2% solution of onion floral odor compounds. After feeding on these solutions for 6 wk, bees were not found to prefer onion flowers to two competing food sources, carrot and alfalfa flowers. However, there was an overall trend indicating a change in honey bee behavior, with fewer "trained" bees visiting alfalfa and carrot and more visiting onion. Thus, it may be possible to alter honey bee behavior with preconditioning but probably not to a degree that would be economically significant.

Use of synthetic lures/ attractant

Use of floral scent feeding to bees on many crops which are less attractive to the bees has been reported to successfully increase the intensity of bees visiting on that crop. Some of such examples have been given here:

Table 2: Different Bee Attractants on Various Crops

Crop	Attractant	Effect
Onion	Spraying cacambe (10%)	Enhanced bee visits upto 15 days; Increased seeds / umbel, filled seeds, seed yield
Cucumber	*Apis* spp. & spraying BeeQ , BeeHere	Doubled fruit length and dia.; Enhanced fruit wt., fruit quality &yield
Litchi	Bee-Q spray @ 2-2.75 kg per litchi tree at 50 % flowering	Increased fruit yield, fruit weight, TSS

Paid Pollination Services

Some beekeepers receive payment for placing hives in close proximity to flowering crops, according to contractual arrangements with farmers. For example, rates for pollination services in inland Australia varied between $25 and $35 per hive in 1996, with variations between crops. It has been estimated that at least $2.9 million is received by the

industry in this way, based on total payments received for pollination services in Tasmania (Gifford 1989) and multiplied up to and Australian figure by numbers of hives. Similar concept is picking up throughout the world including India. In Himachal Pradesh, India this practice has already started and is likely to be followed in other states as the awareness about pollination benefits is realized by the farming community. Evidently to ensure the country's self-sufficiency in foodstuffs, to receive foreign currency from excess production, the stabilization of rural populations by complementary activities of both a financially rewarding and environmental nature, and there is no doubt that beekeeping fits perfectly within this framework and hence, efforts are required to popularize and increase beekeeping still an enormous potential waiting to be tapped.Honeybee pollination is essential for some crops, while for others it raises yield and quality. In addition to the crops, a wide range of pastures, including Lucerne and clover, are pollinated by honeybees, hence, this estimate understated the potential value of the pollination services.

Pollination Assisted Crop Production

Two third of the world's 3000 species of agricultural crops require animals for pollination. Animals provide pollination services for more than 75 per cent of all staple crops and 90 per cent of all the flowering plants of the world. Approx., 70% of the tropical crop species depend on pollinators for optimum yields. The economic value of such pollinated crops to India is estimated to be $726 million. India is the second largest producer of vegetables in the world. Of the total pollination activities, over 80 per cent is performed by insects; among these bees contribute nearly 80 per cent of the total insect pollination. Therefore, they are considered as best pollinators. India is endowed with the greatest biodiversity as far as honey bee species are concerned. Out of the eight *Apis* species four(*A. cerana*, *A. florea*, *A. dorsata*, *A. andreniformis*,) are indigenous to India and *A. mellliferah*as been introduced in to our country. A plethora of other bee species including carpenter bees, bumble bees, megachilids, halictids, sphecids, andrenids, syrphids, etc. are also known to occur in the country. Indian Population is increasing day by day threby increasing food needs proportionately for sustenance.Cultivable land has been decreasing due to population explosion and related activities of urbanisation. Bee pollination is expected to be a tool of 2nd green revolution if we consider it as fifth input after land, labour, cost and capital in agricultural development strategies.

Conclusion

The Honourable Prime Minister, Shri Narendra Modi has already unveiled a seven-point strategy to double the income of farmers in six years with measures to step up irrigation, provide better quality seeds and prevent post-harvest losses. He has emphasized that in the past the framers income was not taken into account but all emphasis was laid on agricultural output. However, for good governance this target of increasing and doubling the farmers income has to be implemented and well designed programmes be taken into account. One of the points in his strategy is the Promotion of ancillary activities like poultry, beekeeping and fisheries. Beekeeping industry is source of livelihood for rural poors/tribals/forest based population. Unemployed youth can start this business with minimal funds (Rs. 1.00 to 2.00 lakhs). Bee keeping utilises the natural resources like nectar and pollen which otherwise go waste, encourages ecological awareness, helps increase national income, helps in rural development and promotes small village industry, encourages biodiversity and will definitely help in doubling farmer's income by complimenting in the agriculture.

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Community Crop-Pollination Management-A Way Forward to Double Apple Production

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Mountain agriculture comprises food crops, livestock, fruits, vegetables, flowers and honeybees constituting maun livelihood sources for local communities. There has been intricate relationship between plants and bees, which has been established since time immemorial and further strengthened overtime. Besides, honey and other marketable products, the invaluable service of pollination provided by the bees accounts for enhancing the productivity of the crops particularly apple, the most dominant fruit crop of mountaneos region of Himachal Pradesh. *A. cerana* beekeeping has remained a part of cultural and natural heritage of several mountain communities. However, a different studies revealed that *A. cerana* population has been declining sharply due to many reasons like monoculture, excessive use of pesticides, sharp change in habitats, etc. and for adversely affecting the crop-pollinator services. Hence, there is need to manage services particularly by supplementing the natural pollination process with *A. mellifera* in apple to enhance and sustain its productivity.Apple farming has emerged as the major livelihood source for tribal people of Himachal Pradesh resulting into the transformation of the socio-economic conditions. Prior to 1950, these resource poor and toughly accessed farmers were dependent upon minor millets and coarsefood grains like Ogla, phaphra, barley, maize, ragi, *kangni* and bathua for their livelihood.

In tribal and dry temperate region of the State, the first record of apple plantation in the dry temperate region of Himachal Pradesh was reported in 1916 at Kalpa in Kinnaur district. After 1980s, its cultivation expanded to the entire Kinnaur district owing to the provision of irrigation facilities and availability of elite planting material. The area under apple cultivation in the district has increased to 10, 828 ha with production of 75,201.8 tons during 2015 generated a revenue of ₹280-300 Crore to Gross Domestic Product (Table 1, Fig 1). Consequences of the climate changes are also visible in these areas and have shown variable production responses due to current status of pollinizer: variety ratio and the available pollinator (Indian Honey bee) density. The study conducted in three development blocks of the district viz., Pooh, Kalpa and Nichar revealed the scare availability of pollinizer cultivars to main variety (1:14 to 1:17) in apple orchards. Often, low yield and/or poor fruit quality are attributed to poor pollination performance by bees due to low numbers, unsuitable weather conditions during flowering, low pollination efficacy or combinations of these factors. However, other non-bee related issues such as genetic compatibility among cultivars, orchard and tree nutrition levels also contribute. Quantitative and qualitative production in apple is affected by climatic variations and poor pollination to a wider extent. Similarly, the habitat loss, land use changes, monoculture-dominated agriculture and the excessive and indiscriminate use of pesticides have resulted in huge loss of native pollinators. This situation has posed a new challenge for maintaining apple productivity. Thus an urgent need to ensure pollination by incorporating managed crop pollination in this distantly accessed and promising area of apple farming.

Scientific Intervension on Managed Pollination

Pollination is an essential ecosystem service, which may rely on biodiversity for effectiveness and stability.Indian honey bee, *A. cerana* has been the major source of pollination for pollinizer deficit apple orchards and honey production. With the changing climatic conditions and expansion of apple orchards to even cold deserts of the tribal area, pollination has identified as the major constraint in enhancing the apple productivity. Every year 5-8 farmers used to hire bee colonies to pollinate their apple orchards. However, the individual hiring of bee colonies did not result well due to lack of hive placement time knowledge and the flowering behaviour of the apple orchards due to varying altitudes. Only 7 no. colonies of Indian Honey bee (*A. cerana*) were found available in one Panchayat with a potential to pollinate up to 7 ha area. The scientific intervention on managed pollination in apple orchards at community levelwas carried out in Gram Panchayat Telangi, Kinnaur, Himachal Pradesh. This valley area of high hills dry temperate zone of the State has been adopted under the project 'National Innovations in Climate Resilient Agriculture' sponsored by ICAR-CRIDA Hyderabad. The project activity was initiated by sensitizing farmers through awareness programmes, through pollination documentaries, and skill development programmes.

Table 1: Trends of Area, Production and Productivity of Apple in Himachal Pradesh (1981-2015)

Year	Area (ha)	Production (MT)
1981–82	45,335	3,06,798
1989–90	59,988	3,94,868
1990–91	62,828	3,42,071
1991–92	66,767	3,01,730
1992–93	69,429	2,79,051
1993–94	72,406	2,94,734
1994–95	75,469	1,22,782
1995–96	78,292	2,76,681
1996–97	80,338	2,88,538
1997–98	83,056	2,34,253
1998–99	85,631	3,93,653
1999–2000	88,631	53,000
2000–01	90,347	3,76,736
2002–03	92,820	3,48,263
2003–04	84,112	4,59,492
2004–05	86,202	5,27,601
2005–06	88,560	5,40,356
2006–07	91,804	2,68,402
2007–08	94,726	5,92,576
2008–09	97,438	5,10,161
2009–10	99,564	2,80,105
2010-11	1,03,600	2,75,000
2011-12	1,03,644	4,12,361
2012-13	1,06,230	4,12,400
2013-14	1,07,686	7,38,720
2014-15	1,09,553	6,25,199
2015-16	1,09,853	7,54,954

(Source: Directorate of Horticulture, Shimla)

Skill Development on Beekeeping

A group of 30 farmers from the Panchayat were imparted a five days skill development hand on training on 'Honey bees handling and hive management' and provided 60 honey bee hives of *Apis mellifera* to the participant of the training programme through the 'Village

Climate Risk Management Committee' (VCRMC) of the NICRA Panchayat through the Tribal Sub-Plan scheme. Knowing that honey bees are best pollinators, an intervention was planned for managed pollination of apple orchards at a community level for getting optimum productivity. A total of 184 households were inhabited in 923 ha with average land holding of 0.44 ha. Scientific investigation claiming changes in Indian Himalayan climate corroborates perceptions of farmers, examined during the present study. The annual rainfall in this zone is <400 mm, the temperature remains between -5 to 32^{o}C, and snow generally from November to March.

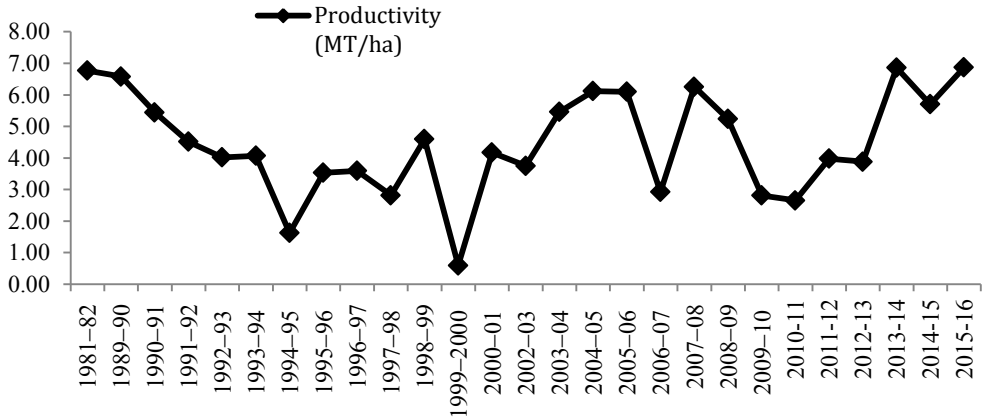

Fig. 1 Trends in apple Productivity in Himachal Pradesh

Monitoring of Honey bees

The 'VCRMC' comprising of 13 members was involved in managing bee colonies and issuing instructions particularly on pesticide applications on apple from time to time. The committee appointed an unemployed youth as beekeeper @ monthly salary of ₹6,000 /- months, who paid out of the total profit incurred from the honey production from these colonies. The farmers' motivation at different point of times through various methods encouraged them to contribute 50 per cent of the total cost incurred on the intervention. This amount was used as the seed money by the VCRMC to meet various expenditures. Out of the total area, 110 ha area falling under apple cultivation mapped through GPS for placement of bee hives established a requirement of 120 colonies for pollination at the onset of flowering, and the pollination activity and hive conditions till the termination of flowering.

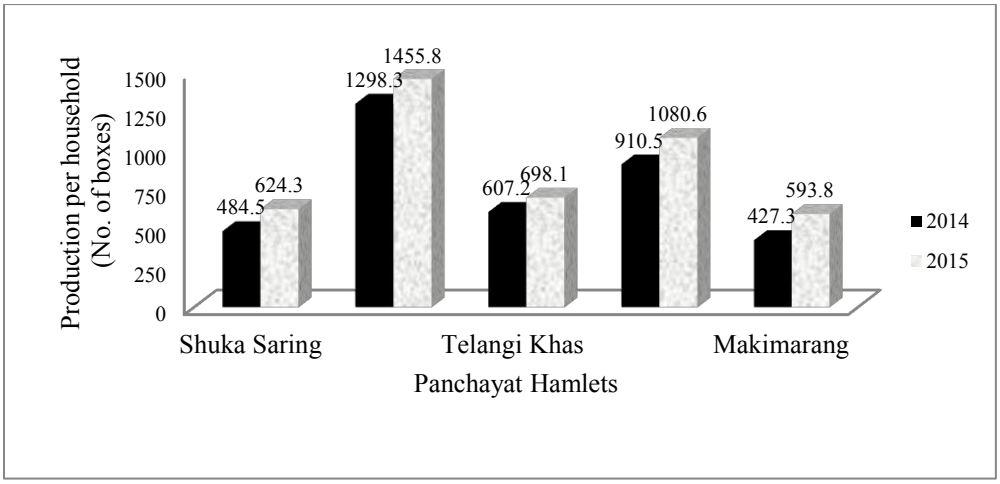

Fig. 2 Impact of Managed Pollination At Community Level in Telangi, Kinnaur

Outcome

The managed pollination at community level in apple orchards resulted in an average enhancement of 19.4 per cent apple fruit yield (Fig. 2). The average enhanced monetary income was observed as ₹17,496 per family. In addition, a bulk of around 1.0 ton honey is expected to be extracted annually from the current stock of honey bees. In addition, the stock of colonies will be provided by the VCRMC on rent @ ₹ 800/- colony to other villages, located at high hill elevations, where the flowering occurs at later stage. Multilocation research trials also documented the impact assessment of managed honey bee pollination with 'natural pollination', 'honeybees only' and 'honeybees plus pollen dispenser' in terms of fruit set, fruit drop and qualitative attributes of apple. Through the implementation of the honey bee plus pollen dispenser, the average apple productivity was 1.19 times higher than the tradition in Reckong Peo and Giabong locations of Kinnaur.

Climate Change, Natural Resource Management and Crop Productivity

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The natural resource foundation is coming under increasing pressure from both increasing population and higher levels of per capita economic activity. During the period 1990 to 2030 the world's population is likely to grow by 3.7 billion. This will often entail an accelerated use of natural resources, both as inputs to the economy, and as recipients of waste. However, the relationship between economic growth and environmental stress is not a linear one, as growth also generates resources to better manage natural resources. Since independence India has made commendable progress in agriculture besides providing food security, it has also transformed in raising the standard of living of large section of the urban and rural population. The gains in food grain production during pre/post green revolution phases is attributed to the improved high yield of crop varieties and optimum use of production inputs of which water and nutrients constitute key components. The best lessons of green revolution in India can be had from its states like Punjab, Haryana, Uttar Pradesh, Tamil Nadu and Andhra Pradesh. In view, the high growth rate of the population and urge for promotion of export inducted by trade liberalisation in India. There is a strong need to continue to maintain high growth rate in agriculture. However, the increase in agricultural productivity has come at the expense of deterioration in the natural resource base on which farming systems depend and that this trend needs to be reversed by encouraging farmers to adopt sustainable methods of farming that will have long-term benefits in environmental conservation and sustaining livelihoods security (Abrol and Sangar, 2006). The sustainable natural resource management is critical in reducing poverty. If productive capacity continues to erode, then the potential to satisfy future food needs will be seriously compromised. The poorest people will suffer the most, through increased food costs and greater vulnerability to their livelihood. Further, increased agricultural production and productivity and enhanced farmers' incomes provide more resources in the long run for addressing environmental problems. Improvements in natural resources facilitate farmers' transition to production systems that are better matched to the available natural and human resources, can respond to market signals, and are more profitable, stable, and sustainable one. Good natural resource management also expands income and employment opportunities throughout the wider community - for instance, through agro-tourism or through agroforestry production that attracts downstream processing industries (Dogra *et al*., 2016).

Four pillars of food security i.e., availability, affordability, accessibility and utilization are well recognized. Availability of food means that sufficient food should be available on consistent basis. While affordability is in terms of purchasing power, accessibility means that the food should be within the reach of everybody. Utilization refers to proper distribution, knowledge about the food components and use. All these pillars may be fine for the time being, but what required is the stability of these pillars. Climate change is going to play a very big role in food security. There is infact big instability within proposed stability. It is now being widely accepted that the climate change is going to create water logging/soil salinity at some places and water crisis at others. Land degradation, floods, droughts, ocean acidification, etc. will be very common but still at uncertain locations. There is going to be a very big threat to food production system from the emerging new insect-pests and diseases. It is going to affect not only to crops/varieties but to natural biodiversity as well. In view of

these changes/threats, a crop or variety, which was suitable to a particular area may become unsuitable, which may put our food security at risk (Chander *et al*., 2015).

The biggest threat to global food security is from our narrow dependence on food items. It is a well recognized fact that sixty per cent of our calories come from just three species of cereals i.e. paddy, maize and wheat. Ninety per cent calories in human diet come from just fifteen species of plants (250 plant species are used for food all over the world). In India, 120 species of plants have been recognized important at national level and less than 150 species of plants are cultivated today. World over about 30,000-40,000 species of plants can be used as source of food but only 7000 plant species are used at local level all over the world. But in good olden days, about one hundred thousand species of plants were being used as source of food. With too huge diversity in nature but the sphere of man's dependence is too narrow, which is required to be increased for sustainability.

The history reveals that narrow sphere of dependence has been disastrous for human beings. We cannot forget the "Irish Potato Famine" which happened in 1845-49. Irish are known for their love for potato and they largely eat potato. There was epidemic of "Late Blight Disease" on potato caused by a fungus called *Phytophthora infestans*. Entire potato crop just perished, resultantly millions died and millions migrated from Ireland to other countries. The diseases did not restrict to Ireland alone but lateron affected 7,00,000 Germans as well. It happened because Irish grew only one variety of potato called 'Irish Lumper', which was very badly attacked by the Blight fungus due to narrow genetic base. Similar devastation happened again in America and Mexico in corn crop in nineteen seventies. The losses of corn were catastrophic, reaching as high as 50-100% in some areas of the US. The corn crop vanished by attacked by blight disease caused by a fungus, *Bipolaris maydis* leading not only to food crisis but the prices of other commodities also increased manifolds. In fact in 1970, almost 85% of US corn fields was planted with one type of corn, called Texas cytoplasmic male sterile (Tcms) corn. Unfortunately, this type of corn proved highly susceptible in wet weather conditions to a new race of the pathogenic fungus *B. maydis* race 'T'. The actual food energy losses were considered to be greater than those caused by the potato late blight epidemic of the 1840's in Ireland. Similar large scale attack was also experienced in rice crop in India, where all rice varieties were affected. Only one wild rice variety was found resistant to the virus. The scientists identified the resistant gene, extracted it and transferred to cultivated rice varieties thus saving the rice from extinction in India. There is worldwide hunger today not only in terms of quantity alone but also in terms of quality too. A person may be getting sufficient food to eat but it may not necessarily be balanced. The food may be lacking in terms of many essential nutrients. So, on one hand the world is required to produce sufficient food to feed everyone, on the other hand it has to be ensured that everyone gets all essential nutrients in optimum quantity. Therefore, under the sustainable development goals (SDG) earlier called millennium development goals (MDG), the member nations are required not only to ensure that their citizens get food in terms of quantity but in quality tool.

Climate Change and Agricultural Productivity

Anthropogenic activities are known to affect the biosphere through changes in the land use and forest management activities, leading to alteration of the natural balance of greenhouse gases in the atmosphere. The environmental security, thus has become a serious concern across the globe. The concentration of carbon dioxide and other greenhouse gases in the atmosphere has considerably increased over the last century (15-25% increase over last 100 years as reported by Haripriya, 2000) having a positive correlation with average global surface temperature. It is possible to manage the carbon dioxide in the environment through targeted land use and management activities i.e., increase energy efficiency or use of carbon

free fuel/refined technologies or storage of carbon in different terrestrial ecosystems. The management of carbon dioxide in the biosphere through afforestation and reforestation is a cost effective opportunity. However, the quantification of the carbon pools in different land use systems is essential so that the carbon stored is quantified, monitored, and traded.

As climate change becomes a reality rather than a jargon, we find ourselves often bewildered by weather, climate and the environment. The weather is changing and we seem to have caused it. Over the last couple of years Kuwait reported snow, Hurricane Katrina decimated New Orleans and Paris sweltered in 40 degrees Celsius heat. In India Mumbai sunk under 900 mm of heavy rainfall in a single day, Delhi froze with below 0 degree Celsius, Rajasthan had floods twice whereas Maharashtra, Madhya Pradesh and Karnataka had unprecedented hailstorms and many more such events. These events have signaled to accept that there is a drastic change in behaviour of the atmospheric variables and we must get prepared to deal with it.

In the last 100 years or so, the Earth's surface and lowest part of the atmosphere have warmed up on average by about 0.6^{o}C (IPCC 2013). During this period, the amount of greenhouse gases in the atmosphere has increased, largely as a result of the burning of fossil fuels for energy and transportation, and land use changes, for food by mankind. In the last 25 years, concern has grown that these two phenomena are, at least in part, associated with each other. That is to say, global warming is now considered most probably to be due to the man-made increases in greenhouse gas emissions, the balance of evidence now indicates that there is a discernible human influence on the global climate). The overall state of the global climate is determined by the amount of energy stored by the climate system, and in particular the balance between energy the Earth receives from the Sun and the energy which the Earth releases back to space, called the global energy balance. How this energy balance is regulated depends upon the flows of energy within the global climate system. Major causes of climate change involve any process that can alter the global energy balance, and the energy flows within the climate system.

The basic principle of crop production lies with how vegetation interacts with atmosphere and soil as a growing medium. The system acts as a SPAC (Soil-Plant-Atmosphere Continuum), the main path-way which regulate the intake of water, nutrients and gas exchanges. Thus any change / deviation in the atmospheric variables will certainly affect the SPAC effect through changes in atmospheric and edaphic factors. Besides these, climate change is also adding salt to the wound by aggravating the extreme weather events. The volume of loss of crop produce due to extreme weather events will be more as compared to global warming effects. We have already realized the effects in cold arid region as well, which otherwise was less affected by the insect-pest and disease. Flood catastrophe during 2010, locust attack in 2011 & 2015 in Zhanskar, wilt disease in solanaceous crops in 2013, defoliator attack in lower Ladakh region in last 4-5 years have already been experienced in this region, which require us to remain vigilant about the projected threat and take remedial measures.

Since climate change is a process that can never be ignored, its dynamic and unpredictable nature already poses and will continue to pose challenges for agriculture and managed ecosystems henceforth. Hence, to make future agriculture remunerative, lesser risky and sustainable; the dynamic characteristics of atmospheric stressors have to be understood so that researches on its impacts on agriculture is take up in a holistic way to formulate adaptation and mitigation options. Events like extreme rain and hailstorm have become a regular phenomena and certainly protective agriculture has to play a significant role. Overall, the Indian agriculture will experience a lots of ups and downs in the coming years due to the unpredictable effects of these atmospheric stressors and only option

available will be to fight it in our own way. Following issues are important to address the issue to sustain Indian agriculture and more specifically the temperate agro-ecosystem (Aggarwal *et al*., 2015).

- Augmenting production
- Developing climate smart crops
- Change in landuse and landuse management
- Resource conservation and use efficiency
- Integrating local technical knowledge and innovations
- Improved risk management through early warning system and crop insurance
- *Enabling institutional and policy support, etc.

Sustainable Land Use Management for Biomass Production

The ultimate challenge for a sustainable management of natural resources is to assess and characterize the indispensable environmental (ecosystem) services that a certain site provides, in terms of both tangible and intangible items. For instance, forests represent some of the world's most sensitive but at the same time productive ecosystems and therefore it is necessary to provide a sound scientific basis in order to develop guidelines that protect forest land from degradation and over-exploitation and finally from a loss of biodiversity and the ability to provide services. The same applies for agricultural systems as soil degradation is one of the key challenges threatening a large share of the global population. In addition, degradation is linked with loss of organic carbon, usually to the atmosphere, which further increases greenhouse gas emissions and ultimately climate change. Biomass production depends on more or less fertile land. Arable land is a limited resource and soils are non-renewable in time scales relevant for human development. Year 2015 was declared the international year of the soils at the 68th UN General Assembly to highlight the important services that soil provides to all living organisms. According to World Bank data for 2012, the global share of arable land is close to 11% of the total terrestrial land area, while that of forests is 31% (World Bank, 2015). While biomass produced in agricultural systems is largely used to produce food and animal feed products, only a limited share (e.g. harvest residuals) may be used as feedstock for other purposes as it was shown long ago that residues fulfil an important function in maintaining soil health and productivity (Cassman, 1999). This suggests that large potentials for biomass as a resource for industrial feedstock materials and energy lie in forest ecosystems (both natural and plantations of fast growing woody species) globally. However, on a regional scale, agriculture can be the most significant biomass resource. Policy decisions have to ensure that on regional scales, biomass production has to be performed in a cascade approach by favoring food over feed and finally biomass for energetic/material utilization purposes.

Wild sources are source of genes for food quality/resistance against insect-pest/diseases. About 12.5% of the 4,22,000 plant species documented worldwide are reported to have medicinal values, but only a few hundred are known to be in cultivation (Rao *et al*., 2004). The identification of such plants can be done on the basis of traditional knowledge and getting clue from the wild animals and birds eating the wild plants and their parts. The next immediate step would be to conserve the wild genes, varieties and species of edible plants, which can be used as the source of food. Creation of germplasm or gene bank for each species at state and national level would be highly appreciated. This would make the entire genetic wealth of that species available to the scientists for future scientific explorations at one place. Forests being the reservoir for this variability, the forest resource managers are morally bound to conserve this variability in the forests in its original form as preservation plots. The second step in this direction would be to make use of wild genes in breeding program and standardize propagation techniques for their multiplication. This has to be a

combined effort of the scientists, developmental agencies, policy makers and the local folks. More explorations have to be permitted from different sources but with word of caution as well - no plant resource should be used till it comes under cultivation.

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Livelihood Security through Climate Resilient Fruit Cultivation

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Climate change impacts on agriculture are being witnessed all over the world but countries like India are more vulnerable in view of the huge population depending upon agriculture, excessive pressure on natural resources and poor coping mechanisms. There has been a significant rise in the frequency of extreme weather events in the recent years affecting farm level productivity and adversely impacting stability in food grain availability at the national level. Weather extremes, such as, drought and flood are being experienced in the same season posing serious problems. Suitable technology interventions are of paramount importance to cope with these aberrant weather conditions. Intensification of agriculture through enhanced productivity and resource use efficiency has to be the main focus as competition for land and water are increasing from non-farm sectors. Further, climate change is predicted to have major impacts on small-scale farmers whose livelihoods depend on rainfed agriculture.

Climate Resilence

The reliance on favourable climate, is any change in the climate system that drive unexpected responses from agricultural systems. Not only will crops be responding to changes in different climate variables, but also farmers and local agricultural researchers will be generating short and mid-term responses to cope with the likely losses in yields. In order to better manage these processes, impacts need to be properly assessed and improved adaptation strategies need to be tested, targeted and implemented. In order to assess impacts of future climate on crop production, researchers have developed 'crop models' that gather the information on the ecology, growth and physiological development of a crop, the local weather, the management practices, the soil characteristics, in order to predict the attainable yield of a particular growing season for a particular crop in a particular place. 'National Innovations on Climate Resilient Agriculture' (NICRA) is a network project sponsored by ICAR-CRIDA, Hydrabad is launched in February 2011 to enhance the resilience of Indian agriculture to climate change, covering major components viz. Strategic Research, Technology Demonstration, Capacity Building and Competitive. The valley area of dry temperate zone of Kinnaur and high hills at Chamba of the State has been adopted.

Climate Change and Nutrient Availability

Climate change (rising temperature, drought and intense precipitation events) is expected to have an impact on soil (EEA 2009), however, its influence on soil fertility and nutrient acquisition and utilization by plants is poorly understood (Lynch and Clair. 2004) and still under study. The major impact of increase in temperatures will be exacerbation of soil moisture deficit (drought) driven by increased rates of evapo- transpiration (Biggs *et al* 2008). The effects of climate change on nutrient availability may be direct (through effects on photosynthesis) or indirect (changes in soil micro-climate affecting rates of mineralization of nutrients). Biogeochemical cycles of plant nutrients (especially nitrogen, phosphorus, sulphur and carbon) are closely linked with the soil moisture regime and with the abiotic and biotic transformation phenomena (fixation, immobilization, mobilization; changes in solubility and redox status, etc.). While high precipitation increases runoff, leaching, and reductive processes, low precipitation (dry conditions) may reduce the solubility, mobility and availability of available elements (Tang *et al*. 2008; Varallyay

2010). Rise in temperature will increase decomposition of soil organic matter and the rate of other soil processes. An increase of 1°C is expected to decrease amount of soil organic carbon by about 110 kg/ha in 0-30 cm soil layer (Singh 2011), accelerate the cycling of carbon, N, P, K and S in the soil-plant-atmosphere system. Nutrient uptake canincrease from 100-300 per cent with temperature increasedue to increase in root surface area and increasing rates of nutrient diffusion and water influx, if soil moisture is adequate(Mackay and Barber 1984).Nutrient diffusion over short distances and the mass flow of water-soluble nutrients such as NO_3, SO_4, Ca, Mg and Si over longer distances decreases under moisture deficit condition (Barber 1995; Brouder and Volenec 2008).

Himalayan Fruit Ecosystem

The mountain ecosystem is one of the most vulnerable ecosystems to the climate change and so that the mountain communities, especially those mainly depend on animal husbandry, marginal agriculture and horticulture products. The Himalayan mountain ecosystem, at present, is facing the challenges created due to increasing aridity, warmer winter season, variability in precipitation, and unexpected frosts and storms, which largely affect the entire range of biodiversity, including agriculture and horticulture crops. Though, the entire Himalayan region is extremely suitable for growing a wide array of temperate fruits, perpetuation with age-old cultivars, low farm inputs and neglect of orchard management practices, etc. are the key factors of low productivity. However, the Himalaya harbours rich biodiversity and is one of the most vulnerable mountain ecosystems to climate change, there is paucity of systematic analysis of climate change and its impacts on the Himalayan ecosystems, biodiversity and local people's livelihoods. Farmers of Indian Himalayan region grow many fruit crops, including pomes (apple and pear) and stone fruits (peach, plum, apricot and cherry) and mango, litchi and guava in Shiwalik foothills in considerable quantity.

Generative Developments and Climate Vulnerability

Apple

Apple farming is an important activity and profession of farmer communities in Himachal Pradesh, being the second largest producer in the country which provides livelihood to a large rural population of the state. In recent years, it has emerged as the leading cash crop amongst fruit crops and alone accounts for 46 percent of total area under fruit crops and 76 percent of the total fruits production. The area under apple cultivation was 712 hectares in 1950 and 1.90 lakh hectares in 2015. However, the productivity still continues low compared to its potential dearth. The state offers ideal conditions for horticulture-based economy because of diversity in topography, altitude, and agro-climatic conditions. The production of apple has revolutionized the economy of the State in spite of facing threat of global warming that has resulted in rise in temperature and shifting its cultivation to lower elevations. The snow line once considered as 'white manure' for the apple crop and forest cover necessary for conservation and recharge of natural water bodies has also shifted upward to higher hills. Therefore, the quality apple production has shifted to higher hills and dry temperate zones of Kinnaur and Spiti areas. The Government of Himachal Pradesh has now stepped up the efforts to save the apple economy. Earlier reports suggested that in the past 3-4 decades that apple is getting affected due to climate fluctuations as the mean air temperature has risen by 1.5ºC in the Himalayas with mean winter temperatures rise by 3.4ºC. The time to harvest will change as apples are expected to behave according to the micro-climate. The scientific reports have recorded that the climate change is likely to cause and affect the vegetative, flowering and fruiting behavior of the

variety. It is also emphasized that the low chilling apple varieties would change the economy of lower areas that was deprived of revolution so far. High-altitude areas (dry temperate/ cold desert) are now becoming congenial for apple cultivation. Traditional 'Delicious' varieties were not suitable for warmer sub-tropics areas, but Oregon Spur, Gold Spur, Anna and Dorsset apples can have the potential for maximizing the production and profitability. It is emphasized to explore possibilities of apple cultivation in low hill subtropics, (i) to identify area and diversify specific variety (ies), (ii) to harvest its sustainability for the produce for harnessing remunerative returns, and (iii) to demonstrate the production technology for commercial and successful temperate fruit orcharding enterprise to the farmers through participatory research methodology.

Litchi

Litchi is a commercially important gruit crop with tremendous export potential contributing to national economy. Owing to specific climatic requirement, successful litchi cultivation has been restricted in certain areas but now with the development of improved cultivation technologies. The time for panicle emergence, blooming period and fruit set influenced by climatic change. Erratic bearing behavior of litchi trees due to the climatic vulnerabilities is also observed. Because of its narrow genetic base, there is a strong need for climatic adaptation strategies to be implemented with efficient water-nutrient management, canopy management and integrated pest management stretegies. Furthermore, the climatic resilient adaptation measures emphasized for successful orcharding enterprise include the windbreakers, elite and better root stocks, canopy management, mulching and managed honeybee pollination, to overcome the ill effects of climatic vagaries. Besides, climate change is expected to have negative effects in nutrient uptake in warmer sub-tropics. Nutrient use efficiency can be acheived by using organic amendments to maintain soil organic matter, its judicious, conserving soil and moisture through mulching and adopting water efficient irrigation techniques so as to enhance the bio-avilability of nutrients.

Climate change, thus, is expected to have negative effects in nutrient uptake vis-à-vis plant growth and yield patterns in warmer regions. Further, due to injudicious use of fertilizers and other farm inputs, the cultivation costs have increased. For example, the available phosphorus content in many soils under apple orchards is high due to continuous use of phosphatic fertilizers. Farmers are indescriminately adding phosphatic fertilizers without getting their soil tested. Due to this, on one hand they are incurring extra expenditure on phosphatic fertilizers, and on the other this is resulting in zinc deficiency, leading to extra foliar sprays of Zn. This, on an average, results in extra expenditure to the tune of Rs 20,000/- per hectare apart from adversely affecting fruit quality and yield. This calls for the adotion of site specific soil –test based nutrient applications along with appropriate and location specific cultivars. The nutrient availability needs to be maintained by using organic amendments to maintain soil organic matter, conserving soil and moisture through mulching and adopting water efficient irrigation techniques so as to enhance the bio-avilability of nutrients.

Public Sector and Social Responsibility- SJVN Partnering In Mission for Doubling The Farmers' Income

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Public Sector Undertakings (PSUs) in India are business entities which have the status of being Government-owned companies and are considered as 'State' under Article 12 of the Constitution of India. During the post-independence era, Government laid down the roadmap for developing Public Sector Undertakings as an instrument of facilitating and promoting self-reliant economic growth. The main objectives for setting up the public Sector enterprises are to help in the rapid economic growth and industrialization of the country, creating the necessary infrastructure for economic development, creating employment opportunities etc. In tune with the above objectives, the public sector has throughout played a strategic role in building up the economy. Besides, the PSUs also serve the interest of society by taking responsibility for the impact of their activities on customers, employees, shareholders, communities and the environment in all aspects of their operations. Accordingly, the CPSEs undertake a number of non-commercial responsibilities in furtherance of their commercial objectives popularly known as Corporate Social Responsibility'. Thus PSUs take further the concept of a welfare state in dual manner. Firstly by doing its core commercial activities and parallelly by undertaking various activities under its Corporate Social Responsibility initiatives.

SJVN: A Responsible Central PSU

SJVN Limited, is a Mini Ratna: Category-I and Schedule –'A' CPSE, a Joint venture of Govt. of India and Govt. of HP under the administrative control of Ministry of Power, Govt. of India. It is been doing its CSR activities since long, even before the issuance of DPE guidelines and advent of clause 135 under Companies' Act, 2013. However, its efforts have become more institutionalized, formalized and directed after the DPE guidelines/ advent of section 135 of Companies Act, 2013. As per the data available in the Ministry of Corporate Affairs, out of 5097 Companies (Private and public sector companies), SJVN is placed at 55th rank in terms of the CSR budget spent. This places SJVN as an important social responsible company in the map of corporate India.

SJVN implements its CSR activities with the belief that a business cannot succeed unless the society around it also develops alongside. Govt. Guidelines, millennium development goals, human rights and the national agenda are the principles which guide the organization's CSR orientation. The SJVN corporate vision statement that motivates all of us "to be the best-in-class Indian power company, globally admired for developing affordable clean power and sustainable value to all stakeholders" and mandate of the mission statement for "developing and operating projects in cost effective and Socio-environment friendly manner" - is how we judge ourselves and draw satisfaction about the smooth alignment that we have been able to demonstrate between our business goals with that of the societal needs. Based on the Millennium Development Goals, human rights and the national agenda, CSR projects at SJVN are undertaken under the following six verticals:

- Education and Skill Development
- Infrastructure Development and Community Development
- Healthcare and Hygiene
- Promotion and preservation of Culture/ Melas, etc.
- Sustainable Development

- Assistance during natural disasters, These six verticals are the broad heads which encompass all the activities mentioned in schedule VII of the Companies Act, 2013.

Doubling The Farmers' Income: A Macro Perspective

Agriculture is the backbone of Indian economy. More than 70 percent of the country's population is agrarian. But beyond the time tested and ancestral farming techniques, the farmers are not given any formal training to upgrade their skills to increase their farming yield and income. The NSSO data on Consumption expenditure Survey for the year 2011-12 reveals that more than one fifth of rural households with self-employment in agriculture as their principal occupation were having income less than the poverty line. Farmers' income also remained low in relation to income of those working in the non-farm sector. The low and highly fluctuating farm income is causing detrimental effect on the interest in farming and farm investment, and is also forcing more and more cultivators, particularly younger age group, to leave farming. This can cause serious adverse effect on the future of the agriculture in the country. Realizing the need to pay special attention to the plight of farmers, the Central Govt. changed the name of Ministry of agriculture to Ministry of agriculture and farmers Welfare in 2015. In this background, the goal set by the Prime minister to double farmers' income by 2022-23 is central to promote farmers' welfare, reduce agrarian distress and bring parity between income of farmers and those working in non-agricultural profession. Doubling real income of farmers till 2022-23, over the base year of 2015-16, requires annual growth of 10.41% in farmers' income. This implies that the on-going and previously achieved rate of growth in farm income has to be sharply accelerated. Therefore strong measures like improvement in productivity, saving in cost of production, increase in cropping intensity and diversification towards high value crops will be needed to harness all possible sources of growth in farmers' income.

The intervention

A paradox is found in the youth of Himachal Pradesh that they are either so attached to their soil and ancestral profession that even after acquiring higher education, they return to their roots and manage with the paltry income from the fields. In many cases they migrate to far off places thus neglecting their age old horticulture profession as well as their ageing parents behind. A lot of deliberations were done at organizational level for infusing suitable intervention/s and at last it was decided that some pioneer institute/ Universities may be roped in so as to develop the training module suited for the peculiar needs of farmers located in hill state of Himachal Pradesh. Thus by taking clue from the national agenda of doubling income of farmers by 2022-23, SJVN envisaged one week residential training in agriculture, floriculture and horticulture not only for project area farmers but also to the farmers of entire Himachal Pradesh during 2016-17. Accordingly a special module of 6 days was developed in association with leading universities of Himachal Pradesh namely Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan and CSK Himachal Pradesh Krishi Vishva vidyalaya, Palampur for imparting skills to 1000 farmers in the fields of horticulture, floriculture, vegetable, mushroom farming, bee-keeping, medicinal and aromatic plants, nursery plant protection, organic farming and environment impact assessment, etc. during the year 2016-17. In view of the feedback from the participants and the universities, the number of sponsored candidates has now been enhanced to 1600 for the year 2017-18.

For imparting training in these fields, the SJVN Foundation, a registered Trust of the company has signed two Memorandums of Understanding (MoUs) one with Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, and the other with CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, recently. The scheme aims at the Government of India's mission of doubling the farmers income by 2022 and has hence been named 'Deen

Dayal Upadhayay Krishi Kaushal Vikas Yojana'. The Skill development training to young aspiring entrepreneurs and farmers of Himachal Pradesh will include training and field demonstrations at these universities under the CSR initiative of the SJVN Foundation. The preference is given to the needy persons who are already engaged in farming and inclined to increase their income. In terms of the MoUs, the two universities shall provide all technical and infrastructural support to train the young entrepreneurs/ farmers in various income generating professional activities/ courses of agriculture, horticulture, forestry and allied disciplines like social science, environmental science, entomology and pathology whereas SJVN will support the project under CSR. The 6 days' long training programs will cover 1600 participants in groups of 25 each at the two universities during the current financial year 2017-18.

SJVN bear the total expenditure on course fees, boarding and lodging charges besides a stipend of Rs. 1400 per participant to compensate the earning loss of farmers. In addition, to and fro travelling expenditure of the participants from their place of stay to the University is also borne by SJVN. An expenditure of around 2 Crore is being incurred for provding training to 2600 farmers in the desired areas of horticulture, agriculture and floriculture etc. Out of the 1600 individuals to be imparted training in 32 groups, 400 will be drawn from the SJVNs project areas and remaining 1200 will be selected by the Universities. Further as per the MOU terms, Universities are maintaining comprehensive database, so as to capture the impact of the programs on farmers' income after 5 years.

The Journey Continues

CSR has given new dimension to the PSUs as the strong professional knowledge to handle and execute the works goes hand in hand to implement the CSR programs. SJVN has been successful in creating opportunities for self-employment, touched the lives of rural folk through its CSR initiatives and bringing smiles through its diverse community programs. The 'Deen Dayal Upadhyay Krishi Kaushal Vikas Yojana' being an ongoing endeavor of the SJVN Foundation will continue to provide such skilling training to more youths of the state in the years to come and aims at doubling the income of farmers. With same vigor and enthusiasm, our tryst with society will continue.

कृषि विभाग , हि.प्र.

विभिन्न योजनाओं के माध्यम से प्रदेश सरकार किसानों के उत्थान हेतु कृत संकल्प



1. डॉ. वाई. एस. परमार किसान स्वरोजगार योजना

- पॉलीहॉऊस निर्माण पर 85 प्रतिशत उपदान
- पानी के स्त्रोत जैसे लघु लिफ्ट , मध्यम लिफ्ट और पम्पिंग मशीनरी पर 50 प्रतिशत उपदान

2. मुख्यमंत्री खेत संरक्षण योजना

- किसानों की फसलों को जंगली जानवरों तथा आवारा पशुओं से बचाने के लिए सौर ऊर्जा अथवा विद्युत ऊर्जा लगाने हेतु 80 प्रतिशत अनुदान

3. मुख्यमंत्री किसान एवं खेतिहर मजदूर जीवन सुरक्षा योजना

- कृषि मशीनरी के प्रयोग के दौरान किसानों तथा मजदूरों के घायल होने अथवा उनकी मृत्यु होने की सूरत में 1.5 लाख रूपये तक की सहायता

4. मुख्यमंत्री ग्रीन हॉऊस नवीकरण योजना

- 5 वर्ष पश्चात या प्राकृतिक आपदा से क्षतिग्रस्त होने पर पॉलीशीट को बदलने हेतु 50 प्रतिशत उपदान

5. राजीव गाँधी सूक्ष्म सिंचाई योजना

- सूक्ष्म सिंचाई जैसे स्प्रिंक्लर व ड्रिप लगाने पर 80 प्रतिशत उपदान

6. उत्तम चारा उत्पादन योजना

- किसानों को उपदान दरों पर चारा और घास के बीजों की उपलब्धता
- अनुसूचित जाति, अनुसूचित जनजाति व बीपीएल किसानों को चारा काटने की मशीनरी पर 50 प्रतिशत उपदान उपलब्ध

7. उठाऊ सिंचाई एवं बोरवैल योजना

- उठाऊ सिंचाई योजना के निर्माण एवं बोरवैल लगाने पर 50 प्रतिशत उपदान

कृषि निदेशालय , हिमाचल प्रदेश , शिमला -5

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2. GAUTAM
3. SWARNA
4. SURYA
5. R.K.-101
6. R.K.-103
7. R.K.-109
8. R.K.-111
9. R.K.-123
10. R.K.-141
11. R.K.151
12. R.K.174
13. RAKSHA-165
14. R.K.-505

CHILLI
1. AGNIREKHA
2. SHIMLA HOT
3. SOLAN HOT
4. R.K.-210
5. R.K.-219
6. R.K.-221
7. TARA
8. NAVELI
9. MAHIMA-212
10. NISHA-213

BRINJAL
1. KARAN (PURPLE)
2. KESHAV (BLACK)
3. KIRTI
4. RUBY
5. MANIK (CHU-CHU)
6. R.K.-71
7. R.K.-91
8. MAYA (SUPER PPL)

BOTTLE GOURD
1. VARDAN
2. R.K.-786
3. R.K.-703 (GUTKA)
4. RANI PLUS (GUTKA)
5. CHAKRA (ROUND)
6. PRIYA (LATTU)

BHINDI
1. BARKHA BAHAR
2. MAITRI
3. R.K.-501
4. R.K.-507
5. R.K.-509
6. R.K.-510

RIDGE GOURD
1. R.K.-183
2. R.K.-186

CUCUMBER
1. CHANCHAL

SPONGE GOURD
1. HARIT
2. R.K. - 112
3. R.K.-113
4. HARIT GOLD

BITTER GOURD
1. PARAS
2. R.K.-163

WATER MELON
1. MINAKSHI
2. SHABNAM
3. R.K.-84

CABBAGE
1. PRAGATI
2. R.K.- 57
3. R.K.- 62
4. R.K.- 66
5. R.K.- 69
6. R.K.- 75

ASH GOURD
1. R.K. - 58

PUMPKIN
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1. SWATI

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- Better storability
- Stay green plant at harvest

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- Attractive orange flint kernels-More Market Price
- Excellent tip filling
- Stay green at harvest

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- 412 मेगावाट रामपुर हाइड्रो पावर स्टेशन, हिमाचल प्रदेश
- महाराष्ट्र में 47.6 मेगावाट की खिरवीरे पवन ऊर्जा परियोजना

- हिमाचल प्रदेश में देश का सबसे बड़ा भूमिगत 1500 मेगावाट जलविद्युत स्टेशन।
- आरएचपीएस को ''जल विद्युत परियोजनाएं शीघ्र पूरी करने'' की श्रेणी में ''**गोल्ड शील्ड**'' तथा ''**सिल्वर शील्ड**''।
- ऊर्जा के अन्य स्त्रोतों, पवन, ताप एवं सौर क्षेत्र में प्रवेश।
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